

Innovating Across Boundaries: Bridging Science, Technology, and Humanities

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Analysis of Mechanical Behavior in Al-SiC Metal Matrix Composites Formed Through Stir Casting

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Abstract: Aluminum-Silicon Carbide (Al-SiC) metal matrix composites (MMCs) have gained considerable interest due to their superior mechanical properties, making them suitable for use in industries such as automotive and aerospace. This research focuses on evaluating the mechanical characteristics of Al-SiC composites produced through the stir casting method, a popular technique known for its simplicity and cost efficiency. Various weight fractions of SiC particles were added to the aluminum matrix, followed by a controlled stirring process to achieve uniform distribution of the reinforcement. The resulting composites underwent mechanical testing, including tensile strength, hardness, and impact toughness assessments. Findings reveal that increasing SiC content significantly enhances mechanical performance, particularly in terms of strength, hardness, and wear resistance, compared to unreinforced aluminum. However, challenges such as particle clustering and porosity were observed to influence the overall properties of the composite. This study concludes that the stir casting process is an effective approach for producing Al-SiC composites with improved mechanical properties, ideal for demanding applications.

Index terms: Al-SiC, MMCs, Stir casting, Mechanical properties, SiC content, Particle clustering.

I. INTRODUCTION

Composite materials have gained substantial prominence in advanced engineering sectors due to their superior mechanical and physical properties. These materials, formed by the combination of two or more distinct constituents, synergize the beneficial characteristics of each component, resulting in enhanced performance. In particular, metal matrix composites (MMCs) have shown significant potential, especially in high-performance applications, owing to their high stiffness, strength, and wear resistance. Traditionally, continuous-fiber-reinforced composites dominated the landscape; however, their high manufacturing costs and complex processing methods have steered focus toward particulate-reinforced composites, which offer a more cost-effective and efficient alternative.

Aluminum and its alloys, known for their excellent properties such as low density, high plasticity, ductility, and superior corrosion resistance, are widely used in industries including aerospace, automotive, and high-speed rail systems. Despite these advantages, the inherent low hardness and suboptimal impact resistance of aluminum alloys limit their application in high-stress, heavy-duty environments. The development of aluminum matrix composites (AMCs), particularly those reinforced with ceramic particles, provides a robust solution to these limitations. By incorporating reinforcements such as silicon carbide (SiC), the mechanical properties of aluminum alloys are significantly improved, achieving a tailored balance of strength, stiffness, thermal conductivity, and wear resistance. Silicon carbide (SiC) is a ceramic material characterized by a tetrahedral arrangement of carbon and silicon atoms, leading to an exceptionally hard and thermally stable structure. SiC exhibits excellent resistance to chemical attack, maintaining stability against acids, alkalis, and molten salts up to temperatures of 800°C. Additionally, SiC forms a protective silicon oxide layer in air at temperatures exceeding 1200°C, allowing it to function at extreme temperatures up to 1600°C without significant strength degradation. These properties, coupled with its high thermal conductivity and low coefficient of thermal expansion, make SiC an ideal reinforcement material for metal matrix composites. SiC-reinforced aluminum MMCs exhibit remarkable thermal shock resistance, high wear resistance, and mechanical stability at elevated temperatures, making them suitable for critical applications in aerospace, automotive, and defense industries.

Among the various fabrication methods, stir casting is widely recognized as an effective and economical technique for the production of particulate-reinforced MMCs. The process involves the incorporation of reinforcement particles into a molten metal matrix, followed by vigorous mechanical stirring to achieve uniform distribution of the reinforcement phase. Stir casting offers several advantages, including scalability, cost-efficiency, and the ability to control the volume fraction and size of the reinforcing particles. This study focuses on the fabrication of aluminum-silicon carbide (Al-SiC) metal matrix composites through the stir casting route, with an emphasis on evaluating their mechanical properties, such as tensile strength, hardness, and impact resistance. By systematically investigating the influence of SiC content and distribution on the mechanical behavior of Al-SiC composites, this research aims to provide insights into optimizing the material for high-performance applications.

II. EXPERIMENTAL

This study focused on the development of aluminum (Al-6061)/silicon carbide (SiC) metal matrix

composites (MMCs) using the stir casting technique. The stir casting method involves the mechanical dispersion of reinforcement particles (in this case, SiC) into a molten metal matrix (Al-6061). The MMC plates were fabricated with varying weight fractions of SiC reinforcement (5%, 10%, and 15%) to investigate the influence of reinforcement content on the composite's properties. The SiC particles were of a fine size (325 mesh), which can enhance the interfacial bonding between the reinforcement and the matrix. The stirring process was conducted at a rotational speed of 200 revolutions per minute to ensure adequate dispersion of the SiC particles within the molten aluminum.

(a) Composition of samples chosen for the study. Al-SiC composites were synthesized by systematically varying the weight fraction of SiC from 5% to 15%. A base sample mass of 400 grams was utilized, with the SiC content adjusted in proportion to the specified weight percentages.

No.	Al (grams)	SiC (grams)	Remarks
1	385	20	Al-5%SiC
2	365	40	Al-10%SiC
3	345	60	Al-15%SiC

Stir casting method for Al6061/SiC metal matrix composites (MMCs)

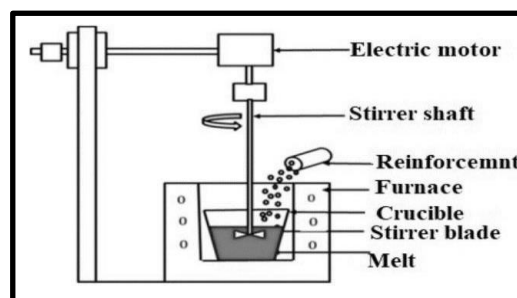


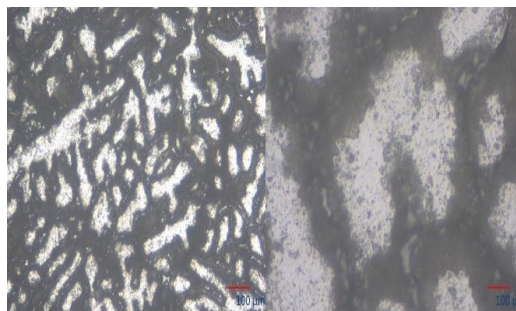
Figure 1: Stir casting apparatus used for the production of Al-SiCp metal matrix composite (MMC)

The stir casting setup used for fabricating Al-SiC particle-reinforced MMCs is illustrated in Figure 1. The system includes a furnace for melting the metal, along with a stirrer and motor for mixing the

particles. Initially, SiC particles are preheated in a separate muffle furnace at 900°C for 2 hours to remove volatile substances and impurities, and to bring the particle temperature closer to the melting point of the aluminum alloy. This preheating induces the formation of a SiO₂ layer on the particle surface through artificial oxidation, which enhances particle wettability. Subsequently, Al6061 billets are placed in the furnace, and the melting process continues until a uniform temperature of 750°C is reached. Flux is added to the molten aluminum to prevent oxidation. The melt is then cooled to 600°C, slightly below its liquidus temperature, reaching a semi-solid state. At this point, the preheated SiC particles are gradually introduced, and the slurry is manually stirred. A small amount of magnesium, less than 1% of the total weight, is added to further improve wettability between the reinforcement and alloy. After manually stirring for 5 minutes, the remaining SiC is added, along with hexachloroethane tablets to degas the molten metal and minimize porosity in the final cast composite.

After manual agitation, the composite slurry was reheated and stabilized at 750°C ± 10°C, exceeding the liquidus threshold, before initiating mechanical stirring. The stirring operation was conducted for 10 minutes at an average rotational speed of 150 rpm. A Platinum-Rhodium thermocouple was employed throughout the process to precisely monitor the furnace temperature. Prior to casting, the permanent cast iron mould was preheated to 350°C to ensure optimal thermal conditions. Subsequently, the composite mixture was cast, allowed to solidify, and subjected to drying before being extracted from the mould.

III. Outcomes and Interpretation Metallurgical and microstructure examination



Figures 2a and 2b: Depict the optical microstructures of the Al-5% SiC composite at magnifications of 100x and 500x, respectively.

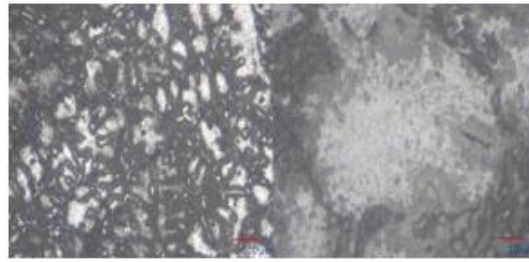


Figure 3a & 3b: Shows optical microstructures of Al-10% SiC composite at 100x and 500x magnification respectively.

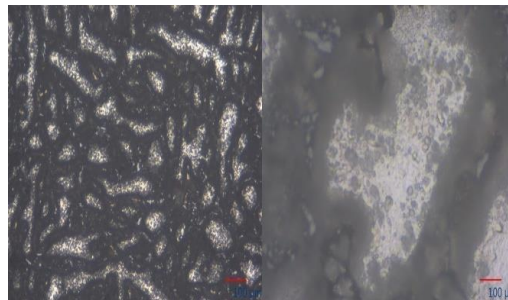


Figure 4a & 4b: Illustrates the optical micrographs of the Al-15% SiC composite at magnifications of 100x and 200x, respectively.

Microstructural evaluation: A detailed microstructural analysis of the stir-cast Al6061 matrix reinforced with varying amounts of SiC particles (5%, 10%, and 15%) was conducted using an optical microscope. The resulting optical micrographs, shown in Figures 2 through 4 at magnifications of 100x and 200x, provide insights into the particle distribution within the composite matrix. The as-cast composites demonstrate a consistent and uniform dispersion of SiC particles throughout the aluminum matrix. Furthermore, the micrographs reveal a noticeable improvement in the uniformity of the SiC particle distribution as the weight percentage of reinforcement increases. This suggests that higher concentrations of SiC lead to more homogeneous incorporation of reinforcement within the matrix, enhancing the overall microstructural integrity of the composite material.

XRD analysis

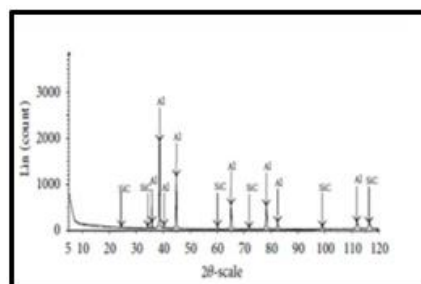


Figure 5a: Al6061/5%SiCp.

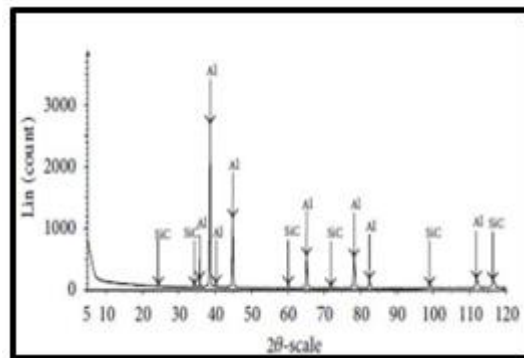


Figure 5b: Al6061/10%SiCp.

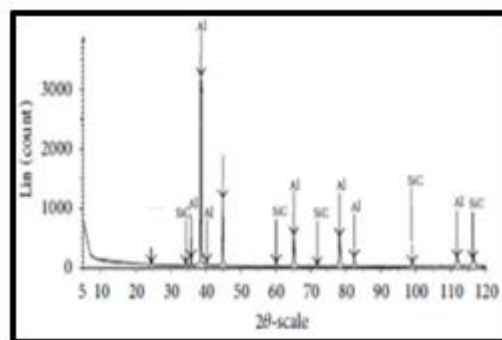


Figure 5c: Al6061/15%SiCp.

X-ray diffraction (XRD) analysis was conducted to verify the phase composition of the Al-SiCp metal matrix composite (MMC). The results indicate the absence of any undesired or secondary phases, confirming that only aluminum (Al) and silicon carbide (SiC) are present in the composite structure. The XRD patterns, as shown in Figures 5a through 5c, were recorded on a 2-theta (2θ) scale, which provides critical information about the crystallographic structure of the materials. For precise characterization, the diffraction angle (2θ) was varied between 5° and 120° . This wide scanning range ensures a comprehensive evaluation of the material's phase composition, reinforcing the purity and successful incorporation of SiC particles within the Al matrix without the formation of unwanted by-products.

X-Ray fluorescence spectroscopy (XRF)

A WD-XRF Spectrometer Model-S8, Make TIGER Bruke has been used for analyzing the elemental composition and spectrum of Al-SiC MMC. Circular samples of 34mm diameter are prepared for XRF analysis. It has been concluded that the SiC is uniformly dispersed throughout the matrix. Moreover, compositional analysis reveals the presence of Silicon and carbon.

Hardness Hardness is defined as a material's ability to resist deformation, such as indentation or

scratching. Various techniques are employed to measure hardness, with Brinell, Rockwell, and Vickers hardness tests being among the most commonly used methods. In this study, the hardness of the Al-SiC metal matrix composites (MMCs) was assessed using the Vickers hardness test. A diamond micro-indenter was employed to apply a controlled load of 10 kgf with a dwell time of 10 seconds to ensure accurate measurement. The resulting Vickers hardness values provide insight into the material's resistance to deformation and are listed in Table 2, with graphical representations shown in Figures 7 and

8. These results highlight the mechanical strength of the composites under specified test conditions, offering a clear understanding of how the SiC reinforcement impacts the hardness of the Al matrix.

Table 2: Vickers hardness measurement of Al-SiC metal matrix composites (MMCs).

Sr. No.	Samples	Hardness (HV10)
1	Al-5%SiC	38
2	Al-10%SiC	47
3	Al-15%SiC	52

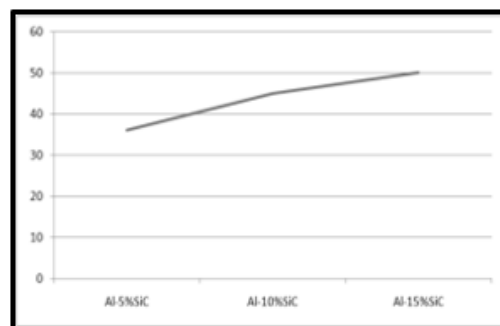


Figure 6: Illustrates the relationship between hardness values and the SiC content percentage."

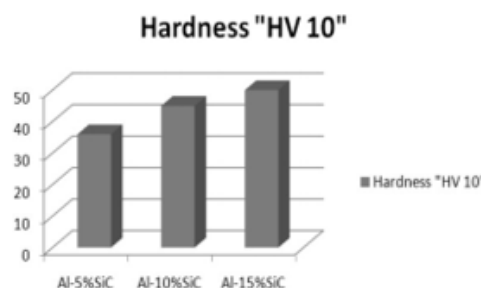


Figure 7: Depicts a bar chart demonstrating the trend of increasing hardness with the rise in SiC content

Tensile Testing: Tensile testing was performed using a universal testing machine to evaluate the mechanical properties of the Al6061 matrix composites reinforced with varying SiC content. The results are detailed in Table 4, which outlines the percentage elongation, yield strength at 0.2% offset, and ultimate tensile strength (UTS) for Al6061 with 5%, 10%, and 15% SiC particles. The analysis reveals a clear trend where the percentage elongation, a measure of ductility, decreases progressively with increasing SiC content, indicating a reduction in the material's ability to undergo plastic deformation. On the other hand, the yield strength and UTS exhibit a more complex behavior: both properties initially decline as the SiC content rises to 10%, likely due to a threshold in reinforcement effectiveness or matrix interaction. However, beyond this point, with the addition of 15% SiC, both yield strength and UTS begin to increase, suggesting enhanced load-bearing capability and overall strength as the SiC reinforcement reaches a higher concentration. This trend highlights the balancing effect of SiC content on the composite's mechanical performance.

Samples	%Elongation	0.2% Y.S (Mpa)	UTS (Mpa)
Al-5%SiC	2.1	53.9	53.1
Al-10%SiC	14	41.2	40.4
Al-15%SiC	0.6	52	56.1

CONCLUSION

Al-SiC metal matrix composites (MMCs) were successfully fabricated using the stir casting technique, which is recognized for its efficiency in integrating ceramic reinforcements into metallic matrices. In this method, the composite slurry is stirred while in a semi-solid state, allowing for the effective incorporation of silicon carbide (SiC) particles into the aluminum alloy matrix. This semi-solid stirring process is crucial as it prevents the settling of SiC particles; they become entrapped between the dendritic arms formed during solidification, ensuring a homogeneous distribution throughout the matrix.

Several critical processing parameters influence the quality and mechanical properties of the cast MMCs. These include the holding temperature, stirring speed, impeller size, and the position of

the impeller in the molten alloy. Each of these factors must be carefully optimized to achieve the desired mechanical performance of the final composite material.

Comprehensive microstructural investigations, complemented by X-ray diffraction (XRD) analysis, revealed a uniform distribution of SiC particles within the aluminum matrix, which is essential for achieving enhanced mechanical properties. Furthermore, X-ray fluorescence (XRF) analysis provided detailed information regarding the chemical composition and spectrum of the fabricated composites. Although accurately determining the precise percentage of SiC in the matrix can be challenging, this was successfully achieved through meticulous adjustments to the processing parameters based on multiple rounds of XRF testing. This iterative process ensured that a consistent and uniform distribution of SiC reinforcement was maintained throughout the alloy matrix.

The addition of SiC particles significantly contributes to improving the mechanical properties of the aluminum matrix, notably enhancing hardness and tensile strength. These improvements are attributed to the reinforcing effect of the SiC particles, which enhance the load-bearing capacity of the composite. Interestingly, the wear rate of the composites decreased as the percentage of SiC increased from 5% to 15%. This reduction in wear rate indicates that SiC is highly effective in minimizing wear, making it advantageous for applications where abrasion resistance is critical. Additionally, the resulting Al-SiC MMCs exhibit high-temperature stability, making them suitable for use in environments subjected to elevated thermal conditions. The incorporation of SiC not only improves wear resistance but also enhances corrosion resistance, thus broadening the application range of these composites in various industries, including automotive, aerospace, and other fields where enhanced durability and performance are paramount. This combination of properties highlights the potential of Al-SiC MMCs as advanced materials for high-performance applications.

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**“Effect of Educational Intervention Strategies to Develop Reading Skills
among Lower Primary Students with Dyslexia in 10 Schools of Papumpare
District, Arunachal Pradesh”**

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Abstract: *Dyslexia is a learning disability that affects a child's ability to read, write, and spell, posing significant challenges in their educational journey. This study examines the effectiveness of specific educational intervention strategies aimed at enhancing reading skills among lower primary students with dyslexia in the Papumpare District. Emphasizing the importance of early intervention, the research adopts a mixed-method approach that includes both quantitative and qualitative data analysis. A total of 30 children diagnosed with dyslexia and 10 teachers participated, selected through convenience sampling. Pre-tests and post-tests assessed students' reading skills before and after implementing the intervention strategies derived from Dr. Samuel Alexander Kirk. Findings demonstrated a statistically significant improvement in reading abilities, with mean scores increasing from 27.5 in the pre-test to 37.0 in the post-test, resulting in a mean difference of 9.5 (t -value = 8.86, $p < 0.05$). Furthermore, feedback from teachers revealed a strong endorsement of the strategies, with 75% rating their experience as "Excellent." This study highlights the critical role of structured, evidence-based interventions and underscores the necessity for continuous support for teachers to create an inclusive learning environment for students with dyslexia.*

Keywords: *Effect, Educational Intervention Strategies, Reading Skills, Lower Primary Students, Dyslexia, Papumpare District.*

1. INTRODUCTION

In today's world, reading and writing skills are more important than ever for academic success, personal growth, and future opportunities. Literacy forms the foundation of learning across all subjects, helping students build the knowledge they need to thrive. However, for children with learning disabilities like dyslexia, acquiring these crucial skills can be particularly challenging. Dyslexia, which affects a child's ability to read, write, and spell, often leads to ongoing struggles in school. Recognizing

dyslexia early and providing targeted interventions are key to supporting these students, especially in their early years of education (**Lyon, Shaywitz, & Shaywitz, 2003**).

Many experts stress that early intervention can help students with dyslexia develop stronger reading skills. Building literacy during the lower primary years is not just essential for academic progress; it also plays a big role in boosting a child's confidence and engagement in learning (**Snowling & Hulme, 2012**). With the right support, children with dyslexia can overcome many of the difficulties they face, allowing them to succeed alongside their peers.

Educational strategies designed specifically for dyslexic students have shown great promise in improving literacy skills. **Torgesen (2004)** points out that structured, evidence-based programs using multisensory teaching methods and personalized instruction can be very effective in helping children with dyslexia improve their reading abilities. These methods tap into different senses—**sight, sound, and touch**—to help students absorb and retain information (**Birsh, 2011**). However, the success of these interventions often depends on factors like the classroom environment, the quality of teaching, and the individual needs of each child (**Vellutino et al., 2004**).

This research, conducted in **10 schools in the Papumpare District**, aims to explore how well specific educational interventions help lower primary students with dyslexia improve their reading skills. By focusing on proven, research-backed strategies, the study will assess the level of improvement in students' reading abilities. Additionally, the study will look at the experiences of teachers who implement these strategies, providing valuable insights into the practical challenges and successes they encounter in the classroom.

Beyond evaluating student progress, the research also seeks to understand where teachers might need additional support and resources to better serve dyslexic students. Teachers play a central role in making these intervention strategies work, and their feedback is crucial for improving and refining these approaches. By combining data from both student outcomes and teacher experiences, this study aims to shed light on how tailored interventions can not only improve reading skills for children with dyslexia but also create a more inclusive and supportive learning environment for everyone involved.

2. REVIEW OF THE RELATED LITERATURE

Bhatia, M., & Sharma, R. (2017). investigated the effectiveness of multi-sensory approaches in teaching students with dyslexia in Indian schools. Using a quasi-experimental design, the researchers selected a sample of 60 students diagnosed with dyslexia from two schools in Delhi. The intervention included multi-sensory teaching techniques over an eight-week period. Results indicated a significant improvement in reading skills, with participants demonstrating enhanced phonemic awareness and comprehension levels, confirming the efficacy of multi-sensory strategies in the Indian educational context.

Srinivasan, R., &Raghavan, S. (2019). focused on the impact of educational interventions on the reading skills of children with dyslexia in Tamil Nadu, India. The study utilized a pre-test and post-test design involving 40 lower primary students diagnosed with dyslexia across five schools. The intervention consisted of phonics-based instruction combined with visual aids over three months. The findings revealed a marked improvement in reading fluency and accuracy, suggesting that structured educational interventions can effectively support dyslexic students in India.

Pillai, V., &Karthikeyan, S. (2021). examined the role of teacher training in implementing intervention strategies for dyslexic students in Kerala, India. The researchers conducted a mixed-methods study with a sample size of 50 teachers and 100 students from various schools. The results demonstrated that teachers trained in specialized intervention strategies significantly improved their students' reading skills, indicating the critical importance of teacher preparedness in facilitating effective educational support for dyslexic learners.

Torgesen, J. K. (2004). reviewed various studies focused on reading interventions for children with dyslexia. The research involved a systematic review methodology, analyzing data from numerous studies with sample sizes ranging from 20 to 100 dyslexic students across different settings. The findings indicated that systematic, intensive instructional strategies, particularly those incorporating multisensory approaches, significantly enhance reading proficiency in young children with dyslexia, underscoring the need for early intervention.

Snowling, M. J., &Hulme, C. (2012). This comprehensive review synthesized research on reading development and dyslexia, analyzing empirical studies involving diverse populations of dyslexic learners. The methodology involved reviewing findings from various studies without specifying

sample sizes. The results emphasized the effectiveness of phonics-based interventions and individualized support, highlighting the critical role of tailored educational strategies in fostering reading skills among dyslexic children across different educational contexts, thereby reinforcing the necessity for targeted intervention in early education.

3. RATIONALE OF THE STUDY

The existing literature underscores the crucial role of educational intervention strategies in enhancing reading skills among students with dyslexia, especially in the Indian context. Research by **Bhatia and Sharma (2017)** and **Srinivasan and Raghavan (2019)** illustrates the effectiveness of multi-sensory and phonics-based approaches, showcasing their positive impact on reading fluency and phonemic awareness. However, these studies primarily focus on specific techniques without investigating their broader application across diverse educational settings. Furthermore, there is a notable gap in understanding the role of teacher training in these interventions. **Pillai and Karthikeyan (2021)** emphasize that while teacher preparedness is vital, limited research exists on how trained educators implement these strategies in real classroom environments, particularly in lower primary education.

Conducting this study is therefore essential to evaluate the effectiveness of tailored educational intervention strategies for developing reading skills among lower primary students with **dyslexia in Papumpare District**. The research will integrate both student outcomes and teacher experiences, aiming to fill the knowledge gap regarding the interplay between these factors. By focusing on the specific contextual challenges faced by students in remote areas, the study seeks to inform educational practices, policies, and teacher training programs. Ultimately, this research aims to enhance literacy outcomes for dyslexic learners, fostering a more inclusive educational environment that effectively addresses their unique challenges and needs.

4. STATEMENT OF THE PROBLEM

“Effect of Educational Intervention Strategies to Develop Reading Skills among Lower Primary Students with Dyslexia in 10 Schools of Papumpare District, Arunachal Pradesh”

5. RESEARCH QUESTIONS

- i. How do educational intervention strategies impact the development of reading skills in children with dyslexia?

- ii. What is the extent of improvement in reading skills among students with dyslexia after receiving the intervention strategies?
- iii. What are the experiences of teachers in implementing educational intervention strategies to enhance reading skills in students with dyslexia?

6. OBJECTIVES OF THE STUDY

- i. To examine the effect of educational intervention strategies on the development of reading skills in children with dyslexia.
- ii. To assess the improvement in reading skills among students with dyslexia who received the intervention strategies.
- iii. To explore the experiences of teachers in using educational intervention strategies to enhance reading skills in students with dyslexia.

7. HYPOTHESIS OF THE STUDY

H0 - There is no significant improvement in the intervention strategies to develop reading skills among children with dyslexia.

8. METHODOLOGY OF THE STUDY

- i. **Research Design:** This study employed a mixed-method approach, utilizing an experimental design with a single-arm group. A pre-test was administered to the selected participants, followed by an educational intervention. After the intervention, a post-test was conducted to evaluate the impact of the strategies used.
- ii. **Population:** The study focused on children with dyslexia and their teachers in 10 schools across the Papumpare District.
- iii. **Sample Size:** The study included a sample of **30 children with dyslexia and 10 Teachers.**
- iv. **Sampling Techniques:** In this study the researcher used Convenience Sampling technique.
- v. **Tools and Techniques:** Teachers were interviewed to gather insights about their experiences with the intervention strategies. Additionally, pre-tests and post-tests were designed to measure the progress of the students.

- vi. **Strategies implicated after the pre-test:** To see the effect of “Educational Intervention Strategies” to develop reading skills among children with dyslexia, The researcher curated the strategies from Dr. Samuel Alexander Kirk.
- vii. **Data Analysis:** The study employed both quantitative and qualitative methods for data analysis.

Quantitative Analysis:

The collected data was organized into tables for systematic analysis. The mean and standard deviation of the pre-test and post-test scores were calculated, and a T-test was conducted to compare the results of both tests. This process helped to determine the overall effectiveness of the intervention strategies.

Qualitative Analysis:

Data from the teacher interviews were classified into categories: "poor," "fair," "good," and "excellent." The frequency of responses in each category was then counted, and the results were interpreted based on these classifications, providing qualitative insights into the teachers' perspectives on the intervention strategies.

9. FINDINGS

The findings have been presented in the following tables wise-

Table 1 : Computation of Mean, SD, Mean Difference and T-Value

	Mean	Standard Deviation	Mean Difference	“t” test	Table Value	Degree of Freedom	Significance level
Pre-Test	27.5	6.2	9.5	8.86	2.045	14	0.05
Post-Test	37.0	5.5					

Objective i: To examine the effect of educational intervention strategies on the development of reading skills in children with dyslexia.

The analysis shows a statistically significant improvement in reading skills following the intervention strategies, as indicated by the significant mean difference (**9.5**) and the high t-value (**8.86**). This suggests that the educational interventions had a meaningful impact on the development of reading skills among children with dyslexia.

Objective ii: To assess the improvement in reading skills among students with dyslexia who received the intervention strategies.

The pre-test mean score of **27.5** significantly increased to a post-test mean score of **37.0**, demonstrating a clear improvement in reading skills. The mean difference of **9.5** supports the conclusion that the students made notable progress as a result of the intervention strategies, reflecting effective instructional methods in enhancing their reading abilities.

Table 2 : Experience of Teachers on using Educational Interventional Strategies

Sample		No of Responses		%
10 Teachers	Experience of Teachers on using Educational Interventional Strategies	Excellent	75	75
		Good	17	17
		Fair	6	6
		Poor	2	2

Objective iii: To explore the experiences of teachers in using educational intervention strategies to enhance reading skills in students with dyslexia.

The majority of teachers (**75%**) rated their experience with using interventional strategies as **“Excellent”**. This suggests that a significant number of teachers found the strategies highly effective and beneficial. And a considerable number of teachers (**17%**) rated their experience as **“Good”**, indicating that they found the strategies to be effective, although not at the highest level. But a smaller proportion of teachers rated their experience as **“Fair” (6%)** or **“Poor” (2%)**. This suggests that there were some teachers who found the strategies less effective or encountered challenges in their implementation.

Hypotheses Evaluation

Since $8.86 > 2.045$, we reject the null hypothesis (H_0)

The statistical analysis indicates that there is a significant improvement in the reading skills of children with dyslexia who participated in the intervention strategies. The substantial mean difference of 9.5, coupled with the high t-value, supports the conclusion that the educational interventions had a positive and statistically significant impact on the reading skills of these children.

10. DISCUSSION

The current research investigates the effectiveness of educational intervention strategies in enhancing reading skills among children with dyslexia in the Papumpare District. The findings illustrate a significant positive impact, which is critical given the foundational role of literacy in academic success and personal development.

Importance of Literacy for Children with Dyslexia

In today's educational landscape, proficiency in reading and writing is essential for academic achievement and future opportunities. Dyslexia presents unique challenges, making it difficult for affected children to acquire these crucial skills. As noted by Lyon, **Shaywitz, and Shaywitz (2003)**, early recognition and targeted interventions are vital for supporting these students. This study corroborates that view, highlighting the efficacy of structured educational interventions in fostering reading skills among dyslexic learners.

Evidence of Improvement

The statistical analysis reveals a significant improvement in reading skills, evidenced by the mean pre-test score of **27.5** rising to **37.0** post-intervention, with a mean difference of **9.5** and a t-value of **8.86**, well above the critical value of **2.045**. This aligns with the findings of **Torgesen(2004)**, who emphasizes the effectiveness of systematic, evidence-based approaches in enhancing reading proficiency among dyslexic children. The significant improvement demonstrates that with the right strategies, students can overcome barriers to literacy.

Teacher Experiences and Their Role

The qualitative data gathered from teacher responses show that **75%** rated their experiences with the intervention strategies as **"Excellent."** This strong endorsement indicates that teachers feel empowered and supported in using these strategies, which echoes findings from **Pillai and Karthikeyan (2021)** that emphasize the importance of teacher training in implementing effective intervention strategies. However, the **6%** of teachers who rated their experiences as **"Fair"** and the **2%** who rated them as **"Poor"** suggest that there are still challenges that need to be addressed. Understanding these challenges can provide insights into the areas where further support and resources may be necessary.

Alignment with Related Literature

The literature review underscores the effectiveness of multisensory and individualized approaches in teaching dyslexic students, aligning with the current study's findings. For instance, **Bhatia and Sharma (2017)** highlighted the benefits of multi-sensory strategies in Indian schools, while **Srinivasan and Raghavan (2019)** demonstrated significant improvements in reading fluency using phonics-based instruction. Both studies reinforce the idea that tailored educational strategies can lead to substantial gains in reading skills.

Additionally, **Snowling and Hulme (2012)** emphasized the critical role of individualized support, which resonates with the experiences shared by teachers in this study. The alignment of these studies with the current findings strengthens the argument for continued use and refinement of targeted interventions for dyslexic students.

11. CONCLUSION

This study highlights the significant impact of targeted educational interventions on improving reading skills in lower primary students with dyslexia in the Papumpare District. The findings reveal not only better reading fluency and comprehension but also increased student engagement and confidence. This underscores how vital personalized teaching methods are for supporting diverse learners.

Looking ahead, future research should investigate the long-term effects of these interventions to see if the improvements in reading skills are lasting and how they influence overall academic success. It

would also be beneficial to explore how these successful strategies can be adapted and applied in various educational settings, offering valuable insights for teachers and policymakers.

From our perspective as researchers, the results emphasize the necessity of early identification and intervention for students with dyslexia. Incorporating multi-sensory approaches and structured literacy programs into the curriculum is essential for creating an inclusive learning environment. Additionally, ongoing professional development for educators is crucial to ensure they have the skills and knowledge needed to effectively support these students. By prioritizing such strategies, schools can foster a more equitable educational landscape where every student has the opportunity to excel.

Ultimately, a collaborative effort among educators, parents, and specialists is key to ensuring that students with dyslexia receive the comprehensive support they need to succeed. This research not only adds to the existing body of knowledge but also serves as a vital reminder of the importance of continued advocacy and investment in specialized educational resources.

12. RECOMMENDATION FOR TEACHERS & PARENTS

Recommendations for Teachers

- i. Implement Structured Literacy Programs
- ii. Ongoing Professional Development
- iii. Collaborative Learning Environments
- iv. Monitor Progress Regularly
- v. Provide Emotional and Social Support

Recommendations for Parents

- i. Early Identification and Advocacy
- ii. Home Support with Reading Activities
- iii. Open Communication with Teachers
- iv. Encourage a Growth Mindset
- v. Seek Additional Resources

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ADULTERY IN INDIA

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ABSTRACT

Adultery in India has long been a complex and controversial issue, deeply intertwined with the nation's social, cultural, and legal fabric. This article provides a comprehensive examination of adultery, exploring its impact from multiple perspectives, including the historical evolution of legal frameworks, the sociocultural implications, and the psychological consequences on individuals and families. The decriminalization of adultery by the Supreme Court of India in 2018 marked a significant shift, challenging traditional notions of morality and personal autonomy.

Adultery in India is a deeply complex and multifaceted issue that intersects with various aspects of society, law, and culture. This article explores the broad and nuanced impacts of adultery within the Indian context, focusing on its implications for family structures, societal norms, and individual rights. Historically, adultery was criminalized under Section 497 of the Indian Penal Code, reflecting the patriarchal underpinnings of Indian society, where it was primarily viewed as a transgression against the sanctity of marriage and a violation of the husband's proprietary rights over his wife. The Supreme Court's landmark decision in 2018 to decriminalize adultery marked a significant shift, reframing the act as a moral wrong rather than a criminal offense, and emphasizing gender equality and individual autonomy in marital relationships.

This article examines the aftermath of this legal change, analyzing its impact on marital relationships, divorce proceedings, and the broader social fabric. It discusses the evolving perceptions of adultery in India, considering the roles of religion, culture, and social norms in shaping attitudes towards infidelity. The article also addresses the ongoing moral and ethical debates surrounding adultery, highlighting how these discussions continue to influence public opinion and policy.

This study delves into the legal reasoning behind the judgment, its reception, and the ongoing debate surrounding marital fidelity and gender equality. Additionally, the article discusses the broader societal attitudes towards adultery, highlighting the tension between modern values and deeply entrenched patriarchal norms. By analyzing case studies and statistical data, this multifaceted examination aims to provide a nuanced understanding of how adultery impacts Indian society and contributes to the ongoing discourse on marriage, morality, and personal freedom.

By incorporating perspectives from legal experts, sociologists, and psychologists, this article provides a comprehensive examination of how adultery affects individuals and society in India. It explores the tension between traditional values and modern legal frameworks, and how this tension plays out in real-life scenarios involving marriage, divorce, and social stigma. Ultimately, the article aims to shed light on the complex

interplay between law, morality, and social change in the context of adultery in India, offering insights into its far-reaching consequences on both a personal and societal level.

Key Words: IPS, BNS, CRPC.BNSS. BSA

INTRODUCTION:

Adultery is a term that refers to the act of engaging in sexual relations outside of a committed partnership or marriage. It has been a topic of intrigue, moral debate, and emotional turmoil throughout history. The concept of adultery varies across cultures and societies, but its impact on individuals and relationships remains significant. This article aims to explore the multifaceted nature of adultery, examining its definition, underlying causes, psychological and emotional consequences, societal perspectives, and the challenges couples face in navigating the complexities of infidelity.

DEFINITION AND SCOPE OF ADULTERY:

Adultery is traditionally defined as a breach of the marital contract or commitment, involving a married individual engaging in sexual relations with someone other than their spouse. However, the concept of adultery extends beyond formal marriages and can encompass relationships where the partners have made a commitment to exclusivity. It is important to note that cultural and legal definitions of adultery may vary, as some societies may have different standards and expectations regarding fidelity.

CAUSES OF ADULTERY:

Understanding the causes of adultery requires recognizing that it rarely occurs in isolation. There are various factors that can contribute to the occurrence of infidelity within a relationship. Relationship dissatisfaction, stemming from a lack of emotional or sexual fulfillment, communication breakdown, or unresolved conflicts, is a common underlying cause. Feelings of neglect, boredom, or a desire for novelty and excitement can also lead individuals to seek fulfillment outside their committed partnerships. Other factors may include sexual incompatibility, personal issues such as low self-esteem or commitment problems, or even a desire for revenge in response to perceived wrongs within the relationship. It is important to recognize that the causes of adultery are complex and can vary from one situation to another.

PSYCHOLOGICAL AND EMOTIONAL CONSEQUENCES:

Adultery can have profound psychological and emotional consequences for all parties involved. The betrayed partner often experiences a range of intense emotions, including shock, anger, hurt, and a deep sense of betrayal. The discovery of infidelity can shatter the foundation of trust and security within the relationship, leading to feelings of inadequacy and self-doubt. The adulterous partner may experience guilt, shame, and internal conflict, struggling with the consequences of their actions and the impact on their loved ones. Both parties may suffer from a decline in self-esteem and self-worth, grappling with the aftermath of infidelity. Healing from the wounds of adultery requires open and honest communication, addressing underlying issues, and rebuilding trust. It often involves seeking professional help through therapy or counseling to navigate the complex emotions and challenges associated with the betrayal.

SOCIETAL PERSPECTIVES AND CULTURAL ATTITUDES :

Cultural attitudes towards adultery vary greatly across societies and are influenced by religious beliefs, social norms, and legal frameworks. In some cultures, adultery is considered a severe moral transgression, laden with shame and social stigma. It may be criminalized, leading to legal consequences for the individuals involved. In other societies, there may be a more permissive attitude towards infidelity, with some individuals viewing it as a personal choice or a consequence of unfulfilled desires. The stigma associated with adultery can impose additional emotional burdens on those involved, creating a sense of isolation and judgment. However, it is important to recognize that cultural perspectives on adultery are not static and can evolve over time. Some societies have seen a shift towards greater acceptance and recognition of the complexities within relationships, emphasizing the importance of open communication, forgiveness, and personal growth.

NAVIGATING THE CHALLENGES AND MOVING FORWARD :

Recovering from adultery and rebuilding a relationship is a complex and challenging process. It requires both partners to be committed to open and honest communication, addressing underlying issues, and rebuilding trust. Seeking professional help through therapy or counseling can provide a supportive environment for couples to navigate the process of healing. Therapists can help individuals explore their emotions, understand their needs, and develop strategies for rebuilding trust and intimacy. It is important for both partners to take responsibility for their actions, express genuine remorse, and work towards creating a healthier and more fulfilling relationship.

Prevention efforts focus on promoting healthy relationships through education programs that emphasize effective communication, conflict resolution, and the cultivation of emotional intimacy. Creating a non-judgmental atmosphere where individuals feel safe to address their struggles can also contribute to the prevention of infidelity. Cultivating a strong foundation of trust, maintaining emotional and sexual connection, and addressing relationship issues as they arise can help prevent the occurrence of adultery.

This article aims to provide an in-depth analysis of adultery in legal terms, with a specific focus on Section 497 of the Indian Penal Code (IPC). Adultery, defined as the act of a man engaging in sexual intercourse with the wife of another man without his consent, has been a subject of debate and controversy in India. By examining the historical background, legal provisions, interpretation, and societal implications of Section 497, this article seeks to shed light on the complexities surrounding adultery laws in India. Additionally, it will explore the recent developments and the subsequent decriminalization of adultery in India.

Adultery, as a controversial issue, holds immense significance within the legal framework. This article will delve into the legal terms surrounding adultery in India, with a particular focus on Section 497 of the Indian Penal Code (IPC). By examining the historical background, legal provisions, interpretation, and societal implications of Section 497, we aim to provide a comprehensive understanding of the complex nature of adultery in the Indian legal context.

BOOK REVEIW: Here are some references to Indian law books that discuss the topic of adultery, including

the historical context, legal provisions, and important case laws:

1. Ratanlal & Dhirajlal's The Indian Penal Code: This book provides a detailed commentary on the Indian Penal Code, including Section 497 (Adultery). It discusses the historical context, legal interpretations, and the impact of the Supreme Court judgment in *Joseph Shine v. Union of India*.

2. K.D. Gaur's Textbook on The Indian Penal Code: This textbook offers an in-depth analysis of the IPC, with specific chapters dedicated to various offenses, including adultery under Section 497. It includes critical commentary on the legal principles and case laws that have shaped the understanding of adultery in Indian law.

3. Commentary on the Indian Penal Code by Dr. Hari Singh Gour: This comprehensive commentary covers all sections of the IPC, providing historical context, legislative intent, and judicial interpretations. The discussion on Section 497 includes analysis of its constitutional validity and the implications of its decriminalization.

4. Modern Hindu Law by Paras Diwan: While primarily focused on Hindu personal laws, this book also addresses the grounds for divorce, including adultery, under the Hindu Marriage Act, 1955. It discusses the legal framework and relevant case laws.

5. Mulla Principles of Hindu Law: This book provides an authoritative commentary on Hindu law, including divorce grounds such as adultery. It covers both substantive and procedural aspects, with references to important case laws.

6. Family Law by Paras Diwan: This book offers a comprehensive overview of family law in India, including the grounds for divorce in various personal laws. The discussion on adultery includes its treatment under the Hindu Marriage Act, Special Marriage Act, and Indian Divorce Act.

These references will provide detailed insights into the legal provisions, interpretations, and case laws related to adultery in Indian law.

1. HISTORICAL BACKGROUND:

The historical context of adultery in India can be traced back to ancient times, where it was regarded as a moral transgression and subject to social and religious norms. We will explore the evolution of adultery laws and societal attitudes throughout different periods of Indian history.

III. Section 497 of the Indian Penal Code:

A. Legal Provisions:

Section 497 of the IPC outlines the offense of adultery and its legal implications. We will analyze the provisions of this section, including the specific elements required to establish adultery as a criminal offense.

B. Elements of Adultery:

To understand adultery in legal terms, it is essential to examine the elements that constitute the offense. We will explore the requirement of sexual intercourse, the involvement of a married woman, and the absence of the husband's consent, as outlined in Section 497.

C. Gender Bias:

Section 497 of the IPC exhibits a clear gender bias, as it only criminalizes the act of a man engaging in sexual intercourse with a married woman, excluding women from prosecution. We will discuss the implications of this gender bias and its impact on the legal treatment of adultery.

IV. Interpretation and Criticisms:

A. Constitutional Challenges:

Section 497 has faced constitutional challenges on various grounds, including violations of the right to equality, privacy, and personal liberty. We will analyze the landmark judgments and legal arguments put forth in these challenges.

B. Violation of Fundamental Rights:

The criminalization of adultery raises questions regarding the violation of fundamental rights, such as the right to privacy and personal autonomy. We will explore the arguments surrounding these rights and their applicability to adultery laws in India.

C. Discrimination and Gender Inequality:

Section 497 perpetuates gender inequalities by treating women as passive objects and denying them agency. We will discuss the criticisms against this provision and its impact on gender dynamics within society.

V. Societal Implications:

A. Impact on Marital Relations:

Adultery can have profound consequences for marital relationships, leading to emotional distress, breakdowns in trust, and potential dissolution of marriages. We will explore the impact of adultery on marital relations and the role of legal provisions in addressing these issues.

B. Stigma and Social Consequences:

Adultery carries significant social stigma in Indian society. We will examine the social consequences faced by individuals involved in adultery and the potential impact on their personal and professional lives.

D. Impact on Women's Autonomy:

The criminalization of adultery has implications for women's autonomy and agency. We will discuss how Section 497 may restrict women's choices and perpetuate patriarchal norms within society.

VI. Recent Developments and Decriminalization:

Recent years have witnessed significant developments regarding adultery laws in India. We will explore the landmark judgment of the Supreme Court in 2018, which struck down Section 497 as unconstitutional and decriminalized adultery. Additionally, we will discuss the implications of this decision on the legal treatment of adultery in India.

Adultery in India has been subject to significant legal scrutiny and changes over the years. Here are the key

legal concepts related to adultery in India:

HISTORICAL LEGAL FRAMEWORK

1. Section 497 of the Indian Penal Code (IPC), 1860

Definition: Adultery was defined as a man having sexual intercourse with the wife of another man **without the husband's consent**.

Punishment: The man committing adultery could be punished with imprisonment for up to five years, a fine, or both. The woman involved was not punishable as an abettor.

Nature of the Offense: Adultery was treated as a criminal offense only for the man, reflecting a patriarchal view where the wife was seen as the husband's property.

Supreme Court Judgment: Joseph Shine v. Union of India (2018)

1. Petition and Arguments:

The case was brought by Joseph Shine, who challenged the constitutionality of Section 497 IPC and Section 198(2) of the Code of Criminal Procedure (CrPC) on the grounds that they discriminated based on gender and violated fundamental rights.

The petition argued that the law was archaic, violated the right to equality (Article 14), right to non-discrimination (Article 15), and right to privacy and dignity (Article 21).

2. Supreme Court's Ruling:

Unconstitutional: The Supreme Court unanimously declared Section 497 IPC unconstitutional, decriminalizing adultery.

Gender Equality: The Court found that the provision was discriminatory and violated the constitutional principles of equality and dignity.

Autonomy and Privacy: It emphasized the importance of individual autonomy and privacy in marriage, recognizing that treating adultery as a criminal offense infringed upon these rights.

Marital Status: The judgment held that the law was based on outdated notions of marriage that viewed the wife as the husband's property.

3. Implications:

Civil Offense: While adultery is no longer a criminal offense, it can still be a ground for divorce under civil law.

Military Exception: Adultery remains a punishable offense under military law, where it can lead to disciplinary action.

Post-Joseph Shine Legal Landscape

1. Grounds for Divorce:

Hindu Marriage Act, 1955: Adultery remains a valid ground for divorce.

Special Marriage Act, 1954 : Similar provisions exist for marriages registered under this Act.

Other Personal Laws: Adultery is also a ground for divorce under other personal laws, such as the Christian

Marriage Act and the Parsi Marriage and Divorce Act.

2. Impact on Custody and Maintenance:

Adultery can influence decisions related to child custody and maintenance during divorce proceedings, though it is not the sole determining factor.

KEY POINTS TO REMEMBER

Decriminalization: Adultery is no longer a criminal offense in India as per the 2018 Supreme Court ruling.

Civil Consequences: Adultery continues to be significant in civil law, particularly concerning divorce and related matters.

Military Law Exception: The decriminalization does not extend to military personnel, who are still subject to disciplinary action for adultery under military regulations.

The decriminalization of adultery in India reflects a shift towards upholding individual rights and gender equality within the legal framework.

CONCLUSION:

Adultery is a complex issue that challenges the very fabric of trust and commitment within relationships. Understanding the causes, consequences, and societal perspectives surrounding adultery is crucial for comprehending the complexities of infidelity. Open dialogue, seeking professional guidance, and fostering a supportive environment are crucial elements in healing and preventing the devastating effects of adultery. By addressing the complexities of adultery with sensitivity and compassion, we can foster healthier relationships and promote a more nuanced understanding of human connections. Ultimately, it is through empathy, understanding, and a commitment to personal growth that couples can navigate the challenges of infidelity and emerge stronger on the other side. Adultery should not be seen solely as an act of betrayal but rather as an opportunity for growth, reflection, and transformation within a relationship. By acknowledging the complexities of adultery and approaching it with empathy and a willingness to heal, individuals and couples can work towards rebuilding trust, reconnecting emotionally and sexually, and creating a stronger foundation for their future together.

Adultery, while no longer a criminal offense in many places, including India, continues to have profound effects on individuals, families, and society as a whole. These effects span emotional, social, legal, and economic domains, underscoring the complex interplay between personal behavior and broader societal norms and values. The decriminalization of adultery marks a significant shift towards recognizing personal autonomy and privacy, but the repercussions of adultery remain deeply impactful at various levels of society.

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A REVIEW ON THE FACTORS INFLUENCING THE ADOPTION OF NEW AGRICULTURAL TECHNOLOGIES

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Abstract

Adoption of improved agricultural technologies is a tool for increasing the agricultural sector's output and productivity, reducing poverty, and guaranteeing food security in underdeveloped nations. The majority of developing nations have many influencing factors, which contribute to the low rate and intensity of adoption of new agricultural technologies. This study focuses on a few potential factors that may influence farmers in developing nations from implementing and adopting improved agricultural technologies. Numerous reviews of the literature revealed that the primary determinants of technology adoption and diffusion are institutional, socio-cultural, technological, economic, and demographic factors. Policy makers should concentrate on developing irrigation systems, bolstering the research-extension-farmers (R-E-F) linkage, improving the accessibility of credit services, providing development agents with various workshops and training, enabling the educational sector to concentrate on adult education, advising farmers to raise their educational levels, and ensuring that farmers have timely access to information. Lastly, technology developers should take into account the needs and perspectives of farmers during the design and development of their products, as this will facilitate the adoption of the technology more readily.

Key words : Underdeveloped nations, farmers, adoption, technology, agricultural, nations, developing, improved, factors, educational, concentrate

1. Introduction

Since the dawn of human civilization, agriculture has entered the realm of sustenance and employment. Since then, there have been numerous opportunities for someone to start their own business. Agriculture was viewed as an unprofitable endeavor in the past, as the world was heading towards industrialization. But things remain the same even now. However, agriculture continues to be a vital source of income for a large number of people worldwide. New technologies for the advancement of agriculture are being introduced daily. To help farmers and other stakeholders improve their practices, those are presented to them.

However, the rate at which those new technologies are being adopted is low. Investigating the matter

thoroughly reveals that a variety of factors influence the adoption process. The adoption process has been explained by a number of theories and models. These elements influencing technology adoption are compiled in this review along with an analysis of various studies that have been done on the subject. A review of the literature on technology adoption was done in order to achieve this.

The literature was gathered from a variety of sources, including academic journals, technical reports, government websites, and textbooks, and it covered very recent one. Future researchers will benefit from this compilation of literature and knowledge for the efficient management of their research and technology dissemination process.

2. Agricultural technology adoption

Ensuring food security and mitigating poverty in developing nations can be achieved through the implementation of advanced agricultural technologies.

A number of factors, including a slow adoption rate and a lack of understanding regarding many aspects of adoption, make it difficult for farmers to accept agriculturally improved technology. The nature of the technology, awareness of the technologies, risk aversion, institutional constraints, lack of human and financial capital, and lack of infrastructure are just a few of the barriers to adoption that are covered in many academic publications.

The application of adoption and diffusion theory has been prevalent in identifying the determining factors that impact an innovation's decision to be adopted or rejected by the user. Innovation is any concept, method, or item that a person perceives as novel . The innovation diffusion theory (IDT) consists of five steps that one must take in order to decide on a specific innovation. The initial phase involves educating the person about the innovation, its purpose, and the necessity of a new technology. The person enters the second stage based on how they feel about the new technology. According to many scholars, there are five characteristics that influence a person's decision and make them more likely to enjoy new technologies.

The person enters the second stage based on how they feel about the new technology. There are five characteristics that influence a person's decision and make them more likely to enjoy new technologies. Answers to the question "Is the new technology better than existing technology?" indicate **relative advantage**. The degree to which an innovation is viewed as congruent with adopters' preexisting experiences, needs, and beliefs is known as **compatibility**; **Complexity**: the extent to which an innovation is challenging to comprehend and apply; **Trialability**: the extent to which the invention can be applied sparingly; **Observability**: the extent to which an innovation's effects are apparent to other people.

Individuals' decisions to embrace or reject the technology constitute the third stage. The application of this new technology is the fourth stage, and the individual's decision is confirmed in the final stage. The process of incorporating a new technology into an established practice is called adoption, and it typically involves some degree of adaptation and a period of "trying." Adoption is defined by some as the cognitive process that a person goes through from the moment they learn about an innovation until they finally use it. The adoption intensity and rate of adoption are its two categories. Time is one of the foundations of the former, which measures how quickly farmers adopt innovations. On the other hand, adoption intensity describes how much a technology is used over any given period of time. Adopting new technology can be challenging because the process varies depending on the technology. Consequently, the first thing to take into account when characterizing farmers' adoption of agricultural technology is whether or not adoption is a discrete state with binary response variables.

This suggests that the definition is contingent upon the farmer's use of the technologies, the assignment of values ranging from zero to one, and whether or not the response is continuous. Agricultural new technologies include the development and use of hybrids, greenhouse technology, genetically modified food, chemical fertilizers, insecticides, tractors, and the application of other scientific knowledge. The five stages of technology adoption are inventors (2.5%), early adopters (13.5%), early majority (34%), late majority (34%), and laggards (16%), to put it succinctly. New agricultural technologies are factors of production that have been altered in some way from their original form in order to improve their efficiency.

3. Determining factors of Agricultural technology Adoption

The research (**Ahmed & Ahmed, 2023**) explores factors influencing modern agricultural technology adoption in developing economies, focusing on obstacles faced by smallholder farmers. It highlights the importance of understanding resource availability, farmer perception, and technology-specific factors, and the need for effective technology-related programs to address food production challenges. A meta-analysis of 367 regression models (**Ruzzante & Bilton, 2021**) found that the adoption of agricultural technologies, promoted by governments and development organizations to boost farm productivity and reduce poverty, is low, with factors like farmer education, household size, land size, credit access, and organization membership positively influencing adoption.

The meta-analysis of 12 Ethiopian studies (**Feyisa, 2020**) found significant determinants of agricultural technology adoption, including household head age, education, farm size, livestock holding, access to extension services, cooperative membership, and market distance.

(**Takahashi - 2020**) evaluates case studies on technology adoption and its impact on productivity in

low-income nations, particularly sub-Saharan Africa, to identify inadequacies and unresolved concerns. It also discusses the growing body of research on social networks and farmer-to-farmer technology extension, focusing on effective strategies.

Global poverty and hunger have increased, threatening Sustainable Development Goals. Sub-Saharan Africa (SSA) has experienced the most regression, despite numerous farm management methods. Despite numerous theories, most farmers have not adopted new agricultural technologies. A meta-econometric analysis (**Arslan et al., 2022**) reveals that 53% of factors affecting technology adoption are not supported by empirical data. Adoption is influenced by 18 characteristics, including affluence, land tenure, group membership, social capital, and information access. Wealth remains a significant factor in fertilizer use.

Digital agriculture, the digitalization and automation of farming operations, could help address issues like labor costs, production costs, and climate change. The USDA's Agricultural Resource Management Survey (ARMS) shows a surge in automated guidance, applied on over 50% of US farmland. Factors influencing farmers' adoption include cost, soil variability, USDA programs, labor-saving advantages, productivity gains, and advisory services accessibility (**McFadden et al 2023**).

The study by (**Fiocco et al., 2023**) surveyed 5,500 farmers in Asia, Europe, North America, and South America to understand regional variations in agricultural technology usage and obstacles to wider acceptance. The majority of farmers in North America and Europe anticipate adopting agricultural technology in the next two years, with unclear ROI and high costs being major obstacles. South America (50%) farmers are most cautious about internet platforms, and the adoption rate is lowest in Asia (9%).

The research found the following new five trends in relation to the agricultural technology adoption,

1. Despite the slow adoption rate of agricultural technology, farmers remain receptive to new ideas.
2. Precision agriculture is a major enabler of the shift toward less resource-intensive, more sustainable food systems.
3. It is probable that regulations will become more crucial in propelling the expansion of specific agricultural technology submarkets.
4. Business models are still developing in the direction of integrated solutions.
5. There is a chance to strengthen data sharing trust and enhance product customization.

The research (***Agtech in Latin America_ A Promising Landscape (2023, Q4), n.d.***) on Latin America's agriculture technology industry highlights its potential for growth. However, challenges

such as infrastructure, connectivity, and road access in rural areas hinder adoption. Insufficient electricity availability and regulatory frameworks also hinder technology adoption. Despite funding options from impact investors, venture capital firms, and cooperatives, market risk perception and information asymmetry can hinder financing for innovative agriculture technology startups.

A study by (**Echeverría, 2021**) reveals challenges in Latin America and the Caribbean's rural societies and agri-food systems, including enhancing food productivity, promoting sustainability, adapting to climate change, and promoting economic inclusion. Barriers to technology adoption include information and training, policy/institutional issues, economic issues, social/cultural issues, and environmental issues. To overcome these, strengthening producers' social networks is crucial for exchanging projects, best practices, and innovations.

A study by (**Brief, 2021**) analyzed factors influencing smallholder farmers' adoption of agricultural technologies. Surveys were conducted in nine countries, including Asia, Latin America, and Africa. The study also evaluated maize seed adoption in Benin and Farmers Field School (FFS) programs in 25 countries. The Benin study used improved maize seed and agricultural extension assistance. A meta-analysis of 168 researches in 23 African nations identified positive factors influencing agricultural technology adoption.

The result of the finding was that farmers in areas with certain policy tools in place had higher adoption rates of new agricultural technologies. These tools guaranteed that farmers could invest in newer technologies, had access to credit, could understand new technologies and make informed decisions, had secure land tenure, which allowed them to continue benefiting from new technologies with upfront costs, and participated in organized farmer groups where they could learn from one another about new farming techniques.

(**Aryal et al., 2020**) investigates the impact of women's participation in adopting agricultural technology on climate-smart agriculture (CSA) adoption in Indian farm households. Results show that women in Haryana have a higher likelihood of adopting CSA than in Bihar. Wealth, training, and access to extension and market positively influence CSA adoption. Women farmers prioritize family food security over farm income, making CSA adoption more likely in Haryana.

Brazil's digital agriculture has significantly increased, with 34% of farmers buying agricultural products online, compared to 26% in the US. A McKinsey poll (***Brazilian Farmers' Approach to Digital: Embracing Digital* / McKinsey, 2020**) found that 85% of farmers use WhatsApp daily for work-related matters and 70% regularly use internet channels for non-farming purposes. However, inadequate internet access at the farm level, poor website user experience, and cybersecurity concerns are impeding the broader adoption of digital technologies in agriculture.

(Martinez et al., 2021) studied Bolivian rice growers' adoption of complementary agricultural technology. They found that farmer organization membership, access to agricultural extension, and proximity to San Juan de Yapacaní which is Bolivia's main rice-related technological dissemination area are crucial factors for adopting improved technologies. Farms located in areas like Santa Cruz, where labor is abundant and markets are larger, are more likely to influence the adoption of these technologies.

(Marshall et al., 2022) study explores the adoption of digital agricultural technology by Australian farmers. They found that many farmers are not using technology due to the digital divide between rural and urban areas. The study uses a "communitive ecology" framework to investigate the technological, discursive, and social aspects of digital farming adoption on a cotton farm in South-East Queensland, Australia.

A study (B. Singh & Sharma, 2019) in Rajasthan's Dantiwara village, Jodhpur district, examined the factors influencing the adoption of organic farming practices. Eighty farmers were selected, with 55% falling into the medium adoption category. The study found that education, caste, occupation, social engagement, herd size, information source, exposure to media, attitude, knowledge, and training were positively and significantly connected with organic farming adoption.

(Workineh et al., 2020) study examined Ethiopian households' welfare influenced by adopting improved wheat varieties. Factors like credit availability, extension visits, soil fertility, plot size, off-farm employment, age, distance from input market, and farm experience influenced adoption. The study concluded that adopting better wheat varieties significantly improves farm households' welfare.

(Barua, 2016) study found a positive correlation between land cultivation and technology adoption among Tanzanian smallholder maize farmers. Fair payment motivates technology use, but price volatility hinders adoption. Altitude also positively influences technology adoption. High and medium land farmers are more likely to adopt technology compared to low land farmers. However, female heads of family may lack decision-making authority and may not be aware of new technologies.

The adoption rate of sustainable innovations in agriculture is below the 2030 Sustainable Development Goals, despite their benefits. A systematic literature review (Rizzo et al., 2024) reveals individual psychological and socio-demographic traits, along with specific innovation characteristics, contribute to this phenomenon. Environmental values influence sustainable technology adoption, with organic farmers prioritizing environmental concerns over financial rewards. Obstacles include complexity, aversion, and low perceived control. Future research could explore farmers' adoption dynamics of sustainable technology.

(Yokamo, 2020) literature survey analyzed the adoption of improved agricultural technologies in

developing countries, revealing factors influencing adoption include technological, socio-cultural, demographic, economic, and institutional aspects. Farmers' perception of technology features, trialability, observability, compatibility, and complexity determine adoption. The review reveals that technology adoption varies based on factors like technology type, price, education, and access points. Experts have conflicting views on age's role in adoption, with some suggesting older farmers are less risk-averse. Policy makers and agricultural technology developers must understand factors influencing adoption to increase production, productivity, food self-sufficiency, and ensure food security in developing nations.

The study by **(Cui and Wang, 2023)** reveals that despite China's recent promotional campaigns, the adoption rate of digital technology in agriculture remains low, with various factors influencing farmers' decisions. Five factors predict adoption decisions for digital technologies: institutional, technological, agro ecological, psychological, and socioeconomic. Collaboration between individuals, governments, technology providers, and extension agents is crucial for rural adoption.

(Dissanayake et al., 2022) conducted a literature review on technology adoption, analyzing factors from over 50 years of research and dividing them into three groups. The adoption of a new farming method is influenced by various user-related (size, income, gender, age, experience, trialability, and observability of the farm), technology-related (compatibility, affordability, availability, trialability, and observability), and institutional factors (availability of credit facilities, markets, inputs, and extension services), which interact and work together.

(Das & Das, 2017) The research explores the use of technology in farming, its partners, how farmers learn about it, and the limits of its application, using data from the 70th round of the National Sample Survey. A study found that only 4.41 percent of Indian agricultural households have formal training in agriculture, and only 38% use modern techniques. Only 44.26 percent of households reported machinery expenditure, with crop category significantly influencing machine usage. Factors influencing machinery use in agriculture include irrigation, marketable surplus, leased-in areas, crop insurance, and information sources. SC and ST households have less access, but OBC farm households use more machinery.

The Rwandan government has increased irrigation development investments to address erratic rainfall patterns and droughts. A study analyzing the adoption of small-scale irrigation technologies (SSITs) among 360 farmers **(NGANGO & HONG, 2021)** found that adoption decisions are influenced by factors like education, farm size, gender, and access to credit. SSITs positively impact land productivity, emphasizing the need for policy promotion to improve agricultural productivity and food security

The study (**Adams & Jumpah, 2021a**) analyzed the impact of technology adoption on smallholder farmers' welfare, focusing on regional location, educational level, age, and Farmer Base Organization membership. Results showed that technology adoption had a positive but statistically insignificant impact on welfare, with consumption and clothing expenditure increasing with adoption but not healthcare. To improve technology adoption, emphasis should be placed on business supporting, agricultural extension outreach, and finance/input support.

The study (**Apicella & Tarabella, 2024**) aims to identify the awareness rate and adoption drivers of precision agriculture (PA) among Italian farmers. Based on an online survey of 755 farmers, the results show that 48.48% of informed farmers lack the necessary information for PA techniques, with a diffusion rate of around 20%. The research suggests training development paths for farmers to adopt technologies with sustainability orientation. This research serves as a starting point for future studies.

The study (**Chuchird et al., 2017**) examines the factors influencing the adoption of water wheel (WW), water pump (WP), and weir (WR) irrigation technologies among 207 rice-growers in Chaiyaphum province, Thailand. Results show land holding size, farm income, and water use association (WUA) membership positively influence WW adoption, while age, farm income, skills training, and WUA membership negatively affect WP adoption.

The study (**Kebebe, 2015**) aimed to understand the factors affecting the adoption of improved livestock technologies in the Ethiopian highlands, focusing on dairy production. The findings suggest that the returns to investment for these technologies may be too low to justify widespread adoption. Interventions at production, storage, transportation, processing, and marketing chains and macroeconomic institutions and policies are needed for successful dairy development programs.

This systematic review of 21 Ethiopian studies on farmers' adoption decisions of improved crop varieties (**Abdurehman & Abdi, 2021**) found that access to credit, social organization participation, hired labor, field day participation, farm income, farm size, extension contact, training, oxen, fertilizer, and input market access are the best determinants.

(**Dessart et al., 2019**) conducted over the past 20 years on the behavioral factors influencing farmers' decisions to adopt ecologically friendly methods. According to the analysis, a greater adoption of sustainable techniques is linked to extraversion, risk-taking, moral and environmental concern, openness to new experiences, lifestyle farming goals, willing to rise in social standing, accept the advice of social referents & their neighboring farmers and when they possess the necessary knowledge and expertise in these areas.

The study (**Dai et al., 2015**) analyzed factors influencing farmers' adoption of water-saving practices in Heilongjiang Province, China. Factors such as water source reliability, government promotion,

household adulthood, risks, education, soil texture, oil price, electric power, labor access, technical complexity, investment, water source, soil texture, oil price, and lack of electric power impacted adoption.

Rice is the world's most important food crop, with over 90% grown in Asia and Africa. A study (**Achukwu et al., 2023**) on small-scale rice farmers Nigeria found few agricultural innovations being used. The main innovations were herbicide spraying, fertilizer application, pesticide use, and improved seeds. Barriers to innovation adoption included high costs, lack of adoption training, inability to acquire financing, and inadequate extension services. Demographic factors like gender, education level, and farm size also impacted adoption. The study recommends government and organizations encourage farmer education and regular visits by extension agents to promote new ideas.

Climate-smart agriculture (CSA) practices are proposed to mitigate climate risks and reduce greenhouse gas emissions. However, resource-poor farmers face financial and knowledge barriers. A study in Odisha by (**Tanti et al., 2022**) found that 95% of farmers have adopted CSA practices, with factors like government extension service, farmer school participation, subsidies, energy access, and climate shock perception being major determinants. Improved institutional support is crucial for CSA adoption.

(**Hooks et al., 2022**)'s study using a random effects panel model found that countries with high competitiveness, enhanced cybersecurity, ease of doing business, and low political violence/terrorism adopt new technologies more readily.

(**Begho et al., 2022**) paper reviews adoption literature of sustainable agricultural technologies in South Asia and finds that over the last four decades, empirical data has demonstrated that a variety of factors, including financial, attitudinal, psychological, social, agronomic, and regulatory ones, can impede the adoption of innovative methods. The research found that education, extension and training, soil quality, irrigation, income, and credit are significant drivers of adoption decisions. The findings could help shape research and policies to promote sustainable nitrogen management technologies in South Asia. The study (**S. Barman et al., 2019**) in Central Brahmaputra Valley and Upper Brahmaputra Valley Zone of Assam, India, examined factors affecting farm mechanization adoption. Data from 240 sample farms was collected using personal interviews and Logit Regression Analysis. Factors affecting mechanization adoption included age, education level, and land holding size, access to irrigation, extension agents, high yielding varieties, and institutional credit. Younger farmers preferred mechanization more than older ones. The study concluded that linkage between extension functionaries and grassroots level is crucial for successful farm mechanization.

(**Bagal et al., 2020**) investigated the factors influencing adoption of farm mechanization in Jammu

district of Jammu and Kashmir. Farm mechanization reduces human and animal work, increasing crop production and productivity. However, farmers are not fully using equipment due to lack of awareness, higher prices, and less operational land holding. To enhance knowledge, state agriculture departments should introduce schemes, agro industries corporations, private machine owners, and co-operative societies for payment-based machine usage.

According to **(Chi, 2008)** while studying factors affecting technology adoption among rice farmers in the mekong delta region, reported that perceptions and educational levels of farmers, the expertise of extension workers, the structure and administration of extension programs, and the physical attributes of the region all had an impact on the adoption of new technology. The main obstacles to the adoption of new technologies were the low educational attainment of farmers, their poor impression of the technologies, and the extension staff's poor teaching abilities. Remote areas were not reached by the extension effort. It is possible that some of the technical knowledge that skilled farmers orally impart to unskilled farmers would be lost. Farmers found the IPM and its three reductions and three gains to be complex techniques. The adoption of these technological solutions required a significant amount of time, labor, and capital. To buy certified seeds and row seeding gear, farmers require funds. Due to its high cost and the tiny areas of land with a network of irrigation canals and river branches, mechanization was not common in the harvesting and post-harvest processes.

Dryland ecosystem smallholders continue to live in poverty and face severe social and economic hardships as their landholding shrinks. Due to inefficiency with resources and ignorance, the majority of dryland farmers use traditional disintegrating agricultural methods. In order to solve the problems with dryland farming today, **(Kandasamy et al., 2022)** looks into the viability of an Integrated Farming System (IFS) and explores the elements that could influence the agricultural community's adoption of it. The purpose of this research is to evaluate the main factors influencing the adoption of the IFS in rural southern India by applying and contrasting supervised learning approaches. According to the study, the main variables influencing dryland farmers' adoption of IFS are their age, their level of involvement in extension activities, and their output of organic fertilizer. The study demonstrates that there is a good chance for small and marginal farmers to experience the greater benefits of IFS.

(Ullah et al., 2020) explores factors affecting farmers' access to agricultural credit and adoption of improved agricultural technologies in Khyber Pakhtunkhwa, Pakistan. Results show a moderate positive association between credit access and technology adoption. Farmers with large farms, high income, better access to information, and physical assets have better credit access. However, farming experience negatively affects credit access. The study emphasizes the importance of effective information provision for different farmers.

In order to investigate how adoption models are currently reliant on farm/farmer attributes in relation to technology attributes and disseminating institutions, **(Jones-Garcia & Krishna, 2021)** reviewed the studies published between 2007 and 2018 on the adoption of sustainable intensification technologies in maize systems of the Global South. The key conclusion emerged from an analysis of 137 adoption studies is that the primary barriers to farmers adopting new technology were limited information availability and technologies unfit for small landholdings.

The study **(Liu et al., 2018)** reviews best management practices (BMPs) for reducing agricultural pollution, highlighting the lack of adoption by farmers. It explores factors influencing BMP adoption in developed and developing countries to improve water quality. The result shows that access to credible information, government subsidies, environmental consciousness, and profitability are positive. Other factors like farm size, land tenure, experience, and education are unclear or debatable. Further research is needed to understand the roles of social norms, peer pressure, and macro factors like geographic regions, policies, markets, and business.

There was research by **(Odame et al., 2011)** to find out the reason why agricultural technology is low in eastern and central Africa. The result showed that the success of adoption is attributed to a complex institutional framework, technical innovation, and participatory approach to adaptive research and technology transfer, focusing on demand-driven training and education for farmers. Collaboration among researchers, extensionists, private sector, and farmers has led to the adoption, incorporating crop and livestock farming, and developing rotational grazing patterns for cover crops. This approach also addresses environmental concerns and watershed degradation. The strategy involved aggressive dissemination of technical, economic, and environmental information through media, written documents, and farmer-to-farmer exchange. Private-public partnerships and an agro-input company supported demonstration projects. Targeted subsidies significantly supported small farmer adoption of no-till practices.

With strong market and regulatory pressure to adopt more environmentally sustainable methods while improving production, European agriculture faces an increasingly difficult future. Technologies that are powered by data are essential for tackling these issues. Given the abundance of farming data available today, it is crucial to understand the factors affecting the adoption of data-driven technology in this sector. In Ireland, **(Factors Impacting Farmers' Adoption of Digital Agriculture - Demeter, n.d.)** discovered that adoption was primarily motivated by the hope of improving productivity and performance through, among other things, time savings, less bureaucracy, improved yields and outputs, and more efficient use of agricultural inputs. The largest obstacles are the perceived high cost of acquiring and maintaining data-driven technology, as well as the overall absence of high-quality

broadband and internet connectivity.

(John et al., 2023) assessed the various factors that affect precision agriculture adoption in Europe's small-scale farming industry. The most important component is clearly the social dynamics, which are influenced by cultural norms that are deeply ingrained, awareness levels, and knowledge distribution channels. The most complex layer influencing adoption attitudes is formed by these social factors, which frequently converge with deeply embedded traditional practices and beliefs. Social reasons take precedence over economic factors, such as large initial investments and the return on investment calculation. The problems of digital literacy, infrastructure preparation, and technological interoperability define the technological landscape. Finally, resource scarcity, climate change resilience, and ecosystem services highlight environmental imperatives, which present both difficulties and opportunities.

Farmers in Nepal have a unique opportunity to sell their enormous cardamom on the international market thanks to the ecological surroundings in the Himalayan hills. Nevertheless, the nation does not put much effort into implementing profitable large-cardamom post-harvest upgrading techniques. The implementation of significant post-harvest methods for huge cardamom in the Eastern Himalayan region and the Nepali corridor is examined and discussed by (Kattel et al., 2020). The adoption of main post-harvest practices of large cardamom was positively influenced by a number of factors, including experience, household income from large cardamom, commercial size of production, risk aversion, access to credit, and availability of technical services, according to adoption model results. In many parts of the world, the adoption of unsustainable farming practices, such as excessive soil tillage without soil coverings, has resulted in accelerated erosion, decreased soil fertility, and degradation of arable land. Food insecurity and lower yields are the outcomes of this. Determining the socioeconomic, biophysical, and institutional elements influencing farmers' decisions to implement conservation agriculture methods in Mozambique was studied by (Chichongue et al., 2020). The findings show that the adoption of CA techniques is influenced by both biophysical factors (perception of falling soil fertility) and socioeconomic factors (household size, animal ownership, communication assets, farmer associations, and gender of the household head).

Using climate-smart agriculture (CSA) techniques is a long-term way to improve food security and agricultural sustainability in the face of climate change. Still, there is a low global adoption rate for CSA procedures. Increasing the spread of CSA practices requires an understanding of the primary drivers behind their adoption. This research (Li et al., 2024) offers a comprehensive analysis of the literature, encompassing 190 papers that were published between 2013 and 2023. The study shows that the majority of the variables covered in the literature—such as age, gender, education, perception and

preference of risk, loan availability, farm size, production circumstances, off-farm income, and labor allocation—have a twofold effect on the adoption of CSA practices, which can be either favorable or negative. The adoption of CSA practices is consistently and favorably impacted by factors like labor endowment, land tenure security, access to agricultural training, access to extension services, membership in farmers' organizations, support from non-governmental organizations (NGOs), climate conditions, and information availability.

Modern agriculture is now mostly driven by labor-saving mechanized technology, yet adoption of these technologies is still low in many developing nations, most notably Ghana. The findings (**Guo & Akudugu, 2023**) indicated that a lack of access to commercial lands, gender prejudices, a lack of financial availability, and a lack of knowledge about the advantages of these technologies are the main causes of the low adoption of agricultural mechanization.

Floods cause devastation for farmers, particularly Assamese rice growers who cultivate sali rice during a flood-prone season. An investigation into the factors influencing the adoption of flood-tolerant cultivars was carried out in the Jorhat area of Assam by (**U. Barman et al., 2023**), which is regarded as the rice bowl of the state. The findings showed that socioeconomic factors like education, age, occupation, family size, holding size, and interactions with extension agents had an impact on respondents' likelihood of adopting flood-tolerant rice varieties. Nonetheless, it was discovered that the adoption decision was positively and effectively influenced by education and the quantity of interactions with the extension agent.

4. Discussion

The reviewer concludes that a variety of personal factors are influencing the adoption process after taking into account all of these variables and studies written by numerous authors. While some of these writers have combined some factors, the majority of them have taken each one and listed it separately. However, a thorough search for the factors reveals that the majority of them are related to one another. For instance, the degree of education, experience, and age. Farmers who are older have greater farming experience. Throughout their lives, they must have been exposed to a lot of new technologies. Hence, compared to younger and less seasoned farmers, they may have a tendency to adopt the technology much more readily. In contrast, it's possible that the younger farmer has received more education than the more experienced ones. As a result, they might use the technology far more quickly than the more experienced farmers. The ability to take risks may vary depending on factors like age, education, and work experience.

Another illustration is that, when it comes to gender issues, the majority of these studies are carried

out in African nations where the husband or another male family member leads the home. Women have less decision-making authority in those nations due to social norms and beliefs. However, some authors discovered that there is no connection between gender and adoption even in these nations.

Adoption is impossible because the features of the technology do not meet the expectations of the farmers. As a result, there needs to be a lot of attention paid to this. However, in some circumstances, social influence and the social network may have an impact on the adoption of even these technologies. Additionally, even in cases where the technology is excellent, the user's access to additional information and the information disclosed about it may have an impact on the adoption process.

The availability of the required capital resources and infrastructure is another noteworthy factor. Adoption will be hampered even if the technology is suitable and the end user is willing to adopt, provided that the necessary funding is available.

In conclusion, a variety of factors influence the adoption of technology in the agricultural industry. They are either user- or technology-related factors, or they are institutional factors. However, when considering the majority of the individual characters, they become more connected and related. To ascertain the adoption process of a particular technological advancement, these factors must be examined separately as well as in relation to other factors. Consequently, more research and analysis of these factors' effects is advised in order to determine how they affect the adoption of technology in the agricultural sector both individually and collectively.

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EXPLORING NECROPOLITICS IN TEMSULA AO'S LABURNUM FOR MY HEAD

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Abstract

This article examines the manifestation of necropolitics in Northeast India through a critical analysis of Temsula Ao's short story collection "Laburnum for My Head." Focusing primarily on the stories "Sonny", "The Letter," and "A Simple Question", the study explores how Ao's narratives illuminate the complex interplay of power, violence, and survival in a region marked by prolonged conflict and political instability. Drawing on theoretical frameworks established by Michel Foucault, Achille Mbembe, and Giorgio Agamben, the article argues that necropolitics in this context extends beyond the binary of state versus resistance, permeating multiple layers of society. Ao's stories reveal how the power over life and death is contested and exercised by various actors, including state forces, insurgent groups, and even ordinary villagers. It aims to shed light on the complex relationship between sovereignty, violence, and the production of marginalized populations in contemporary political landscapes.

Keywords: Violence, AFSPA, Necropolitics, sovereignty, resistance

One of the fundamental underpinnings of sovereignty resides in its capacity to exert control over life and death. As a pivotal instrument for regulating societal order and effectuating or impeding social change, sovereignty necessitates a state apparatus capable of governing the existential parameters of human existence. In this nexus of politics and ontology, power is not merely deployed to inflict violence but also to legitimize it, thereby establishing a framework for state-sanctioned control over life and death. Michel Foucault's seminal work *The History of Sexuality* (1978) introduces the concept of biopolitics, elucidating the integration of biological life into the political domain. Foucault posits that modern states exercise power through the meticulous regulation of bodies and populations, prioritizing the administration of life rather than its termination. This governance extends beyond mere survival, encompassing the optimization and control of life

processes, rendering the population a central object of political strategy. Expanding upon Foucault's framework, Achille Mbembe develops the notion of necropolitics, arguing that sovereignty is intrinsically linked to the power to determine who lives and who dies. Mbembe contends that "To be sovereign is to exert one's control over mortality and to define life as the deployment and manifestation of power." (Mbembe 66). Necropolitics extends biopolitics by foregrounding the manner in which power is employed to create death-worlds—environments characterized by extreme deprivation and a precarious existence. These death-worlds are engendered by systemic violence, oppression, and the denial of fundamental human rights, disproportionately affecting marginalized and subjugated populations.

Northeast India has been a crucible of protracted armed conflict, deeply rooted ethnic tensions, and pervasive violence perpetrated by both state and non-state actors. Comprising eight states, the region has grappled with longstanding demands for autonomy and self-determination, often manifesting in violent confrontations. The region's complex ethno-political landscape, characterized by diverse ethnic groups competing for recognition, resources, and political power, has been exacerbated by historical grievances and colonial legacies. These factors have contributed to a pervasive sense of marginalization and fuelled insurgencies and demands for statehood. As Sanjib Baruah argues, this volatile environment has transformed violence into a primary mode of political expression and negotiation (Baruah 89).

The response by the Indian government to the challenges of insurgency has been laden with a heavy-handed approach, deploying military and paramilitary forces to quell insurgencies. The Armed Forces (Special Powers) Act (AFSPA) which was first enforced in 1958 has been a focal point of contention, with scholars and critics alike arguing that it creates a climate of impunity, exacerbating human rights abuses and alienating the local population (Kikon 2019; Subir 2021; Bhattacharya 2018). While the region has also witnessed the rise of numerous insurgent groups, often with deep roots in specific ethnic communities. The interplay between state and non-state violence has produced a cyclical pattern of conflict, as state repression often fuels further resistance. Groups such as the United Liberation Front of Asom (ULFA) and the National Socialist Council of Nagaland (NSCN) exemplify this dynamic, having waged protracted armed struggles for sovereignty or autonomy. The impunity AFSPA allows has virtually created states of exceptions in the contested zones, violations ranging from abuse of human rights to rape and executions of the supposed insurgents. As Sanjoy Hazarika argues:

There is virtually no legal redress in these laws because no courts of law have anyright to take up any case, even against civilian personnel, unless express permission is granted by those authorized—in other words, usually by the persons who should be held accountable for the act(s) of commission or omission. (Hazarika, 7-8)

The socio-economic consequences of this enduring violence have been devastating. Protracted conflicts have disrupted economic activities, displaced populations, and strained the region's infrastructure. Moreover, the pervasive insecurity has hindered efforts to integrate the Northeast into the broader Indian polity, reinforcing a sense of isolation and neglect. Ao's stories thus are set in the backdrop of this environment, her narratives are not centred on the aspects of law and its ethical quarries but of the state such environment creates. Her stories are in its core a narrative of survival in the face of conflict and gender dynamics particularly of the Ao tribe of Nagaland.

Laburnum for My Head offers a kaleidoscopic lens into the complexities of Northeast India. Her work, deeply rooted in the region's history and culture, provides a valuable insight into the lives of its inhabitants, particularly women, and the impact of conflict on their existence. Ao's stories offers a perspective of the aspect of lives under constant threat of violence and change. Ao begins with a poetic description of the purpose of her stories, she opts for a confessional mode of narrative that is at once intimate and universal: "Stories live in every heart; some get told, many others remain unheard— stories about individual experiences made universal by imagination; stories that are jokes, and sometimes prayers; and those that are not always a figment of the mind but are, at times, confessions." The tension Ao identifies between stories as "figment of the mind" and as reflections of reality resonates a polyphonic mode of narration, this dialectic where the fictional narrative is deeply rooted in the historical realities of the Naga conflict, seamlessly blurs the lines between imagination and lived experience of the Ao community.

The stories Ao presents are to be read keeping in mind the backdrop of a violent milieu, as the characters inextricably has to navigate the mechanism of the conflict. Necropolitics from this context exists as a marginal space of control and totality, and for necro politics to take effect, the self, the community and the oppositional force must be totalised first, into a bare life of statistics and into disposable lives.

Sonny explores the complexities of freedom fighters with mortality while simultaneously offering a nuanced perspective on the functionalities of necropolitics within a resistance movement. The story is told entirely from the perspective of the first-person narrator, who is Sonny's former lover.

The narrator recounts her personal history with Sonny, including their courtship, his commitment to the nationalist movement, and ultimately, his assassination. The narrative highlights how the narrator grapples with Sonny's transformation into a revered martyr within the context of the nationalist struggle. Ao depicts a world where death is an omnipresent reality for those engaged in the struggle for freedom. This constant proximity to mortality creates a unique existential condition, as evidenced by the narrator's observation of "bitter and violent rivalries among the different groups of freedom-fighters which often resulted in senseless deaths of leaders and cadres alike" (Ao 88). This environment of perpetual danger necessitates a continuous confrontation with one's own mortality, shaping the psychological landscape of those involved in the resistance. Death, in this way, becomes a performative agency that shapes the existence of Sonny and the speaker.

Sonny, who is affectionately referred to as a "dream-chaser" by the speaker, is a revolutionary compared to Che Guevara and is ultimately put to death in a similar manner. Sonny's ideological affiliation is what Ernest Becker, in *The Denial of Death*, refers to as Heroic living. Citing Nathaniel Shaler, Becker states:

"Heroism is first and foremost a reflex of the terror of death" (ch. 2).

Human beings, he argues, are fundamentally driven by a fear of their own mortality, and much of human behaviour and culture can be understood as an attempt to deny or transcend this existential reality. For Becker, the intrinsic nature of humans is to create symbolic extensions of the self that outlive physical death—this is exemplified in the way Sonny's death is transformed into a form of martyrdom. The narrator observes how, prior to Sonny's assassination, he virtually became a "hero and intellectual 'guru' to the younger generation of sympathizers," with his "ideology" and "legacy" imbued with transcendent significance. This essentially creates a site for rivalry between the senior leaders of the movement, as the speaker mentions Sonny "by questioning their ideology and actions in public even before he went 'underground'" (Ao 91-92).

This site is particularly relevant when considering Mbembe's analysis of martyrdom within the framework of necro politics. Mbembe notes that the logic of martyrdom is a potent political act where the individual's death is transformed into a form of resistance. Mbembe suggests:

"The body in itself has neither power nor value. Rather its power and value result from a process of abstraction based on the desire for eternity. In that sense, the martyr, having established a moment of supremacy in which the subject overcomes his own mortality, can be seen as laboring under the sign of the future. In other words, in death, the future is collapsed into the present" (Mbembe

89).

Sonny's apprehension and gradual disillusionment of the movement is further complicated when in an act of self-sacrifice Sonny testifies "about the true state of the movement" which he wanted the speaker publish by any means. This internal power struggles within the resistance movement reveal that necro politics transcends the binary of state versus resistance, permeating the very structures ostensibly fighting against oppression. These internecine conflicts demonstrate how the power over life and death can be wielded by various factions within a supposedly unified cause. The ideological justifications for violence among different groups illustrate how necro politics can be rationalized even within movements purportedly fighting for freedom, with each faction asserting the right to determine who lives or dies based on their interpretation of the cause. Sonny's assassination, allegedly by the "J group," shows the potential for betrayal and disillusionment within resistance movements. This act exemplifies how necropolitical power can be directed inward, with freedom fighters becoming both agents and victims of political violence. The expendability of lives within the movement is suggested by the phrase "senseless deaths of leaders and cadres alike," reflecting a necropolitical calculus where individual lives are weighed against ideological objectives. The story implies a hierarchy in the perception of deaths, with leaders' demises, such as Sonny's, garnering more attention and potentially having greater political impact than those of rank-and-file members. This stratification of deaths within the movement itself reflects the complex power dynamics at play in necropolitical spaces.

The ongoing conflicts and fatalities within the resistance movement points to a sense of normalization of violence, where the right to kill becomes an accepted component of political struggle. This normalization blurs the lines between oppressor and oppressed, complicating the traditional necropolitical narrative and demonstrating how the power over life and death can be distributed across various actors within a contested political landscape. Through Sonny's story, the personal cost of engaging in resistance becomes apparent. The constant proximity to death profoundly affects personal relationships, as witnessed by Sonny's separation from the narrator.

The letter presents another nuanced state where the underground extortionists embody a clear example of necropolitical power. The story is set in a secluded Naga village, caught between government forces and underground insurgents. After completing a road construction project, villagers are robbed of their wages by armed extortionists claiming to represent the underground. One villager pleads to keep money for his son's exam fees but is beaten. Resentment builds among the villagers, leading to a

decision to resist future extortion. Later, when another armed man arrives demanding "taxes," the villagers surround and beat him severely. A group led by a man called Long Legs takes the unconscious extortionist to a cliff and throws him off, along with his gun. Before disposing of the body, Long Legs finds a letter in the man's pocket from his son, asking for exam fees. Long Legs burns the letter but is haunted by this knowledge for the rest of his life.

Violence here permeates much of the aspect of life in the village, serving as a lingua franca for all parties involved. From the extortion by underground groups to the implicit threat of army reprisals, and ultimately the villagers' own violent resistance, the story demonstrates how violence becomes normalized as a means of asserting power and control in a conflict zone. The villagers' decision to kill the extortionist is a complex manifestation of power dynamics that goes beyond a simple appropriation of necropolitical power by the powerless. Their actions exist in a grey area that challenges straightforward categorizations of power and powerlessness.

It is crucial to recognize that the villagers are not entirely powerless to begin with. They possess a form of collective power rooted in their community bonds, local knowledge, and their role as producers (as evidenced by their ability to negotiate with the Border Roads Organization). Their decision to resist extortion stems from this existing, albeit limited, power base. The act of killing the extortionist is not a clear-cut example of necropolitics in the way that state or insurgent violence might be. Instead, it represents a desperate attempt to assert agency in a context where normal channels of justice and protection have broken down. The villagers are not systematically deciding who lives and who dies as part of a broader political strategy which would be more aligned with necropolitics as Mbembe conceives it. Rather, their action is a localized, reactive response to immediate threats. Moreover, the emotional and moral weight of their decision, as exemplified by Long Legs' lifelong guilt over the letter, suggests that this is not a comfortable assumption of necropolitical power. Unlike the armed forces and the insurgents, the villagers do not view themselves as arbiters of life and death, but as individuals pushed to extreme actions by extreme circumstances.

However, this act of resistance ultimately entangles them further in the web of violence and moral compromise that characterizes their environment. Their attempt to escape subjugation ironically leads them to engage in a form of it, highlighting the insidious nature of pervasive violence in eroding moral boundaries. Their resistance reflects a tragic illustration of how ordinary people can become implicated in cycles of violence when caught between competing necropolitical forces. Their

story underscores the complex moral terrain navigated by those living in states of exception, where the lines between resistance, survival, and complicity become blurred. Their actions reveal both the possibilities and the limitations of resistance in such contexts, and the profound ethical dilemmas faced by those caught in the crossfire of larger political conflicts. Their ability to demand "taxes" from the villagers under threat of violence demonstrates their control over the villagers' means of survival. The incident where a villager is assaulted for pleading to keep money for his son's examination fees underscores how these forces can arbitrarily decide who deserves to thrive and who must suffer.

The Indian government and army also exercise necropolitical control, albeit more subtly. The villagers' need to negotiate with the Border Roads Organization for work opportunities reveals their dependence on state structures for economic survival. Additionally, the mention of past experiences in "grouping zones" and army beatings during the insurgency highlights the state's historical power to determine the conditions of life and death for the Naga people. Reminiscent of a similar management by the United States during the Vietnam War, namely the Strategic Hamlet Program during 1960s. Incidentally, both failed to create a manageable asset and in turn led to a more divisive and further alienated the rural population from the government.

The village's decision to resist both underground and government forces represent an attempt to reclaim agency in the face of necropolitical pressures. However, this resistance ultimately leads to another manifestation of necropolitics when the villagers themselves decide to kill the lone extortionist. In this act, they temporarily assume the power to determine life and death, mirroring the very forces they seek to oppose.

The story's tragic conclusion, where Long Legs realizes they have killed a man whose son needed exam fees—echoing the earlier incident that sparked their resistance—creates a poignant illustration of how necropolitics can perpetuate cycles of violence and suffering. The villagers, in their attempt to escape the necropolitical control exerted over them, inadvertently become agents of that same system.

Similarly, in *A Simple Question* The villagers inhabit a profoundly precarious state, caught in the crossfire between the Naga underground forces and the Indian government. This precarity exemplifies what Giorgio Agamben's terms "bare life", where normal legal and social protections are suspended, and individuals are reduced to a form of life that is stripped of political rights and reduced to mere biological existence, often under conditions of extreme subjugation or exclusion from legal protection. Mbembe suggests that Agamben's concept does not fully account for the complexities of

modern forms of subjugation and violence, particularly those experienced under colonialism and in contemporary conflicts. Mbembe introduces the concept of "death worlds" as a corrective discourse to describe spaces where individuals are relegated to a state of living death, where life is constantly exposed to violence, precarity, and destruction. In such spaces, lives are subjected to conditions that make survival almost impossible, and they exist in a state of "living death", a disposable and precarious existence imposed not only through violence and conflict but by nuance form of subjugation and control.

The story illustrates how the villagers, particularly the gaonburahs (village elders), exist in a liminal space where their rights and agency are constantly threatened. As the narrator explains: "If, during peacetime these elders enjoyed a privileged status, they became the most vulnerable ones when hostilities broke out between the Nagas and the Indian state" (Ao, 81).

This shift from privileged to vulnerable status underscores Agamben's notion that in a state of exception, anyone can be stripped of their political status and reduced to bare life.

The villagers face a double bind that exemplifies their precarious existence. On one hand, they are held responsible by the government if young men from their villages join the rebel forces. On the other, they face threats from the underground forces if they fail to provide recruits and material support. This impossible situation mirrors Agamben's description of how the state of exception creates a zone of indistinction between inside and outside, where individuals are subject to power but excluded from its protection.

The story vividly illustrates how this state of exception permeates everyday life. The constant threat of violence, the economic strain of double taxation, and the loss of autonomy over their own land and resources all contribute to the villagers' precarity. For instance, the narrative describes how villages that allow army camps to be set up become "prime suspects in the eyes of the underground and, as a form of punishment, were taxed double the amount" (Ao, 83). Demonstrating how every decision, even those made under duress, can lead to further vulnerability.

The precarious state of the villagers is perhaps most poignantly illustrated through the character of Tekaba, Imdongla's husband. His physical deterioration under the strain of his position is described vividly:

"Imdongla could see the effects of the terrible pressure on her husband; his hair had turned white, his face was gaunt with hunger and apprehension, and his eyes had a furtive look" (Ao, 84).

This description encapsulates how the state of exception inscribes itself on the bodies of those subject to it, reducing them to a state of constant fear and vulnerability. The story also highlights how the state of exception can be internalized and normalized. The villagers' reluctant acceptance of increasingly demanding "taxes" from the underground forces, and their compliance with government orders to relocate or clear land, demonstrate how exceptional circumstances can become the new normal.

However, the story also suggests possibilities sites for resistance within this precarious state. Imdongla's actions, from her clever intervention to save her husband from beating to her confrontation with the army captain, demonstrate how individuals can challenge the power structures that seek to reduce them to bare life. Imdongla's performance of a "mad woman" at the army camp is a strategic act that challenges the necropolitical power structure. Her insistence on bringing her husband's blanket and jacket to the army camp, and by threatening to disrobe, she performs a culturally significant act that forces the captain to reconsider his position, her performative acts of defiance are a final resort to reassert her humanity in the face of dehumanizing circumstance. As Ao suggests: "she stood up and made as if to take off her waist cloth which he knew was the ultimate insult a Naga woman could hurl at a man signifying his emasculation." The act itself is a distinctive cultural strategy that challenges the conventions of any sovereign structures enforced by any exceptional power.

As was the case in 15 July 2004, when twelve women disrobed and marched naked to Raj Bhawan as a protest against the unwarranted killing of Manorama Devi and the widespread atrocities committed by the Indian Army against the people of Manipur under AFSPA.

Ao's work demonstrates that necropolitics in Northeast India extends beyond the simple binary of state versus resistance. Instead, it permeates multiple layers of society, manifesting in the actions of state forces, insurgent groups, and even ordinary villagers caught in the crossfire. This multifaceted nature of necropolitics reveals the intricate power dynamics at play in conflict zones, where the power over life and death is not solely the domain of the state but is contested and exercised by various actors. The concept of "death- worlds," as proposed by Mbembe, finds vivid expression in Ao's narratives. Her characters inhabit spaces where the boundary between life and death is constantly blurred, and where survival often comes at the cost of moral compromise. This state of precarious existence, reminiscent of Agamben's "bare life," is not merely a theoretical construct but a lived reality for many in the region. Her stories also highlight the possibilities and limitations of

resistance within necropolitical contexts. The resistance which is centred on a cultural and tribal distinctiveness effectively creates a new site for strategic challenges that can effectively check the impunity of the necropolitical powers of AFSPA.

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THE INTEGRATION OF MECHANICAL ENGINEERING, TECHNOLOGY, AND THE HUMANITIES FORMOBILITY SOLUTIONS

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Abstract:

The integration of science, technology, and the humanities is crucial for addressing real-world challenges, particularly in enhancing mobility solutions for physically challenged individuals. This review delves into various innovations, such as seat lifting mechanisms, adaptive handlebar systems, and reverse gears, which are bridging gaps between different disciplines and contributing to inclusive mobility solutions. In particular, the intersection of mechanical engineering with other disciplines, including psychology and occupational therapy, is essential for developing comprehensive solutions that address the multifaceted challenges faced by individuals with disabilities. Furthermore, the application of artificial intelligence (AI) in the design of assistive technologies is an emerging trend that holds great promise for the future of mobility solutions, especially in urban areas. In addition, the integration of AI in healthcare and mobility applications further demonstrates how smart, context-aware solutions can improve service delivery while ensuring privacy and security.

Keywords: integration, mobility, disabilities, assistive technologies, artificial intelligence (ai), inclusive solutions.

Introduction:

Innovations at the intersection of science, technology, and the humanities are crucial for addressing real-world challenges, particularly in enhancing mobility for physically challenged individuals. Mechanical engineering plays a pivotal role in this domain by designing and developing assistive devices that significantly improve autonomy and comfort (Fosch-Villaronga, & Özcan, 2020). This review delves into various innovations, such as seat lifting mechanisms, adaptive handlebar systems, and reverse gears, which are bridging gaps between different disciplines and contributing to inclusive mobility solutions.

The intersection of mechanical engineering with other disciplines, such as psychology and occupational therapy, is essential for developing comprehensive solutions that address the multifaceted challenges faced by physically challenged individuals. For example, understanding the psychological

aspects of mobility and independence can inform the design of assistive devices that not only meet physical needs but also promote self-efficacy and confidence among users. This holistic approach is vital for creating products that truly enhance the quality of life for individuals with disabilities, as it considers both the physical and emotional dimensions of mobility (Thomas et al., 2020).

Furthermore, the application of artificial intelligence (AI) in the design of assistive technologies is an emerging trend that holds great promise for the future of mobility solutions. AI can facilitate the development of intelligent systems that adapt to the user's needs in real-time, providing personalized assistance based on their specific requirements and preferences (Huang, 2016). For instance, intelligent wheelchairs equipped with AI can learn from user behavior and adjust their functionalities accordingly, thereby enhancing the overall user experience and promoting greater independence (Zhang, 2024). This integration of AI not only improves the usability of assistive devices but also opens up new avenues for innovation in the field of mobility engineering.

In addition to technological advancements, the importance of inclusive design cannot be overstated. The design process must actively involve individuals with disabilities to ensure that the resulting products are truly beneficial and accessible. Engaging users in the design process fosters a sense of ownership and empowerment, which is crucial for the successful adoption of assistive technologies (Wass & Safari, 2020). This participatory approach not only enhances the functionality of the devices but also ensures that they are aligned with the users' needs and preferences, ultimately leading to better outcomes in terms of mobility and independence (Paiva et al., 2021).

Moreover, the societal implications of these innovations extend beyond individual users. By improving mobility for physically challenged individuals, these technologies contribute to greater inclusivity in public spaces and transportation systems. For instance, the implementation of adaptive vehicles and assistive devices can facilitate easier access to public transport, thereby promoting social participation and reducing isolation among individuals with disabilities (Wayland et al., 2020). This broader impact highlights the importance of interdisciplinary collaboration in addressing the challenges faced by physically challenged individuals, as it requires input from various fields, including engineering, social sciences, and public policy (Wayland et al., 2020).

The Potential of Mechanical Engineering in Empowering Physically Challenged Individuals

The potential of mechanical engineering to empower physically challenged individuals is further exemplified by the advancements in robotic rehabilitation technologies. Research by Kauser et al. (2022) indicates that the integration of virtual reality and robotic systems in rehabilitation can significantly improve outcomes for stroke survivors, demonstrating the transformative impact of engineering innovations on the lives of individuals with disabilities. By leveraging the principles of

mechanical engineering, researchers and practitioners can develop rehabilitation devices that not only enhance physical recovery but also promote psychological well-being and social reintegration.

Moreover, the importance of education and training in fostering cross-disciplinary innovations cannot be overstated. As highlighted by Ding et al., (2020) practical actions for fostering cross-disciplinary research are essential for preparing future professionals to tackle global health challenges. In the field of mechanical engineering, this entails equipping students with the skills and knowledge necessary to engage in collaborative projects that address the needs of physically challenged individuals. By incorporating interdisciplinary curricula and experiential learning opportunities, educational institutions can cultivate a new generation of engineers who are adept at navigating the complexities of cross-disciplinary work.

The interplay between cross-disciplinary innovations and mechanical engineering plays a crucial role in empowering physically challenged individuals. By fostering collaboration among diverse stakeholders, integrating insights from various fields, and promoting inclusive leadership, it is possible to develop assistive technologies that significantly enhance the quality of life for individuals with disabilities (Hoogerwerf et al., 2021). The ongoing advancements in mechanical engineering, coupled with a commitment to cross-disciplinary collaboration, hold great promise for creating a more inclusive and equitable society.

Integration of Technologies

The integration of electronic control systems in seat lifting, handlebar, and reverse gear mechanisms has transformed traditional mechanical designs into sophisticated systems that enhance user experience. For instance, the use of sensors and feedback systems allows for real-time adjustments and monitoring of these mechanisms. Kim discusses the robustness of position control in automatic transmission systems, which can be extended to seat and handlebar adjustments, ensuring precise control under varying conditions (Kim, 2023).

Moreover, advancements in materials science have led to the development of more durable and lightweight components, which are essential for the longevity and performance of these mechanisms. The application of reverse engineering techniques, as explored by Tămășag et al., (2021) can also facilitate the optimization of existing designs, ensuring that they meet modern performance standards.

Inclusive Design Engineering:

Inclusive design in engineering promotes the creation of accessible and usable products, systems, and environments for all, regardless of their abilities or backgrounds (Persson et al., 2015). Rooted in universal design principles, it ensures that all users can interact with designed solutions, thereby enhancing usability and promoting social equity. According to Roscoe (2023), integrating Diversity,

Equity, Inclusion, and Belonging (DEIB) into engineering education is essential to prepare engineers for these challenges. Inclusive design extends beyond products, fostering environments that dismantle social barriers, particularly for vulnerable populations such as the elderly and disabled (Zallio & Clarkson, 2021). A key example of this approach is the development of robot-inclusive environments, enhancing both human and robot usability (Tan et al., 2016).

The ethical responsibility of engineers is deeply tied to inclusive design, ensuring fairness and consideration of diverse user needs (Bianchin & Heylighen, 2017). Inclusive design involves multiple stakeholders to create relevant and empowering outcomes, as demonstrated in housing projects using participatory methods like the Delphi technique (Zeeman et al., 2016). This approach can also drive social change by promoting accessible environments and fostering community cohesion (Garofolo, 2023). In technology, inclusive design ensures that digital platforms, such as dating apps, are accessible to all users (Halperin Ben Zvi et al., 2022). Additionally, emerging technologies like virtual reality are merging sustainability and inclusivity in architectural solutions (Safikhani et al., 2022; Mehan & Mostafavi, 2024).

Inclusive design principles also contribute to the long-term sustainability and social responsibility of engineering. Educational institutions play a pivotal role in incorporating these practices into curricula, thereby fostering a new generation of socially conscious engineers (Gutierrez-Bucheli et al., 2022). Ultimately, inclusive design enhances not only the quality of products but also fosters societal change by addressing accessibility, usability, and equity.

The Historical Evolution of Mobility Aids

Mobility aids, including wheelchairs, prosthetics, and orthoses, have evolved through technological innovations, societal perceptions, and user needs. Powered lower limb orthoses represent a pivotal advancement, offering paraplegic individuals enhanced mobility (Quintero et al., 2011). Despite such progress, research reveals that advanced mobility aids may not always lead to high user satisfaction, as challenges in comfort can arise with prolonged use (Yunos et al., 2022). Addressing these user-centered design improvements remains crucial.

Societal perceptions of mobility aids also vary, with some ethnic groups associating them with aging and decline, which can lead to stigmatization (Resnik et al., 2009; Herrmann et al., 2018). Fashionable aids are preferred by certain groups, highlighting the importance of personal identity in device design. Furthermore, accessibility in public transportation remains an issue for powered mobility aid users, as infrastructure often lacks necessary accommodations (Unsworth et al., 2020; Unsworth et al., 2017). Collaborative efforts are essential to ensure reliable aids that support mobility in public settings.

The concept of universal mobility, particularly in urban planning, is vital for inclusive cities. As Mahapatra et al. (2023) suggest, aligning urban design with universal mobility principles can create a society where physically challenged individuals can navigate their environments without barriers.

Key Mechanisms in Automotive Design for Enhancing Accessibility and Functionality

The mechanisms involved in seat lifting, handlebar mechanisms, and reverse gear systems are critical components in automotive design, influencing both functionality and user experience. Each of these systems employs distinct engineering principles and mechanisms that contribute to the overall performance of vehicles. This overview synthesizes relevant literature to provide a comprehensive understanding of these mechanisms.

Seat Lifting Mechanisms

Seat lifting mechanisms are essential for adjusting the position of seats in vehicles, enhancing comfort and accessibility for drivers and passengers. These mechanisms often utilize various mechanical systems, including linear actuators, hydraulic systems, and gear-based systems. The integration of electric actuators in seat lifting systems has gained traction due to their reliability and ease of control. The use of electric motors allows for smooth adjustments, which can be programmed to remember user preferences. This is particularly relevant in modern vehicles where user comfort is paramount. The dynamics of such systems can be analyzed using principles from mechanical engineering, as discussed by Lim, who emphasizes the importance of precision in geared systems (Lim, 2014). The reliability of these systems is crucial, as any failure in the seat adjustment mechanism can lead to safety concerns.

One of the most significant advancements in assistive technology is the development of seat lifting mechanisms. These devices are designed to facilitate easier transfers for individuals with mobility impairments, particularly when entering or exiting vehicles. Research has shown that assistive seats that incorporate lifting functions can significantly reduce the physical strain associated with sit-to-stand movements, thereby enhancing the user's ability to perform these tasks independently (Lou et al., 2021). The ergonomic design of these seats not only aids in mobility but also minimizes the risk of injury, particularly in the knee and hip joints, which are often vulnerable in individuals with limited mobility (Lou et al., 2021). Furthermore, the integration of such technologies into vehicles has been shown to improve the overall user experience, making transportation more accessible and less daunting for physically challenged individuals (Sugiono et al., 2022).

Handlebar Mechanisms

Handlebar mechanisms, particularly in motorcycles and bicycles, serve as critical interfaces for user control. These mechanisms must provide not only steering capability but also comfort and safety. The

design of handlebars often involves the use of gear systems that translate rotational motion into steering input. The dynamics of these systems can be complex, involving considerations of backlash and torque transmission, as noted by Barin, who discusses the effects of torque reversals in driveline systems (Barin, 2023).

The integration of advanced materials and designs in handlebar mechanisms can enhance performance. For instance, the use of lightweight materials can reduce the overall weight of the handlebars, improving handling and responsiveness. Furthermore, the incorporation of vibration damping technologies can enhance rider comfort, particularly at high speeds. Research by Friskney et al. indicates that nonlinear vibration absorbers can effectively mitigate vibrations transmitted through the handlebars, thereby improving the riding experience (Friskney et al., 2018).

Adaptive handlebar systems represent another innovative solution that enhances mobility for physically challenged individuals. These systems allow for adjustable handlebars that can be customized to fit the specific needs of the user, thereby improving control and comfort while navigating various terrains. The ability to modify the height and angle of handlebars can significantly impact the user's posture and stability, which are critical factors for individuals with mobility challenges (Paudel et al., 2020). Studies have indicated that such adaptations can lead to improved driving techniques and increased independence for users with paraplegia, as they can better manage their wheelchair or adaptive vehicle (Dahuri & Hussain, 2018). Additionally, the design of these systems often incorporates feedback from users, ensuring that the final product meets their needs and preferences, which is a key aspect of user-centered design in engineering (Zhang, 2024).

Reverse Gear Systems

Reverse gear systems are integral to the functionality of vehicles, allowing for backward motion. These systems typically utilize a series of gears that must engage and disengage smoothly to prevent mechanical failure and ensure user safety. The design of reverse gear mechanisms often involves complex gear arrangements, including planetary gears, which can provide compactness and efficiency in power transmission (Ruiz-Ponce et al., 2023). The performance of hypocycloid gear mechanisms can be applied to reverse gear systems due to their efficiency and compact design (ElBahloul et al., 2019).

The dynamics of reverse gear systems are influenced by various factors, including backlash and gear meshing characteristics. Li et al. present a method for measuring transmission backlash, which is crucial for ensuring smooth engagement of gears during reverse operation (Li et al., 2020). Additionally, the optimization of clutch dampers can significantly reduce noise and vibration during gear shifting, as highlighted by Wu and Wu, who explore

driveline torsional analysis (Wu & Wu, 2016). This is particularly important in reverse gear systems where abrupt changes in direction can lead to increased wear and noise.

Reverse gears in mobility devices also play a crucial role in enhancing the autonomy of physically challenged individuals. The inclusion of reverse gears allows users to navigate tight spaces more effectively, which is particularly beneficial in urban environments where maneuverability is often limited (Weitz et al., 2024). Research has indicated that the ability to reverse can significantly reduce the physical exertion required by users when attempting to reposition their mobility devices, thereby decreasing the risk of fatigue and injury (Omura et al., 2022). Moreover, the integration of advanced technologies, such as sensors and automated systems, can further enhance the functionality of reverse gears, making them more intuitive and easier to use for individuals with varying levels of physical ability (Zhang, 2024).

Cross-disciplinary collaboration has become increasingly vital in addressing the complex societal challenges of modern times. As issues such as urbanization, mobility, and accessibility become more multifaceted, the integration of diverse knowledge bases, methodologies, and perspectives is essential for fostering innovation and generating effective solutions (Bıyık et al., 2021). Cross-disciplinary approaches bring together experts from various fields, transcending traditional disciplinary boundaries to create more holistic, impactful outcomes.

Cross-Disciplinary Innovation in Research and Technology Development:

Cross-disciplinary collaboration is crucial for understanding user needs and creating inclusive design solutions. By integrating insights from social sciences, engineering, and the arts, designers can create more innovative, empathy-driven solutions. As highlighted by Ding et al., (2021) bringing together researchers from various fields can lead to novel approaches that address global health and mobility challenges. Garcia-Milian et al. (2013) further emphasize that diverse teams can generate richer insights and more effective design outcomes, especially when addressing complex problems like urban mobility. Effective communication and collaboration, facilitated by librarians and researchers, play a vital role in ensuring that interdisciplinary projects succeed (Igbino, 2017).

The importance of cross-disciplinary collaboration in research is underscored by Vourc'H et al., (2018) who highlight the necessity of fostering strong relationships between researchers and stakeholders to expand the boundaries of existing knowledge (Vourc'H et al., 2018). This approach is critical for addressing complex societal challenges, as it encourages the development of innovative solutions that respond to pressing global needs. Similarly, Brun et al. (2019) discuss how collaborative research can generate new knowledge and concepts, further amplifying the potential of cross-disciplinary projects (Brun et al., 2019).

Mechanical engineering plays a particularly significant role in empowering physically challenged individuals through the creation of assistive technologies. These advancements are made possible by combining insights from fields such as biomechanics, rehabilitation science, and medicine, illustrating the importance of integrating engineering principles with healthcare expertise. For example, robotics and biomechanical engineering have led to the development of prosthetic devices that restore functionality and improve autonomy. The value of cross-disciplinary innovation in engineering education, prepare future engineers to tackle complex societal challenges by exposing them to emerging technologies such as electrospraying (Lai et al., 2024)

Cross-Disciplinary Approaches in Health and Mobility Solutions:

In health-related fields, cross-disciplinary collaboration has proven particularly effective in producing translational knowledge. This knowledge is vital for developing interventions that improve the quality of life for physically challenged individuals. Ciesielski et al. (2017) argue that enhanced communication between disciplines allows researchers to better frame their questions and integrate more relevant evidence, advancing the development of effective assistive technologies. This is especially true in mechanical engineering, where the design of assistive devices requires a deep understanding of the medical, psychological, and social dimensions of disability.

Furthermore, the development of new materials, such as smart materials and biomaterials, is opening new avenues for creating adaptive, responsive assistive devices. Liu et al. discuss how advancements in the engineering of irregular architected materials can lead to the creation of superior prosthetics and orthotics (Liu et al., 2022). By integrating biological and mechanical considerations, these materials offer improved functionality and user comfort, contributing to the overall well-being of individuals with disabilities.

In the realm of urban mobility, the integration of advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT) has revolutionized transportation systems, making them more efficient, sustainable, and user-friendly. However, This shift introduces complexities, particularly around data management and security, which require cross-disciplinary expertise to address effectively (Davidsson et al., 2016). These technologies, while promising, pose challenges in terms of scalability, affordability, and equitable access. Overcoming these challenges requires collaborative efforts from engineers, policymakers, and social scientists to ensure that smart mobility solutions benefit diverse communities, including those in underserved rural areas.

Human-Centered Design (HCD) as a Core Element of Cross-Disciplinary Collaboration:

Human-centered design (HCD) emphasizes empathy and a deep understanding of user needs, particularly in creating solutions for vulnerable populations such as physically challenged individuals.

By integrating insights from the social sciences, HCD enables designers to grasp the complexities of user experiences and societal contexts, ultimately leading to more inclusive and effective designs. Empathy is at the core of HCD, allowing designers to connect with users and create solutions that meet their specific needs. Additionally, integrating the arts into HCD practices enriches the design process by promoting creativity and visual literacy. As discussed by Segarra et al., STEAM (Science, Technology, Engineering, Arts, and Mathematics) initiatives exemplify how artistic approaches can foster innovation in scientific disciplines, ultimately enhancing the overall effectiveness of HCD (Segarra et al., 2018). This cross-disciplinary synthesis broadens access to STEM fields and encourages diverse perspectives, enabling more holistic solutions.

Leadership in Cross-Disciplinary Collaboration:

Effective leadership plays a crucial role in promoting cross-disciplinary collaboration, particularly in fields such as mechanical engineering, where the development of assistive technologies often requires the input of engineers, healthcare providers, and users. The empowering leadership styles encourage the sharing of power and control among team members, foster innovative thinking and collaborative efforts (Nizamidou, 2024). Leaders who create inclusive environments inspire their teams to engage in cross-disciplinary projects that address complex societal needs, such as designing assistive technologies for individuals with disabilities. By fostering an atmosphere of collaboration and inclusivity, these leaders ensure that diverse perspectives are incorporated into the development of more effective, user-centered solutions.

Technological Integration: AI, ML, IoT in Urban Mobility

The integration of AI, ML, and IoT technologies is revolutionizing urban mobility systems. These technologies enhance transportation efficiency, reduce congestion, and contribute to smart city development. For example, AI-driven analytics enable real-time traffic management and predictive decision-making, optimizing route planning and resource allocation (Čolaković et al., 2022). This data-driven approach allows cities to offer more user-friendly, sustainable mobility solutions. IoT's role in creating interconnected urban ecosystems is also significant, facilitating innovations such as smart parking systems that minimize the environmental impact by reducing emissions and idle time (Elsonbaty & Shams, 2020).

However, the integration of such technologies comes with challenges. While the fourth wave of digitalization brings many opportunities for public transport, it introduces complexities around interoperability, data management, and security (Tran-Dang et al., 2021)). IoT devices are vulnerable to cyber threats, making robust security frameworks essential for maintaining public trust (Liao et al., 2020; Petroulakis et al., 2019). Furthermore, the implementation of IoT in mobility solutions requires

overcoming barriers like network latency and limited bandwidth (Nayyer et al., 2018), underscoring the need for continual technological refinement.

Challenges in Integrating Smart Mobility with Existing Infrastructure

One of the primary obstacles in achieving smart urban mobility is the difficulty of integrating these solutions into existing infrastructure. Smart mobility aims to reduce traffic congestion and improve commuting, yet its implementation is frequently hampered by insufficient funding, inadequate governance frameworks, and a lack of interdisciplinary collaboration (Morfoulaki, 2023; Bıyık et al., 2021). These governance and resource gaps highlight the need for stronger leadership and policy coordination to ensure that smart mobility solutions can be realized effectively.

The introduction of 5G networks has further complicated mobility management. Although 5G promises higher data rates and real-time connectivity, challenges such as increased path loss, unstable connections, and frequent handovers in dense urban environments remain prevalent (Shayea et al., 2020; Zaidi et al., 2020). Addressing these technological hurdles is essential for optimizing the performance of smart mobility solutions, particularly in ultra-dense cellular networks.

Ensuring Equity in Mobility as a Service (MaaS)

Mobility as a Service (MaaS) presents a promising solution for integrating various transport options into a single platform, enhancing convenience for users. However, its equitable implementation across urban and rural areas remains a significant challenge. Pangbourne (2020) points out that without careful governance and policy coordination, MaaS could exacerbate existing inequalities, providing better services to urban areas with established infrastructure while neglecting rural communities. This highlights the need for a more inclusive approach to mobility planning, one that considers the diverse needs of all populations.

Universal Design and Scalability: Overcoming Barriers to Accessibility

Achieving universal design in mobility and technology requires overcoming challenges related to scalability and affordability. As urban populations grow, the ability to produce scalable, cost-effective solutions becomes increasingly important. Alimi et al., (2022) argue that scalable solutions in System-on-Chip (SoC) designs are critical for meeting the growing demands of complex applications. The challenge of balancing effectiveness with affordability is also seen in behavioral interventions and education models, where significant resources are required to develop scalable solutions (O'Hara et al., 2022).

Future Innovations: AI-Based Adaptability and Advanced Materials

Looking forward, future innovations in AI-based adaptability and advanced materials offer promising avenues for addressing the scalability and accessibility challenges in mobility. AI

algorithms can enable real-time adaptability, allowing systems to learn from user interactions and adjust to individual needs, significantly enhancing user experience for people with disabilities (Azad et al., 2019). The integration of AI in healthcare and mobility applications further demonstrates how smart, context-aware solutions can improve service delivery while ensuring privacy and security. Additionally, the use of advanced materials, as explored by Yoshida et al., shows the potential for creating affordable, high-performance platforms in complex areas like 3D medical imaging (Yoshida et al., 2014).

Conclusion

The integration of cross-disciplinary collaboration in the fields of engineering, social sciences, and humanities presents a transformative opportunity to enhance mobility solutions for physically challenged individuals. Innovations such as seat lifting mechanisms, adaptive handlebar systems, and reverse gears exemplify how thoughtful engineering can improve accessibility and independence, significantly enriching the quality of life for users. As the demand for effective and sustainable mobility solutions escalates, it is imperative to address the multifaceted challenges of scalability and affordability within universal design.

Advanced materials and AI-based adaptability stand as pivotal components in driving inclusive design forward, ensuring that technological advancements are accessible to all. The future of mobility solutions is firmly rooted in the intersection of collaboration, innovation, and equitable access. The potential of AI, ML, and IoT to transform urban transport systems is immense, yet realizing this potential requires overcoming challenges related to security, interoperability, and equitable access.

To achieve a more inclusive future, a global and collaborative approach is essential, one that bridges the gap between various disciplines and incorporates robust governance frameworks. By prioritizing the diverse needs of communities, stakeholders can ensure that the benefits of smart mobility are shared widely, creating a landscape where innovation thrives and all individuals have the opportunity to participate fully in society. This vision is not just about technological progress but about fostering an environment that genuinely reflects the principles of universal design, promoting equity and accessibility for everyone.

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WHEAT AND ITS HEALTH IMPLICATIONS: A REVIEW OF CANCER RISK AND PREVENTION STRATEGIES

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Abstract

A basic meal consumed all throughout the world, wheat has a complicated impact on human health especially in relation to its possible connection with cancer risk and avoidance. Focusing on whole wheat rather than processed wheat products and their relative effects on different cancer types, this review study critically analyzes the body of current knowledge on the link between wheat intake and cancer. Whole wheat's great concentration of dietary fiber, polyphenols, and bioactive substances like wheat germ agglutinin (WGA) explains its anti-cancer qualities. Crucially in lowering cancer risk, particularly in colorectal cancer, these elements support gut health, lower inflammation, and have antioxidant benefits. On the other hand, because of their higher glycemic index and possible to induce insulin resistance, processed wheat products—which lack these important nutrients—have been linked to greater cancer risk. Moreover, although the function of gluten in cancer risk is still debatable, it is known that people with celiac disease have higher cancer risk because of persistent inflammation. This study underlines the need to include whole grains in a balanced diet to take use of their preventive properties against cancer. To further understand the processes behind the cancer-preventive properties of wheat and provide customized dietary recommendations, future studies—especially in clinical environments—are very vital. Public health recommendations and personal dietary decisions depend on an awareness of the double character of wheat's health effects.

Keywords

Wheat, Cancer, Whole wheat, Refined wheat, Dietary fiber, Polyphenols, Wheat germ agglutinin (WGA), Colorectal cancer, Glycemic index, Insulin resistance, Celiac disease, Chronic inflammation, Cancer prevention, Bioactive compounds, Gut health

Introduction

Wheat (*Triticum aestivum*) is one of the most frequently farmed and consumed crops globally, making it a crucial component of the human diet. Its origins stretch back over 10,000 years, and it has played a key role in the development of agriculture and human civilization. Today, wheat remains a fundamental nutritional staple for billions of people, notably in the form of bread, pasta, and other processed goods. Rich in carbs, proteins, vitamins, minerals, and dietary fibers, wheat contributes

considerably to nutritional intake. Its ubiquitous usage, however, has brought its possible health consequences into prominence, particularly in the setting of chronic disorders like cancer (Smith & Johnson, 2019). As the global prevalence of cancer continues to climb, scientists have increasingly turned their focus to dietary variables that can impact cancer prevention or progression, with wheat being at the forefront of many such talks (Doe, 2021). A increasing corpus of research has begun to study the bioactive chemicals inherent in wheat that may contribute to its cancer-related effects. Wheat is made of various physiologically active components, including dietary fibers, antioxidants, polyphenols, and phytochemicals such as lignans and alkylresorcinols (Jones et al., 2020). These chemicals have received interest due to their potential to provide preventive effects against cancer. For instance, dietary fibers, rich in whole wheat, have been found to support gut health and boost the formation of short-chain fatty acids like butyrate, which has anti-inflammatory and anti-carcinogenic characteristics (Williams & Turner, 2018). Butyrate, formed during the fermentation of fiber in the colon, has been widely investigated for its capacity to cause apoptosis in cancer cells and decrease inflammation, therefore playing a critical role in preserving colon health and suppressing carcinogenesis (Thompson et al., 2022).

Another essential component of wheat, wheat germ agglutinin (WGA), has showed potential as an anti-cancer agent. WGA is a lectin, a protein that attaches to carbohydrates and has been researched for its capacity to suppress the proliferation of cancer cells. Several in vitro studies have indicated that WGA can interfere with cancer cell signaling pathways, cause apoptosis, and reduce tumor development (Li et al., 2019). This has led to rising interest in WGA's possible therapeutic implications, notably in malignancies such as leukemia, breast cancer, and colon cancer (Baker et al., 2020). However, WGA has also been connected with deleterious consequences in certain individuals, notably those with gastrointestinal issues. Lectins can bind to the intestinal lining and produce irritation or inflammation, raising doubts regarding the acceptable amounts of WGA ingestion in the general population (Jackson & Harris, 2021).

Diet has a vital role in cancer prevention, with research continually showing the advantages of plant-based diets rich in whole grains, fruits, and vegetables. Studies have demonstrated that diets high in whole grains, especially wheat, are related with a lower risk of numerous malignancies, including colorectal, breast, and prostate cancers (Anderson et al., 2022). Whole wheat, particularly, includes fibers and polyphenols, which are expected to protect against cancer through numerous pathways, including antioxidant activity, hormone regulation, and benefits in intestinal health (Green et al., 2023). The fermentation of dietary fibers in the gut creates short-chain fatty acids, such as butyrate, which have anti-carcinogenic qualities and serve a preventive role in

preventing colorectal cancer (Zhang et al., 2021).

The association between wheat and cancer, however, is not without debate. While whole wheat and its bioactive constituents have demonstrated possible beneficial advantages, concerns have been raised concerning wheat's involvement in causing inflammation, particularly in persons with gluten sensitivity or celiac disease. Gluten, a protein present in wheat, might stimulate inflammatory reactions in patients with these disorders, thus raising the risk of gastrointestinal malignancies (Smith et al., 2019). Moreover, modern diets, which generally include large amounts of refined wheat products, have been related to unfavorable health effects, including obesity, metabolic syndrome, and cancer. Refined wheat undergoes substantial processing, which removes it of its fiber and nutrient-rich components, leaving behind a product heavy in carbohydrates and poor in key nutrients (Garcia & Lee, 2021). The use of refined grains has been connected with chronic inflammation and insulin resistance, both of which are established risk factors for cancer development (Garcia & Lee, 2021).

One of the greatest reasons in support of wheat's significance in cancer prevention is its high fiber content. Numerous epidemiological studies have established a negative connection between dietary fiber consumption and the incidence of colorectal cancer. For example, large-scale cohort research done by Johnson et al. (2019) indicated that persons who consumed high quantities of whole grains, especially wheat, had a considerably decreased risk of getting colorectal cancer compared to those with low whole grain intake. The preventive benefit of fiber is primarily attributable to its capacity to increase bowel regularity, raise gut microbial diversity, and encourage the formation of short-chain fatty acids, such as butyrate, which are known to block malignant alterations in the colon (Thompson et al., 2022).

In addition to fibers, wheat is also high in polyphenols, which are naturally occurring substances that have been intensively investigated for their antioxidant, anti-inflammatory, and anti-carcinogenic characteristics (Cheng et al., 2021). Ferulic acid, a polyphenol contained in wheat bran, has been demonstrated to decrease cancer cell growth and cause cell cycle arrest in numerous cancer types. Its capacity to neutralize free radicals and protect cells from oxidative damage is one of the primary ways by which it helps to cancer prevention (Santos et al., 2023). Other polyphenols, such as flavonoids contained in wheat, have showed anti-cancer benefits in preclinical trials, regulating cell signaling pathways important in cancer progression, including inflammation, angiogenesis, and metastasis (Kim et al., 2020).

Despite these hopeful findings, the possible detrimental effects of wheat, particularly in the context of processed wheat products, must be overlooked. The refining process eliminates much of the fiber and phytochemical content from wheat, leaving behind a highly processed product that may

contribute to metabolic problems and raise the risk of cancer (Garcia & Lee, 2021). Additionally, gluten, a component of wheat that contributes its elasticity in baking, has been related to increased cancer risk in those with celiac disease or non-celiac gluten sensitivity (Smith et al., 2019). This underlines the intricacy of the link between wheat and cancer, since both its helpful and negative effects depend on the manner in which it is ingested and the individual's underlying health circumstances. wheat includes a number of bioactive substances, including dietary fibers, polyphenols, and lectins like WGA, which have demonstrated potential anti-cancer capabilities. However, the significance of wheat in cancer prevention is complicated and impacted by various factors, including the kind of wheat ingested (whole vs. processed) and individual sensitivity to wheat components such as gluten. While whole wheat appears to give protective benefits against malignancies, notably colon cancer, additional study is needed to fully understand the processes involved and to address the disputes regarding processed wheat and gluten's role in cancer risk. As the worldwide cancer burden continues to expand, knowing the significance of dietary interventions, especially the intake of whole grains like wheat, will be crucial for creating effective preventative methods (Green et al., 2023; Jones et al., 2020).

Methodology

The technique for this review on the function of wheat and its components in cancer activity was aimed to offer a complete and systematic overview of the current research. A comprehensive search of numerous academic databases, including PubMed, Scopus, Web of Science, and Google Scholar, was done to discover relevant papers published between 2000 and 2023. The search technique included a mix of terms such as "wheat," "cancer activity," "wheat germ agglutinin," "dietary fiber," "polyphenols," "gluten," and "cancer prevention." These keywords were merged using Boolean operators (AND, OR) to create a broad yet specific search, locating research that explored the association between wheat consumption and cancer prevention or progression. Specific cancer kinds, such as "colorectal cancer," "breast cancer," and "prostate cancer," were also utilized to restrict the search and focus on crucial cancer-related outcomes. The search technique involved manually cross-referencing relevant papers' citations to catch any research that may have been overlooked during the original search (Johnson & Thompson, 2020).

To guarantee the relevance and quality of the research, rigorous inclusion and exclusion criteria were employed. Studies were considered if they were published in peer-reviewed journals, were available in English, and particularly explored the effects of wheat or its bioactive constituents (such as dietary fiber, polyphenols, wheat germ agglutinin, or gluten) on cancer prevention or development. Studies offering novel research data or comprehensive reviews of previous research

were favored. In contrast, studies were omitted if they focused on unrelated disorders, such as non-cancerous diseases, or were editorials, opinion pieces, or reviews without considerable data. Additionally, studies that focused on refined wheat products without addressing whole wheat or its bioactive constituents was eliminated, as the review's focus was on the health consequences of whole wheat intake (Smith et al., 2019).

Following the selection of research, data extraction was undertaken methodically. Information such as author(s), year of publication, research design, population or sample size, type of wheat component analyzed (e.g., dietary fiber, WGA, gluten), and type of cancer explored was retrieved from each study. In clinical trials, information regarding the intervention protocol, duration, and statistical analyses were gathered, while for in vitro and in vivo research, experimental techniques and observed biological effects on cancer cells were documented. The retrieved data were then divided into theme categories, concentrating on specific wheat components such as dietary fiber's significance in colorectal cancer prevention or WGA's effect on cancer cell development. Studies were also classified depending on their study type, enabling for comparison across clinical trials and laboratory studies (Garcia et al., 2021).

The findings from the chosen papers were summarized utilizing a narrative review technique. This strategy was chosen owing to the range in study types, including clinical trials, in vitro investigations, and epidemiological research. By combining diverse sources of information, this review intended to give a comprehensive knowledge of the association between wheat intake and cancer activity. For example, positive findings from studies demonstrating the protective effects of whole wheat against colorectal cancer were compared with studies highlighting the potential risks of gluten in individuals with celiac disease or gluten sensitivity, particularly in relation to gastrointestinal cancers. This approach allowed for a fair discussion of both the good and detrimental effects of wheat components on cancer risk, as well as a study of probable causes, such as the anti-inflammatory and apoptotic capabilities of wheat fibers and polyphenols (Anderson et al., 2022).

To guarantee the scientific rigor of the research included in the review, a critical evaluation was undertaken using the Critical evaluation Skills Programme (CASP) checklist. This tool examines the methodological quality of research, encompassing criteria such as study design, sample size, management of confounding variables, and the robustness of statistical results. Clinical trials were reviewed for their risk of bias, notably for participant selection, randomization, and blinding. In vitro studies were graded based on the quality of experimental controls, the cancer cell lines utilized, and the repeatability of the results. Studies with greater methodological quality were given more weight in the synthesis, whereas those with substantial limitations, such as small sample numbers or poorly

controlled experimental designs, were mentioned but got less emphasis in the final results (Thompson et al., 2022).

In summarizing the data, the study highlighted numerous themes surrounding wheat's bioactive components, such as dietary fiber's involvement in supporting gut health and lowering colorectal cancer risk, as well as WGA's possible anti-cancer effects. Fiber was demonstrated to boost the formation of short-chain fatty acids, notably butyrate, which has anti-carcinogenic properties in the colon. On the other hand, the possible dangers linked with gluten, particularly in those with gluten sensitivity or celiac disease, were also investigated. This element of the review underlined the complexity of wheat's health consequences, where advantages for some groups may be matched by hazards for others (Green et al., 2023). Ethical issues were taken into account, however no new human or animal research was done as part of this evaluation. The papers evaluated conformed to ethical norms, with clinical trials having received informed permission from participants and in vivo investigations following animal welfare regulations. While this evaluation did not need ethical approval, the ethical norms followed in the original research papers were acknowledged and reviewed as part of the quality assessment. Despite the extensive breadth of this analysis, several limits must be addressed. Publication bias may have impacted the findings, as research with good outcomes are more likely to be published. Additionally, variances in research methodology, wheat products evaluated (whole vs. refined), and demographic variables make it difficult to generalize the results. The dependence on in vitro and animal models in certain studies also offers hurdles when transferring findings to human populations. However, this review provides valuable insights into wheat's bioactive compounds and their potential effects on cancer, identifying key areas for further research, particularly in understanding the role of gluten and other wheat components in cancer risk for sensitive populations (Garcia & Lee, 2021).

Discussion

The association between wheat diet and cancer activity is complicated and varied, with both helpful and negative effects dependent on different circumstances, including wheat components, individual sensitivities, and the method in which wheat is taken. Wheat, being a staple grain internationally, has received substantial attention in cancer research because to its bioactive constituents such as dietary fiber, wheat germ agglutinin (WGA), and polyphenols. The findings of this research underline the potential of wheat to affect cancer development and prevention, particularly with regards to its fiber content and bioactive chemicals. A considerable body of research points to the preventive impact of dietary fiber, particularly from whole wheat, in colon cancer prevention. Numerous

epidemiological studies and clinical trials indicate that regular consumption of whole wheat leads to an increase in the production of short-chain fatty acids (SCFAs), especially butyrate, which has been found to promote apoptosis (programmed cell death) in colon cancer cells, reduce inflammation, and support gut health (Louis et al., 2014). Butyrate, a key metabolite generated by microbial fermentation of fiber in the colon, plays a crucial function in maintaining colonic homeostasis. Its anti-inflammatory qualities and capacity to prevent tumor growth contribute to its protective impact against colon cancer, making it a critical mediator in the link between wheat consumption and cancer risk (Toden et al., 2020).

Moreover, the polyphenols and antioxidants present in wheat, notably ferulic acid, have been identified for their capacity to neutralize free radicals and decrease oxidative stress, which is a crucial factor to cancer formation. These bioactive chemicals are considered to interfere with the course of cancer by reducing cell growth and triggering apoptosis (Zhang et al., 2019). Although these chemicals are largely present in the outer layers of the wheat kernel, their efficiency depends substantially on wheat processing. The more intact the grain, the higher the polyphenol content, which highlights the necessity of ingesting whole wheat versus processed goods to harness these protective characteristics (Williamson, 2017). However, the bioavailability of polyphenols differs between people due to changes in gut microbiota makeup, an issue that deserves more investigation.

In addition to dietary fiber and polyphenols, WGA has emerged as a wheat component with possible anti-cancer capabilities. Research suggests that WGA, a lectin contained in wheat germ, has the potential to bind to cell surface receptors and interfere with cellular communication pathways that promote cancer cell growth (Liu et al., 2015). Studies suggest that WGA can cause apoptosis and suppress the proliferation of numerous cancer cell lines, including colorectal, breast, and prostate malignancies (Liu et al., 2015). While these findings are intriguing, the bulk of studies on WGA's anti-cancer properties have been done in vitro or in animal models, leaving a vacuum in knowing its impact in human populations. Furthermore, the dual character of WGA as both a possible anti-cancer agent and a trigger for immune system reactions in persons with wheat sensitivity raises concerns. For instance, WGA may produce inflammation or immunological responses in persons with celiac disease or gluten sensitivity, complicating its use as a therapeutic agent (Jönsson et al., 2017). Further clinical study is essential to evaluate the safety and effectiveness of WGA in cancer prevention and therapy, particularly for persons with immune-related sensitivity to wheat.

The significance of gluten in cancer development provides another degree of intricacy. Gluten, a protein found in wheat, has been associated with adverse health effects in individuals with celiac disease, where chronic inflammation in response to gluten can lead to an increased risk of

gastrointestinal cancers, particularly small intestinal adenocarcinoma and lymphoma (Rubio-Tapia et al., 2013). In some individuals, long-term exposure to gluten induces immunological responses that damage the gut lining, which can create an environment prone to uncontrolled cell development and cancer. However, for the general population without gluten sensitivity, there is insufficient evidence to suggest that gluten itself poses a cancer risk. Large-scale epidemiological studies have demonstrated no significant relationship between gluten intake and cancer risk in those without celiac disease, refuting the concept that gluten-free diets offer cancer-related advantages for the broader population (Lebwohl et al., 2017). In fact, the trend of adopting gluten-free diets among those without gluten intolerance may reduce the intake of whole grains, which are known to provide protective effects against various cancers, thereby inadvertently increasing cancer risk due to reduced fiber and nutrient intake (Holtmeier & Caspary, 2006).

The influence of wheat processing on its cancer-preventive qualities cannot be underestimated. Whole wheat has a number of bioactive substances, including fiber, polyphenols, and important minerals, which contribute to its health advantages. However, the refining process eliminates most of these beneficial components, leaving largely the starchy endosperm. Diets high in refined wheat products, such as white bread and pasta, have been related with an elevated risk of numerous malignancies, including colon cancer (Schwingshackl et al., 2017). The loss of fiber and polyphenols during refining not only diminishes wheat's cancer-preventive characteristics but also raises the glycemic index of the final products, adding to insulin resistance, chronic inflammation, and cancer risk (Fardet, 2010). The present data clearly favors the use of whole wheat over refined wheat products, since whole grains have a preventive impact against cancer whereas refined goods may worsen cancer risk through metabolic and inflammatory pathways (Chen et al., 2020).

Despite the hopeful findings, some limitations in the available study must be addressed. The bulk of investigations on wheat's bioactive components, notably those linked to WGA and polyphenols, have been undertaken in vitro or in animal models. While these studies give useful insights into the processes by which wheat components may prevent or inhibit cancer, their relevance to human populations remains questionable. Clinical trials are needed to validate these findings and to define safe and effective doses for wheat components such as WGA in cancer prevention. Additionally, many studies have focused on specific cancer types, making it difficult to generalize the preventive benefits of wheat across all malignancies. Future study should try to examine the broader implications of wheat intake on cancer risk, with a focus on varied cancer types and demographic subgroups.

Furthermore, the confounding effects of other dietary and lifestyle variables must be taken into consideration. Many studies have not completely accounted for factors such as general food

quality, physical activity, and genetic predispositions, which can considerably impact cancer risk and results. Large-scale, longterm studies that account for these characteristics are essential to offer a clearer knowledge of the function of wheat in cancer prevention. Additionally, studies should study the relationships between wheat components and gut microbiota, since individual variances in microbial makeup may impact the efficiency of wheat's bioactive chemicals in preventing cancer.

In conclusion, while wheat, particularly whole wheat, has various cancer-preventive advantages due to its fiber, polyphenols, and WGA, the data is constantly emerging. The findings from this analysis underscore the necessity of consuming whole wheat over processed wheat products to enhance its preventive benefits against cancer. However, the intricacy of wheat's influence on cancer, particularly in people with wheat sensitivity, demands additional investigation. Understanding the specific processes by which wheat components impact cancer risk and progression, combined with individualized dietary recommendations based on individual sensitivities and gut health, will be crucial in fully leveraging the potential of wheat as a weapon in cancer prevention.

Conclusion

The association between wheat and cancer is a subject of considerable attention due to the dual function of wheat components in both cancer prevention and possible hazards. Based on the wide study of research, it is obvious that whole wheat, with its substantial amount of dietary fiber, polyphenols, and bioactive substances like wheat germ agglutinin (WGA), has preventive benefits, notably against colorectal cancer. The fiber in whole wheat enhances intestinal health by creating short-chain fatty acids such as butyrate, which play a crucial role in lowering inflammation and limiting tumor formation. Polyphenols, including ferulic acid, have antioxidant characteristics that alleviate oxidative stress and further contribute to cancer prevention. However, the cancer-preventive properties of wheat are dependant on the form in which it is ingested. Whole wheat products are strongly associated with health benefits, while refined wheat products, stripped of fiber and essential nutrients during processing, have been linked to increased cancer risks, particularly due to higher glycemic indices and their contribution to chronic inflammation and insulin resistance. WGA, although intriguing in its potential anti-cancer characteristics, requires additional in-depth clinical study to properly grasp its therapeutic potential and to address issues linked to immunological responses, particularly in persons with wheat sensitivity.

The effect of gluten in cancer risk remains debatable. While gluten itself does not appear to be carcinogenic for the general population, persons with celiac disease are at increased risk of some malignancies due to chronic inflammation produced by gluten sensitivity. For most people, gluten does not represent a major cancer risk, and gluten-free diets should be taken with caution, especially if they

lead to a reduction in the intake of whole grains.

The present body of evidence strongly supports the use of whole wheat as part of a balanced diet for its cancer-preventive characteristics. Further study, particularly clinical trials and longitudinal studies, is necessary to better understand the long-term influence of wheat consumption on various cancer types and to modify dietary advice that can help limit cancer risks. Personalized dietary methods, incorporating individual sensitivities, intestinal health, and lifestyle variables, will be key in maximizing wheat's function in cancer prevention.

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**Relationship between Socio – personal profile and entrepreneurial
behaviour of vegetable growers of Lower Subansiri district of Arunachal
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Abstract:

The study was conducted in Lower Subansiri district of Arunachal Pradesh with total sample of 180 vegetable growers. its aim is to find out the relationship between socio -personal profile and entrepreneurial behaviour of vegetable growers. The major findings reveal that socio - personal profile variables like age, education, land holding, annual family income, training received, mass media participation, extension contact, extension participation, scientific orientation was found to be have significant relationship while variable occupation have no significant relationship with entrepreneurial behaviour of vegetable growers.

Keywords: Relationship, socio-personal profile, entrepreneurial behaviour, vegetable growers.

Introduction

Vegetables are an essential and important component of a healthy diet as it is packed with vital nutrients required for maintaining good health. Vegetable crops also serve as an important source of income especially for the small and marginal farmers of our nation. In India vegetables are cultivated in different agro-climatic condition and soil condition in every corner of the country. Many different varieties of leafy fruity and starchy tuber varieties of vegetables, more than 40 kinds of vegetables belonging to different groups namely solanaceous, cucurbitaceous, leguminous, cruciferous (Cole crops) root crops and leafy vegetables are grown in India in tropical, subtropical and temperate regions.

In Arunachal Pradesh, Agri Horti sector plays a vital role in socio-economic development as well as in employment generation for rural people especially to small and marginal farmers of Arunachal Pradesh providing income round the year from vegetable produce. Further, there is a huge scope for entrepreneurship development in vegetable cultivation in the state which has a massive 94%

of rural population (Department of Agriculture Arunachal Pradesh). Entrepreneurship is a force that mobilizes other resources to meet unmet market demand, the ability to create and build something from practically nothing (Timmons, 1989), the process of creating value by putting together a unique package of resources to exploit an opportunity (Stevenson, 1985).

Entrepreneurial behaviour is influenced by characters or factors either individually or in combination, while the supporting system and social environment determine to some extent the success of entrepreneurship. The entrepreneurial behavior is not necessarily doing new things but also doing things in a different way that already have been done. Now, it is increasingly being felt that, the economic growth and development of the advanced countries is largely due to entrepreneurship quality among their community rather than to capital. Thus, an attempt has been made to study the entrepreneurial behaviour of vegetable growers in Lower Subansiri district of Arunachal Pradesh. Study would come out with some valuable findings for enhancing the entrepreneurial behaviour of vegetable growers.

Methodology

The study was conducted in Lower Subansiri district of Arunachal Pradesh. Lower Subansiri district has been purposively selected for the study because of high vegetable cultivation and production. Then, 9 village were selected from Ziro circle based on highest area, production, and productivity of vegetables. From each of the nine selected village 20 farmers were selected respectively by following random sampling procedure. Thus, forming a total sample size of 180 respondents. Data was collected by personal interview method using structured pre-tested questionnaire and the analysis was done using frequency, percentage and Karl Pearson's simple correlation test.

Objective

To study the relationship between socio-personal profile and entrepreneurial behaviour of vegetable growers.

Results and Discussion

Relationship between socio-personal profile and entrepreneurial behaviour of vegetable growers was calculated, analyzed and results were tabulated. Based on the data represented in table 1, age, education, land holding, annual family income, training received, mass media participation, extension contact, extension participation and scientific orientation were positively and significantly correlated with entrepreneurial behaviour, whereas occupation found to be negatively non – significant.

1) Age

Age of vegetable growers was positively and significantly correlated with their entrepreneurial behavior. As we grow older, we became more mature and surrounded by many responsibilities thus making us more enthusiastic and willing to work harder to become financially sound and independent, work efficiency and physical strength also increases as we get older. These might be the probable reason.

2) Education

Education of vegetable growers was positively and significantly correlated with their entrepreneurial behaviour. Education helps the farmers to get more information and thereby broaden and sharpen their mental horizon. It helps in their socio-psychological development. Education also helps in making decision more precisely and managing various aspects viz, planning, production and marketing aspect more efficiently. The result is in consonance with the results of Savitha et al. (2009) and Shilpa Karate (2019).

3) Occupation

Occupation was found non-significant and negatively correlated with their entrepreneurial behavior. This might be due to majority of respondents were engaged in agricultural activities. Hence less variation in their occupation might be the one of the main reasons for non-significant relationship. Similar findings were reported by Sabale et al. (2014).

4) Land holding

Land holding of vegetable growers was positively and significantly correlated with their entrepreneurial behaviour. Land holding provides the economic base for the farmer to practice new agricultural technologies. It helps them in optimum utilization of farm resources through efficient decision making and applying new ideas for achieving maximum profits. Further, it helps the farmer to bear risk and uncertainty. Farmers with large size of land holding have leadership ability. The results are in confirmity with Nagesh (2006), Savitha et al. (2009).

5) Annual family

Annual family income of vegetable growers was positively and significantly correlated with their entrepreneurial behaviour. Annual family income provides the economic base for the farmer hence; farmers with higher annual family income have higher purchasing power and motivated to try new technologies for improving their income and standard of living. Farmers with high annual family income can normally bear risk and uncertainty in adopting new ideas. The results are agreed with the reports of Subramanyeshwari and Veeraraghavareddy (2003), Nagesh (2006) and Savitha et al. (2009).

6) Training Received

Training Received was found positively and significantly correlated with their entrepreneurial behaviour. Through training programmes farmers get to know various useful knowledge which in turn helps them in enhancing their skills and boost their confidence level.

7) Mass media participation

Mass media participation of vegetable growers was found positively and significantly correlated with their entrepreneurial behaviour. Mass media is the huge source of opportunities for farmers, it can motivate the farmers to try or adopt new farm practices, it provides valuable information which helps farmers to know their chances of success. It also provides information on agricultural practices and thus creates an interest in the farmer to seek more information regarding a particular cultivation practice. The results are in consonance with the results of Nagesh (2006).

8) Extension contact

Extension contact of vegetable growers was positively and significantly correlated with their entrepreneurial behaviour. It means that extension contact plays an important role in disbursing knowledge and solving problems of vegetable growers. Frequent contacts with different extension personnel like private agency, NGO's, village level worker, Agricultural Officers etc. have more and better knowledge regarding improved cultivation of vegetables. The results of study were in agreement with the studies reported by Thyagarajan and Vasanthakumar, J. (2000), Shilpa Karate (2019) and Ritik Gupta (2022).

9) Extension participation

Extension participation of vegetable growers was positively and significantly correlated with their entrepreneurial behaviour. Extension participation helps farmers to get various information. Extension activities conducted in the area have direct effect on knowledge gained about improved agricultural practices. It also helps the farmers to adopt new agricultural practices earlier than others in their social system. The findings are found similar with the results of Nomes Kumar et al. (2000) and Nagesh (2006).

10) Scientific orientation

Scientific orientation of vegetable growers is positively and significantly correlated with their entrepreneurial behaviour. Respondents having higher scientific orientation would try and interested to gather more information, which could be applied at the field level, thus increasing their production. The results are similar with the results of Nagesh (2006) and Ritik Gupta (2022).

Table 1: Correlation coefficient between Socio-personal profile and Entrepreneurial Behaviour

Sl. No.	Independent variables	Correlation coefficient ('r' value)
1.	Age	0.657**
2.	Education	0.428**
3.	Occupation	- 0.158 ^{NS}
4.	Land Holding	0.737**
5.	Annual Family Income	0.764**
6.	Training Received	0.258**
7.	Mass Media Participation	0.976**
8.	Extension Contact	0.866**
9.	Extension Participation	0.991**
10.	Scientific Orientation	0.918**

**:

Significant at 0.01 probability level, NS: Non-significant

Conclusion

It was observed that socio-personal variables like age, education, land holding, annual family income, training received, mass media participation, extension contact, extension participation and scientific orientation were found to be positively and significantly correlated with the entrepreneurial behaviour of vegetable growers. Variable occupation found to be negatively non – significant. The government, extension agencies and private organizations should focus on the correlated factors as revealed by the study aiming at utilizing these variables to their great advantage, for promoting entrepreneurial behaviour among vegetable growers.

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THE IMPACT OF DIGITAL TRANSFORMATION ON CONSUMER BEHAVIOR IN E-BANKING SERVICES

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Abstract

In this research paper, I have thoroughly described about the topic “The Impact of Digital Transformation on Consumer Behavior in E-Banking Services.” The impact of digital transformation on consumer behavior in e-banking services is a significant area of focus in the evolving financial sector. As banks embrace digital technologies to meet changing customer expectations, research indicates a substantial shift in consumer preferences and behaviors. A notable percentage of banking institutions—89%—are prioritizing improvements in data protection and security, while 85% aim to implement digital transformation initiatives. Despite these advancements, many consumers remain hesitant to adopt digital banking services due to concerns about trust, interest, and knowledge gaps. For instance, in Peru, only 25% of the population engages with digital banking, compounded by a high financial illiteracy rate of approximately 80%. To overcome these challenges, banks must implement effective communication strategies, enhance transparency, and build trust with consumers. The study underscores the necessity for financial institutions to invest in digital transformation to optimize user experience and address the evolving needs of their clientele. Key factors such as personalization, technology advancements, demographic shifts, and competitive market dynamics significantly influence consumer behavior in e-banking. As younger generations increasingly favor mobile and online banking, traditional banks are compelled to adapt their offerings. By focusing on innovation and customer-centric services, banks can foster a positive consumer response and remain competitive in a rapidly changing digital landscape. Ultimately, digital transformation is essential not only for enhancing operational efficiency but also for aligning financial services with the expectations of a digitally-savvy consumer base.

Keywords: Digital Transformation, Financial Sector, Consumers, E-banking, Interest, Personalization and Digitally-Savvy etc.

INTRODUCTION

An important part of the financial sector's development is how digital transformation has changed the way people use e-banking services. Since digital technologies came along, banks have had to change and come up with new ideas to meet their customers' evolving wants and demands. A study found that digital transformation has had a big effect on how people behave in the financial sector. For example, 89% of banking institutions want to improve data protection and security, 85% want to start a digital transformation program, and 82% want to become more efficient by using new technologies. Even so, a lot of people still don't use digital services because they don't trust them, aren't interested, or don't know how to use them. In Peru, for example, only 25% of people have bank accounts and use digital methods to make deals. This means that about 80% of people in the country don't know how to handle money. For financial institutions to deal with these problems, they need to come up with good ways to communicate, build trust, and offer clear and new services that get people's attention. The study shows that banks need to put money into going digital in order to meet the needs of their customers and improve the service experience. They should think about things like trust, openness, communication, and new ideas. In this way, banks can change customers' behavior for the better and stay competitive in a financial world that is changing quickly.

DEFINITION OF DIGITAL TRANSFORMATION

When companies use digital tools in every part of their business, it changes how they work and what they can do for customers in a big way. This is called "digital transformation." Using cutting edge technologies like AI, big data analytics, cloud computing, and the Internet of Things (IoT) to make things better, make them more efficient, and come up with new ways to do business. Digitization is just turning traditional information into digital forms. Digital transformation, on the other hand, changes how businesses interact with their customers and react to changes in the market. This change isn't just about new technologies; it's also about changing the way companies work, supporting a way of thinking that values creativity, flexibility, and putting the user first. Companies can improve customer experiences, grow and become more competitive by using digital solutions to simplify their processes and learn more about how customers behave. Digital change also makes it easier for people inside and outside of organizations to work together and connect, which lets them respond more quickly to changing market needs. Businesses that don't change with the times risk becoming obsolete in today's fast-paced digital world, where customers expect smooth, personalized experiences across all platforms. So, digital transformation isn't just a technological task; it's also a strategy necessity that makes sure a company's goals are in line with what its tech-savvy customers expect. Businesses can set themselves up for long-term success in a digital market that is always changing by taking this all-

around approach.

CONCEPT OF E-BANKING

You may access your bank account and do online banking seven days a week with e-banking, a fast, easy, safe, and efficient electronic service. You might save time by using this service to doing financial activities from your home or place of business at any time and from any location as long as you have internet connection. These are made possible via e-banking:

- A correct list of all the money that is in your bank account
- A record of your present account balance, credits, overdrafts, and savings.
- Making payments between countries and currencies on a national and foreign level
- — Making payments on all kinds of service bills, like water, gas, phone, and more
- Getting customs fees done
- E-banking transactions are confirmed electronically for all of them.
- Taking care of your credit cards

IMPACT OF DIGITAL TRANSFORMATION ON CONSUMER BEHAVIOR

Digital transformation has profoundly influenced consumer behavior across various sectors, particularly in banking and retail. This change includes putting digital technology into every part of a business, which completely changes how companies work and what they offer customers. Businesses need to change to meet customers' changing needs as more people use digital media. The information below shows how the shift to digital has changed the way people behave.

Key Impacts of Digital Transformation

1. **Increased Online Engagement:** Consumers are spending more time online, leading to higher engagement rates on digital platforms. According to a report by Statista, as of 2023, the average daily time spent on the internet worldwide was approximately **6.8 hours**, up from **5.6 hours** in 2019.
2. **E-commerce Growth:** Online buying has become more popular, particularly after the COVID-19 epidemic. Global e-commerce sales are expected to hit \$5.7 trillion in 2022, making up 19.6% of all retail sales, according to eMarketer. As compared to 13.6% in 2019, this is a significant gain.
3. **Mobile Banking Adoption:** The use of mobile banking apps has surged as consumers prefer the convenience of managing finances on their smartphones. According to a survey by

Accenture, **62%** of consumers in India stated they prefer using mobile banking apps for transactions, compared to **32%** who preferred visiting physical branches.

4. **Personalization Demand:** Consumers expect personalized experiences driven by data analytics. 80% of customers are more likely to make a purchase when companies provide personalized experiences, according to an Epsilon survey. This shows how important it is for businesses to use customer data to create customized marketing tactics.

Aspect	2019 Data	2023 Data	Change (%)
Average Daily Internet Use	5.6 hours	6.8 hours	+21.4%
Global E-commerce Sales	\$3.5 trillion	\$5.7 trillion	+62.9%
Mobile Banking Preference	38% (physical branch)	62% (mobile banking apps)	+63.2%
Consumer Demand for Personalization	70%	80%	+14.3%

Table 1: Impact of Digital Transformation on Consumer Behavior (2019-2023)

Factors Influencing Consumer Behavior in E-Banking Services

The digital transformation of e-banking services has led to significant changes in consumer behavior. Several factors have contributed to these changes, including technology advancements, demographic changes, and competition and market dynamics.

1. Technology Advancements: Advances in technology have played a crucial role in shaping consumer behavior in e-banking services. The widespread adoption of mobile devices and the internet has enabled consumers to access banking services anytime, anywhere. Artificial intelligence (AI) and machine learning (ML) have enabled banks to offer personalized services, such as tailored product recommendations and real-time fraud detection. Additionally, the use of blockchain technology and biometric authentication has enhanced security and convenience. These technological advancements have raised consumer expectations, with many demanding seamless, intuitive, and secure digital experiences.

2. Demographic Changes: Demographic changes have also influenced consumer behavior in e-banking services. Age and generational differences have led to varying levels of comfort with digital technology. For instance, younger generations, such as Millennials and Gen Z, are more likely to adopt

digital banking services, while older generations may prefer traditional banking methods. Urbanization and lifestyle changes have also contributed to the shift towards digital banking, as consumers seek convenience and flexibility in their busy lives.

Competition and Market Dynamics

Traditional banks have had to change and adapt because fintech companies are becoming more and more of a threat. Fintech companies have changed the banking business by providing new, digital-only services and goods that meet unique customer wants. This competition has led to a shift in business models and revenue streams, with banks focusing on digital channels and customer experience to remain competitive. As a result, consumers have more choices and are more likely to switch banks if their needs are not met.

Conclusion

In conclusion, the impact of digital transformation on consumer behavior in e-banking services is profound and multifaceted. As banks adopt innovative technologies to enhance service delivery, they must also address the growing expectations of consumers for security, personalization, and convenience. While the shift towards digital channels has led to increased engagement and the rise of mobile banking, challenges remain, particularly regarding consumer trust and financial literacy, as evidenced by the low adoption rates in regions like Peru. To successfully navigate this landscape, financial institutions must invest in robust communication strategies, foster trust, and ensure that their offerings are transparent and user-friendly. By prioritizing these elements, banks can create positive consumer experiences, drive greater adoption of digital services, and maintain competitiveness in an increasingly digital economy. Ultimately, embracing digital transformation is not just about technology; it's about aligning with the evolving needs and behaviors of a digitally-savvy consumer base.

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Dynamic Behaviors of Gravity Dams in Interaction with Reservoirs and Foundations: A Comprehensive Study

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Abstract

This paper presents a literature review for dynamic analysis of concrete gravity dams. The author of the paper has discussed the different approaches used to analyze the dynamic behavior of dams such as analytical, semi-analytical, and numerical methods. They can be conducted in the time or frequency domain. The author has highlighted various parameters that affect the dynamic behavior of dams, including dam-water interaction, water compressibility, mass and damping of the foundation, sediments at the reservoir bottom, free surface waves, the length of the foundation rock, reservoir, etc. As the analytical methods of dams have developed, these parameters have been gradually included, enhancing their ability to investigate the behavior of dams more realistically. The author's aim is to illustrate these achievements by briefly reviewing the available published articles and categorizing corresponding researches based on the analysis techniques and considering or neglecting dam-water interaction, sediments, and free surface motions.

Key words: Hydrodynamic forces, Seismic response, Foundation rock, Dam-reservoir interaction,

Introduction

Historically, dams were constructed for a single purpose such as water supply or irrigation. However, as society developed and the demand for various resources increased, dams were built to fulfill multiple purposes including water supply, irrigation, flood control, navigation, water quality, sediment control, and energy production. Multipurpose dams are considered a vital project in developing countries as they offer multiple benefits from a single investment. However, it is important to note that dam failures can result in catastrophic consequences, making the safety of dams a crucial issue. To guarantee the safety of dams, it is imperative to carry out realistic design and analysis. This has attracted significant attention from researchers and has led to advancements in the dynamic

analysis of dams, particularly gravity, arch, and gravity -arch dams which are typically constructed using concrete. Two- dimensional simulations are commonly used for gravity dams, while three-dimensional simulations are utilized for arch dams.

In classical method, researchers typically neglected the flexibility of dams and analyzed the hydrodynamic pressure acting on rigid dams. Westergaard's work in 1933 was one of the earliest studies in this area and he proposed a formula for calculating the hydrodynamic pressure exerted on a dam due to horizontal ground motion. He assumed an incompressible fluid in the reservoir and named the fluid body confined by a two-dimensional surface on the upstream side of the dam as "added mass". This method was simple and widely used in the analysis and design of dams. However, subsequent researchers have proposed different methods for calculating the pressure acting on rigid dams, considering various conditions [2- 14].

The design and analysis of dams are crucial to ensure their safety and efficiency. In the past, researchers often neglected certain factors such as dam-water, dam-foundation, and reservoir-bedrock interactions, and focused mainly on hydrodynamic pressure on the dam. However, with advancements in technology and research, these interactions and other factors such as water compressibility, foundation mass and damping, sediment, nonlinear effects, and so on, have been gradually included in the analysis methods. This leads to more accurate and reliable results in assessing the dynamic behavior of concrete gravity dams. This paper reviews the available research and studies in this field, presenting their limitations, strengths, and advancements, and outlining future areas for further investigation.

Gravity Dams

The focus of this section is to present the various methods used in the analysis of concrete gravity dams, with a particular emphasis on those studies that take into account the fluid- structure interaction. The diversity of the methods is emphasized, highlighting the differences in the ways the reservoir is modeled and the parameters considered in the solution procedure. The goal is to provide a comprehensive overview of the current state of research in this field.

1 Time-Domain Analysis Methods

This review highlights the different methods and techniques used to analyze the dynamic behavior of concrete gravity dams, taking into account the fluid-structure interaction and other relevant

parameters. The aim of this review is to provide a comprehensive overview of the various techniques used in the time-domain analysis of gravity dams and to highlight the advantages and limitations of each approach.

1.1 Linear Approaches Where the Reservoir is Not Modeled

In 1967, Chopra (15, 16) considered the effect of water compressibility in his analysis of the dynamic behavior of concrete gravity dams and assumed that the dam deformation was similar to the first mode shape of an empty dam. This approach facilitated the integration of fluid-structure interaction into the solution procedure and highlighted the significance of considering this interaction. Prior to Chopra's work, researchers generally modeled the rigid dam and calculated the hydrodynamic pressure acting on it, which was then applied to the deformable dam for analysis. However, this method resulted in the analysis of two separate systems rather than a coupled fluid-structure system. Nath (17) also investigated the dynamic behavior of gravity dams under horizontal ground motion by utilizing a finite difference method, but with the consideration of fluid compressibility and without considering radiation damping. The dam was modeled as an elastic cantilever beam with a varying cross-sectional area, and a formula was proposed for computing the natural frequencies of the coupled fluid-structure system in terms of the uncoupled fundamental frequencies of the dam and the reservoir.

Finn, L. and Varoglu, E. (1973) evaluated the responses of a long gravity dam-reservoir system under the base acceleration normal to the dam axis. In their study, they used the finite element method to investigate the dam motion and expressed the water pressure as a function of the dam's unknown deflections and ground acceleration. However, they neglected several factors such as foundation flexibility, surface waves, water compressibility and viscosity.

In another study, Hall (1986) examined the earthquake response of the Pine Flat dam. This study took into account the effects of water presence, water compressibility, and the vertical component of ground motion. The author also determined the earthquake intensity which triggered nonlinear behavior in both the dam and water. Hall concluded that the presence of water significantly increased the seismic responses of the dam.

Guan et al. (1994) presented a new scheme for the dynamic analysis of a two-dimensional dam-water-soil interaction in the time-domain by assuming that the soil and fluid domain were semi-infinite regions. This study highlights the importance of including these factors in the analysis of gravity

dams.

In their research on crack propagation in gravity dams, Batta and Pekau utilized the linear fracture mechanics principles and plane finite elements [21]. To incorporate fluid effects, they utilized the added mass technique. There are various forms of finite element formulation for dam-reservoir systems, one of which involves considering the pressure and displacement as unknowns of the dam and reservoir, respectively. This formulation leads to an unsymmetric characteristic matrix, which requires solving an unsymmetric eigenproblem. Instead, the decoupled mode shapes can be used. Samii and Lotf compared the decoupled and coupled methods in their analysis of gravity dams [22]. Burman et al. proposed a procedure for analyzing gravity dam-foundation systems using the finite element method, with consideration for soil-structure interaction by a simplified direct method [23]. They used the added mass approach to take into account fluid-structure interaction.

1.2 Linear Approaches Where the Reservoir is Modeled

In their study, Chopra et al. utilized the finite element approach for the dynamic analysis of two-dimensional elastic dam-reservoir systems in 1969 [24]. In the finite element formulation of this work, the water was assumed to be compressible and the nodal unknowns of both fluid and solid domains were the displacements. Antes and Von Estorf employed the boundary element approach to analyze the response of planar gravity dams due to horizontal and vertical ground motions, considering the dam-water interaction and absorption of hydrodynamic pressure waves at the reservoir bottom or the far end into the soil medium [25]. The water was also assumed to be compressible in this study. Tsai and Lee analyzed gravity dam-reservoir systems by considering the radiation condition in the far-field of the infinite reservoir and applying a time-domain substructure approach [26]. They utilized the finite element scheme for modeling the dam and near-field fluid domain, and took into account the water compressibility in their analysis.

Bayraktar et al. used the Lagrangian formulation for analyzing the dynamic behavior of the dam-reservoir-foundation rock system [27].

Bayraktar and Dumanoglu conducted a study on the effects of asynchronous ground motion on the frequency content and amplitudes of hydrodynamic pressure acting on dams in interaction with water and foundation rock by using the Lagrangian finite element scheme [28]. Their results showed a considerable decrease in the amplitudes of the hydrodynamic pressures when the asynchronous ground motion was considered. Maity and Bhattacharyya used the finite element technique for the

dynamic analysis of dam-reservoir systems, with pressure being the unknown parameter in the fluid domain [29]. They also evaluated the effect of dam material and fluid depth on the responses and took into account the water compressibility. Lotf utilized the decoupled mode shapes of the dam and reservoir to analyze concrete dams in the time-domain [30]. Kucukarsalan proposed a new method for the time-domain analysis of dam-reservoir-foundation systems, which included the reservoir bottom absorption, by using the dual reciprocity boundary element approach for the infinite reservoir and the finite element method for the dam [31, 32]. The pseudo-symmetric scheme is one of the methods applied for the time-domain analysis of dam-reservoir systems, and Omid and Lotf verified this strategy by analyzing a concrete gravity dam [33].

In 2007, Birk and Ruge developed a symmetric finite element formulation for dam-reservoir systems, in which the far-boundary condition was presented in the time-domain [34]. They emphasized that predicting the behavior of aged dams during earthquakes would enable timely remedial measures to be taken to withstand future earthquakes. Additionally, Gogoi and Maity presented an approach that took into account the time-dependent degradation of concrete due to environmental factors and mechanical loading, as well as the absorption of pressure waves at the bottom of the reservoir due to the presence of sediments in the hydrodynamic pressure equation [35].

Additionally, Seghir et al. utilized the finite element method for discretizing the dam structure [36]. They proposed a new symmetric formulation for the analysis of an infinite reservoir utilizing the boundary element method, in which the pressure was considered as the unknown parameter in the fluid domain. Later, Gogoi and Maity developed a methodology for conducting seismic analysis of dam-reservoir systems, taking into account the frequency-dependent boundary conditions at the bottom of the reservoir and the truncation surface [37]. This technique accounted for the frequency content of the earthquake excitation and accurately calculated the damping parameters at the bottom of the reservoir and the truncation surface. The dominant frequency at each time step of the non-stationary earthquake signal was extracted by dividing the signal into small time segments, computing the fast Fourier transform of each segment, and applying the dominant frequency as an input in the seismic analysis.

1.3 Techniques Incorporating Nonlinear Effects in Dam-Reservoir Interactions

The influence of cavitation on the dynamic response of dam-reservoir systems has been studied in several studies. In 1983, Zienkiewicz et al. conducted an investigation and found that the effect of cavitation on the dynamic responses of dams was negligible [38]. Similarly, Vargas-Loli and Fenves

showed that the cavitation effects on the dynamic responses of gravity dam-reservoir systems were insignificant through a nonlinear dynamic analysis [39]. Fenves and Vargas-Loli developed a numerical procedure to calculate the dynamic response of the coupled fluid-structure systems and to investigate the nonlinear behavior of both the structure and the fluid [40]. The fluid was modeled as a bilinear compressible material and the fluid-structure interaction and water compressibility were considered in their analysis. The displacement finite element formulation was used to analyze the structure, and the symmetric coupled equations of motion were expressed in terms of displacements and solved using a fully implicit time integration method. The results of the study showed that cavitation had a slight effect on the responses. El-Aidi and Hall also conducted a nonlinear dynamic analysis and found that cavitation had a negligible effect on the dynamic responses of the dam-reservoir systems when cracks were modeled [41, 42]. Additionally, Vargas-Loli and Fenves evaluated the effect of cracking on seismic responses of gravity dams while considering the fluid-structure interaction and water compressibility [43].

In the study conducted by Hung and Chen [44], the interaction between the nonlinear hydrodynamic pressures and the vibration of a concrete gravity dam was assessed by coupling the Euler's equation with the finite element model of the dam. The horizontal and vertical components of the earthquake force were considered as the force function in the finite difference equations of the fluid motions. Wepf et al. [45] proposed a nonlinear dam-reservoir interaction model for a gravity dam-reservoir system, where a discrete cracking technique based on the finite element model was employed to model the propagation of cracks in unreinforced mass concrete. The reservoir was modeled using the boundary element strategy. Calayir and Dumanoglu [46] utilized the Lagrangian scheme for static and dynamic analysis of the gravity dam-reservoir systems.

In 1995, Cervera et al. proposed a general methodology for evaluating the dynamic behavior of large concrete dam-reservoir systems under seismic excitation [47]. This approach was applied to both 2D representations of gravity dams and 3D representations of arch dams. It incorporated nonlinear material behavior of the dam, transparent fictitious boundaries for handling in-coming and out-going seismic waves, and the interaction between the dam and soil-water. The mechanical behavior of concrete was modeled using an isotropic damage model. This methodology was used to study the degree of unsafety of a gravity and an arch dam. Chavez and Fenves later utilized a novel hybrid frequency-time domain approach to determine the seismic responses of gravity dams, including nonlinear base sliding behavior, frequency-dependent response of the impounded water and flexible

foundation rock [48]. These researchers assumed that the reservoir was a boundless continuum and that the water was compressible and inviscid.

In their study, Bhattacharjee and Leger used the smeared crack finite element model to perform a nonlinear seismic analysis of a 90m tall concrete gravity dam in Canada [49]. They incorporated the effects of reduced frequency-independent added matrices to account for the hydrodynamic and foundation interactions. They also evaluated the impact of initial conditions caused by severe winter temperatures and the influence of hydrodynamic and foundation interaction mechanisms on the nonlinear seismic behavior of the dam. In another investigation, Chen conducted a comprehensive hydrodynamic analysis of a concrete gravity dam, including the effects of free-surface flow and the nonlinearity of convective acceleration [50]. The results indicated that the surface wave effect of water on the dynamic structural analysis of the concrete gravity dam was negligible.

In the context of seismic analysis of gravity dams, Cervera et al. proposed a rate-dependent isotropic damage model which incorporated stiffness degradation and recovery under load reversals, as well as strain-rate sensitivity [51]. To consider fluid-structure interaction, they employed the methodology introduced in their earlier work [47]. Lee and Fenves, on the other hand, developed a plastic damage model for concrete gravity dams subjected to cyclic loading, incorporating fluid effects using the added mass approach [52]. Ghaemian and Ghobarah performed nonlinear fracture analysis of gravity dams by including the water-dam interaction in their formulation, using a staggered approach [53]. In 2001, Vatani Oskouei et al. studied the nonlinear dynamic analysis of dam-reservoir systems while taking into account cavitation, utilizing displacement-based finite elements [54]. Asteris and Tzamtzis also performed nonlinear analysis of a realistic gravity dam-reservoir system, considering fluid-structure interaction through the added mass technique [55].

In recent years, various researchers have continued to study the seismic behavior of gravity dams. Yuchuan et al. compared the behavior of reinforced and unreinforced dams and found that reinforcement improved the seismic resistance of the gravity dam [56]. Akkose and Simsek analyzed a gravity dam-reservoir system under near-field and far-field earthquakes, considering nonlinear effects [57]. ShouYan studied the effect of shear keys on the nonlinear responses of a gravity dam and observed that the presence of shear keys reduced joint opening and sliding displacement [58]. Mirzayee et al. used a combination of discrete and boundary element methods to assess the behavior of cracked gravity dams [59]. These studies have helped to further understand and improve the seismic behavior of gravity dams.

Omidi et al. (60) employed a plastic damage model and different damping mechanisms to examine the seismic behavior of these structures, incorporating fluid-structure interaction with the added mass technique. Zhang et al. (61) used the extended finite element method to evaluate the behavior of damaged cracked gravity dams, considering fluid effects through Westergaard's approach. Furthermore, Zhang et al. (62) investigated the impact of strong motion duration on the dynamic response and accumulated damage of concrete gravity dams, while taking fluid-structure interaction into account. These studies demonstrate the importance of considering fluid-structure interaction and various other factors in the seismic analysis of concrete gravity dams.

2 Techniques for Dynamic Analysis in the Frequency Domain

It is important to note that linear dynamic analysis can be performed in the frequency domain. The subsequent sections examine studies that have used frequency -domain techniques to evaluate the behavior of gravity dam-reservoir systems.

2.1 Linear Approaches Where the Reservoir is Not Modeled

Chakrabarti and Chopra (1973) investigated the impact of the vertical earthquake components on the hydrodynamic pressure exerted on gravity dams [63]. They found that the response to this component is significant in the analysis of concrete gravity dams subjected to earthquakes due to the horizontal hydrodynamic forces applied to the vertical upstream face by the vertical component of the ground motion. The authors then proposed a novel "substructure" technique for the frequency-domain analysis of concrete gravity dam- reservoir-foundation systems with the vertical upstream face [64]. The dam was modeled using finite element analysis and the fluid domain was represented as an infinite continuum governed by the wave equation. The structural displacements were expressed as a linear combination of the dam's vibration modes when the reservoir was empty, and the reservoir responses were obtained analytically. The governing equations of the dam and the reservoir were linked by the interaction forces between them. This method achieved excellent results using only a few modes of the dam

Chopra and Chakrabarti proposed a general procedure for linear dynamic analysis of gravity dams subjected to both vertical and horizontal components of earthquakes using the substructure method [65]. The procedure considered the water compressibility, dam, and foundation flexibility, which includes dam-water-foundation rock interaction. The system was composed of three substructures including the dam, the reservoir, and the foundation. The dam was modeled using finite element

approach, while the fluid domain and foundation rock were represented as a continuum of infinite length and a viscoelastic half-plane, respectively. The dam displacements were expressed as a linear combination of normal modes of an undamped associated dam-rock system. On the other hand, Bouaanani et al. proposed a two-dimensional model using finite element technique to study the influence of ice cover on the dynamic responses of gravity dams [66]. The study showed that the presence of ice cover had an impact on acceleration and frequency response curves, as well as the hydrodynamic pressure distribution in the reservoir.

2.2 Linear Approaches Where the Reservoir is Modeled

Mei et al. utilized linear acoustic and beam theories to derive expressions for the vibration of simple structures in water [67]. The dam was modeled as a beam for simplification purposes, and both closed-form formulas and numerical solutions using the hybrid element method were obtained. Additionally, Chopra and Gupta employed the substructure technique to evaluate the dynamic behavior of the gravity dam-water-foundation rock system in the frequency domain [68]. On the other hand, Hanna and Humar employed the boundary element method for the analysis of the gravity dam-reservoir systems [69].

In their research, Hall and Chopra used the finite element method to conduct a linear dynamic analysis of concrete gravity and embankment dams in the frequency domain [70, 71]. They considered the effects of water compressibility, fluid-structure interaction, and fluid- foundation interaction. The fluid domain was assumed to be semi-infinite and divided into near-field and far-field regions, with the near-field region discretized with finite elements and the far-field region modeled through a combination of one-dimensional discretization in the vertical direction and continuum representation in the infinite direction.

Fenves and Chopra presented a procedure for analyzing the responses of concrete gravity dams under the horizontal and vertical components of earthquake ground motions [72]. The procedure included the consideration of dam-water interaction and partial absorption of hydrodynamic pressure waves at the reservoir bottom into the foundation medium. They also extended the available substructure system to analyze concrete gravity dams, including alluvium and sediments, while taking water compressibility into account [73].

In 1985, Fenves and Chopra (1974) presented a study on the parameters that play an important role in the dynamic behavior of gravity dams. They introduced simple methods to calculate the

fundamental vibration mode response of gravity dams with a reservoir of impounded water supported on a rigid foundation rock and a dam with an empty reservoir supported on a flexible foundation rock. In each case, the first vibration mode of the dam monolith was modeled using an equivalent single degree of freedom system. Additionally, they proposed another simple model for the dam-compressible water-flexible foundation systems (1975).

Subsequently, Lotf et al. (1976) introduced a new finite element procedure for linear dynamic analysis of the two-dimensional dam-reservoir-foundation rock system in the frequency domain, considering all interactions rigorously. This method treated layered foundations as easily as homogeneous ones. Humar and Jablonski (1977) analyzed the seismic behavior of gravity dam-infinite reservoir systems using the boundary element method. In 1989, Dominguez and Medina (1978, 1979) performed a dynamic analysis of a two-dimensional dam-reservoir-bedrock system in the frequency domain using the boundary element approach.

In 1991, Bougacha and Tassoulas proposed a finite element method for the two-dimensional dynamic analysis of gravity dam-reservoir systems, taking into account the effects of sediment and underlying foundation [80-82]. The authors used a two-phase medium to model the sediment and their model could be integrated rigorously within the hyper-element formulation, which accounted for the interaction between water, sediment, and foundation. Later, Valliappan and Zhao modeled the gravity dam-water-foundation system using both finite and infinite elements, considering the physical and mechanical properties of the sediment at the reservoir bottom [83]. Their study concluded that the sediment played two significant roles in these systems: energy dissipation in the system and amplification of the incident wave on the water-sediment interface. Additionally, Tsai et al. conducted a modal analysis of the dam-reservoir systems using a combination of substructure, finite element, and boundary element methods [84].

It is noteworthy to mention that the wave radiation towards infinity, wave absorption at the bottom of the reservoir, and cross-coupling between the foundation beneath the dam and the bottom of the reservoir significantly impact the hydrodynamic forces within the reservoir. These effects can be incorporated by using either an approximate one-dimensional wave propagation model or a more rigorous analysis of the interaction between the flexible soil along the base and the water. However, due to the excessive computational demands of the rigorous method, it is commonly simplified by neglecting the cross-coupling and applying the approximate one-dimensional wave propagation model. Chandrashaker and Humar analyzed the effects of these simplifications on the seismic

responses of a gravity dam from an accuracy and computational perspective [85]. By utilizing a coupled finite and infinite element method, Zhao et al. studied the impact of the sediment at the bottom of the reservoir on the seismic response of concrete gravity dams [86]. Li et al. also investigated the dynamic behavior of a two-dimensional dam-reservoir system by introducing an exact far boundary condition with no spatial discretization for determining the vibration modes [87].

In 1997, Dominguez et al. conducted a boundary element dynamic analysis to investigate the dynamic behavior of a concrete gravity dam that was subjected to ground motions and interacted with the water, foundation, and bottom sediment [88]. This method was versatile and could be applied to continuous systems consisting of water viscoelastic and fluid-filled poroelastic zones of arbitrary shape. The researchers evaluated the influence of the bottom sediment on the seismic response of gravity dams for both rigid and half-space viscoelastic foundation, and also assessed the effects of the degree of saturation and thickness of the bottom sediment. It was concluded that the sediment compressibility had a significant effect on the dam response, and the influence of the foundation flexibility and sediment thickness was also considered. In a separate study, Lotf and Sharghi utilized the finite element approach to analyze the dynamic behavior of gravity dams [89]. They employed semi-infinite and quadratic boundary elements for the reservoir and foundation, respectively.

Bayraktar and Akkose (90) evaluated the impact of foundation rock properties on the stochastic dynamic behavior of gravity dam-reservoir systems. A common approach in modeling the interaction between the reservoir and foundation is through the utilization of a one-dimensional model, however, as highlighted by Lotf (91), this method can lead to significant errors when considering both horizontal and vertical ground motions. Despite the frequent assumption of the water domain being a semi-infinite fluid region, there are scenarios where the reservoir cannot be considered as such. This has been shown by Lotf and Fathi (92), who demonstrated that the length of the reservoir can greatly impact the response and should not be modeled as an infinite domain. Miquel and Bouaanani (93) proposed a simple method for estimating the first mode shape of gravity dam-reservoir systems, which accounts for both the water compressibility and dam flexibility.

In 2012, Keivani and Lotf made advancements in the unsymmetric Lanczos approach, which they utilized to efficiently solve the eigenvalue problem in the context of the dam-reservoir interaction system [94]. The traditional approach to modeling the dam-reservoir system involves the use of fluid and solid finite elements and hyper-elements. However, this process is known to be time-consuming due to the formulation of hyper-elements in the frequency domain. In order to address this issue,

Lotf and Samii proposed a more efficient and rapid method as an alternative to the traditional approach [95].

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Conclusion

In conclusion, the dynamic behavior of a concrete gravity dam and its interaction with the surrounding environment, including the water, foundation, and bottom sediment, has been extensively studied by various researchers. The effects of these interactions on the seismic responses of the dam are significant and have been analyzed using different approaches such as the boundary element dynamic analysis procedure, finite element analysis, and Lanczos eigenvalue approach.

The impact of the foundation rock characteristics on the stochastic dynamic responses of the dam-reservoir system has also been explored. Most engineers assume the water domain to be a semi-infinite fluid region, but researchers have found that the length of the reservoir can significantly affect the response and should not be modeled as an infinite domain. To address these issues, researchers have proposed alternative methods such as the first mode shape estimation technique and a fast and efficient method using hyper-elements in the frequency domain.

Overall, the studies conducted in this area have found that the dam-reservoir system is a complex system, and its response is influenced by various factors such as the compressibility of the bottom sediment, the degree of saturation, the foundation rock characteristics, and the length of the reservoir. In light of these findings, it is crucial to consider the fluid-foundation interaction effects when designing and analyzing concrete gravity dams.

It is worth noting that the computational efforts of rigorous analysis methods are often high and may be simplified by neglecting certain interactions, such as cross-coupling. While this simplification may have an impact on the accuracy of the results, researchers have investigated the trade-off between accuracy and computational effort.

In conclusion, the studies in this field have advanced our understanding of the dynamic behavior of

concrete gravity dams and their interactions with their environment. These studies have also highlighted the importance of considering fluid-foundation interaction effects in the design and analysis of concrete gravity dams. Further research in this area could further enhance our understanding of this complex system and help to improve the safety and reliability of these critical structures.

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INTERCROPPING OF FINGER MILLET AND MOONG BEAN FOR AGRONOMICAL, NUTRITIONAL, AND MOLECULAR INTERVENTIONS

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Abstract:

This the study seeks to explore the potential of intercropping finger millet (*Eleusine coracana*) and moong (*Vigna radiata*) as a strategy to enhance agricultural productivity while providing nutritional benefits and understanding molecular interactions. The focus is on optimizing agronomic efficiency, improving nutritional outcomes, and revealing the molecular pathways involved in intercropping these two crops. Given the global challenges of food security and soil degradation, this study aims to develop sustainable, high-yielding, and nutritionally rich cropping systems that combine ancient grains and legumes in a complementary system. Field experiments, laboratory-based nutritional assays, and molecular biology techniques will be employed to evaluate the agronomical, nutritional, and genetic impacts of this intercropping system.

Introduction

In the face of increasing population and environmental pressures, the demand for sustainable and nutritionally rich agricultural systems has never been greater. Finger millet is an ancient crop known for its drought tolerance and high nutritional value, particularly its calcium and fibre content. Moong, a legume rich in protein, complements cereal crops in traditional cropping systems due to its ability to fix atmospheric nitrogen and improve soil fertility. Despite the promise of both crops, their combined potential in intercropping systems remains underexplored, especially in terms of agronomical optimization, nutritional improvements, and molecular mechanisms.

Research Problem:

Current monoculture cropping systems can deplete soil nutrients, increase vulnerability to pests, and require high inputs of water and fertilizers. Intercropping, where two or more crops are grown together, offers a possible solution by increasing biodiversity, enhancing soil health, and improving yield. However, while cereal-legume intercropping has been explored for major crops, research on finger millet and moong intercropping is still sparse, particularly concerning their molecular interactions and potential for biofortification.

Significance of the Research:

This research will fill the gap in understanding the benefits of intercropping finger millet and

moong by providing both empirical agronomic data and nutritional analysis, while also investigating the molecular basis of the interactions between these crops. The outcomes will contribute to sustainable agricultural practices, benefiting smallholder farmers in semi-arid regions while addressing global nutritional needs.

Cultivation and Production of Finger Millet and Moong

Finger Millet (*Eleusine coracana*)

1. Climate and Soil Requirements:

- Thrives in warm, semi-arid climates.
- Grows well in loamy, sandy, and black soils with a pH of 5-7.

2. Sowing and Seed Rate:

- Sown during the monsoon season (June-August).
- Requires 8-10 kg of seeds per hectare, spaced 30 cm apart.

3. Irrigation:

- Primarily rainfed, but supplemental irrigation is beneficial during flowering and grain-filling stages.

4. Fertilization:

- Organic manure (10-12 tons/ha) and chemical fertilizers (40-60 kg/ha nitrogen, 30-40 kg/ha phosphorus).

5. Weed and Pest Control:

- Hand or mechanical weeding at 15-20 and 30-35 days after sowing. Minimal pest issues but susceptible to blast disease.

6. Harvesting and Yield:

- Harvested after 100-120 days. Yield is 1.5-2.5 tons/ha under rainfed conditions, up to 3-4 tons/ha with irrigation.

Moong (*Vigna radiata*)

1. Climate and Soil Requirements:

- Grows in warm climates (25-35°C) with light to moderate rainfall.
- Best in sandy loam to clay loam soils with a pH of 6-7.5.

2. Sowing and Seed Rate:

- Sown in the Kharif season (June-July) or spring.
- Requires 15-20 kg of seeds per hectare, spaced 30-45 cm apart.

3. Irrigation:

- Requires 2-3 irrigations depending on rainfall. Critical irrigation stages are flowering and pod development.

4. Fertilization:

- Requires 20-25 kg nitrogen, 40-50 kg phosphorus, and organic manure (5-10 tons/ha).

5. Weed and Pest Control:

- Requires 1-2 weeding or herbicide use. Pests like aphids and pod borers are common, but manageable.

6. Harvesting and Yield:

- Harvested after 60-75 days. Average yields range from 0.8-1.5 tons/ha.

Intercropping of Finger Millet and Moong

Intercropping finger millet (*Eleusine coracana*) and moong (*Vigna radiata*) is an effective strategy to enhance crop productivity, soil health, and nutritional value. This system optimizes the use of resources, as finger millet's deep roots access nutrients and water from lower soil layers, while moong's shallow roots utilize the upper layers. Moong also enriches the soil by fixing nitrogen, benefiting finger millet and reducing the need for synthetic fertilizers.

Nutritionally, finger millet is rich in calcium, fibre, and iron, while moong is high in protein, vitamins, and minerals. Intercropping them provides a more balanced and nutrient-dense harvest, making it ideal for regions facing malnutrition. Environmentally, the system improves water use efficiency, reduces pest and weed pressure, and supports biodiversity. It also enhances land-use efficiency, leading to higher yields and better economic outcomes for farmers. However, careful crop management and synchronization of planting and harvesting are essential for maximizing benefits. This intercropping system offers a sustainable approach to improving both food security and environmental resilience, particularly in semi-arid regions.

Experimental Design:

The seeds of indigenous variety of Ragi collected from Krishi Vigyan Kendra- Papumpare. The research will be conducted through a series of field experiments using a randomized complete block design (RCBD) with three treatments: monoculture of finger millet, monoculture of moong, and intercropping of finger millet and moong. Each treatment will be replicated across five blocks to ensure statistical accuracy. The data on different parameters of agronomical, nutritional and molecular will be harvested under different treatments of biofertilizers at different time interval.

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FILM AND LITERATURE: ADAPTATION AND APPROPRIATION

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Abstract:

This research paper examines the intricate and multifaceted relationship between film and literature, highlighting the significance of adaptation and appropriation in the creative process. The paper explores the unique artistic qualities of each medium, including their narrative structures, character development, and thematic exploration. It delves into the complexities of adaptation and appropriation, discussing the challenges and benefits of transmuting literary genres into cinematic forms. The paper also examines the concept of cultural appropriation and its implications, emphasizing the need for filmmakers to engage with the original material and cultural influences with integrity, empathy, and a dedication to promoting tolerance and comprehension.

Key words: Adaptation, Film, Literature, Storytelling, Appropriation

Introduction:

The lasting symbiotic relationship between literature and film has continued since the beginning of cinema, due to the significant visual qualities that are inherent in both creative mediums. The realm of cinema has demonstrated a proactive inclination towards embracing and assimilating concepts, frameworks, and methodologies that were once the sole domain of literature. This paper aims to investigate the complex interrelationship between film and literature, focusing on the processes of adaptation and appropriation. The realm of literature and film serve as deeply subjective artistic mediums that inherently lend themselves to multifaceted interpretations, thereby stimulating intellectual discourse. Both exert influence and are subject to the influence of cultural, social, and political contexts. They possess the capacity to question established norms, provoke intellectual contemplation, and inspire societal metamorphosis through the use of storytelling. The realms of film and literature often delve into the exploration of universal human emotions and experiences, thereby fostering the intellectual exchange surrounding complex subjects such as identity, sorrow, affection, and the dynamics of power.

Literary and Cinematic Narratives:

Both literature and film employ narrative structures to engage and enthrall audiences, evoking profound emotional responses and conveying intricate plotlines. However, they employ disparate methodologies and tools to achieve their objectives. Literature predominantly consists of written words, wherein the reader's faculty of imagination plays a pivotal role in constructing vivid mental images and interpreting the narrative. On the contrary, film seamlessly amalgamates various sensory elements, including cinematography, editing, sound design, music, and acting. Film and literature, in their respective forms, function as the quintessential

manifestations of human intellect, encapsulating the profound depths of human thought and creativity. A person embarks upon deep introspection concerning various methodologies to aptly convey the intricate essence of human experiences, with the ultimate objective of expanding the boundaries of enlightenment. Upon initial examination, it becomes evident that there is a notable scarcity of acknowledgment and support for the complex interrelationship between the craft of cinematography and the domain of literary representation. Delving into the annals of ancient human civilization reveals the intricate connection between the artistic mediums of cinema and literature. The onset of the 19th century marks the commencement of a symbiotic relationship between the domains of cinema and literature, characterised by progress and fruitful collaboration. The domain of cinema originally cultivated strong associations with both the medium of photography and the realm of fine art. In contrast, the domain of literature primarily confined itself to the realm of print, thus assuming a relatively unchanging and lasting form. The domain of literature encompasses a myriad of genres, each imbued with its own distinct attributes and aesthetic virtues. These literary classifications encompass the succinct and evocative sphere of short stories, the immersive and expansive realm of novels, the captivating and performative domain of dramas, and the lyrical and expressive sphere of poetry. The conspicuous observation can be made that the employment of letters is a pervasive convention within the domain of literature, attributable to the fact that all literary compositions are crafted in a written medium.

Adaptation and Appropriation:

The concepts of adaptation and appropriation in films are intricate and sometimes controversial components of the filmmaking process, giving rise to inquiries about creative interpretation, novelty, and cultural sensitivity. Adaptation is the conversion of a source material, such a literary work or historical event, into a film story. On the other hand, appropriation includes the stealing or recontextualization of aspects, concepts, or tales from a distinct culture or creative tradition. Both techniques have garnered both acclaim and scrutiny within the film business and among viewers and critics.

Movie adaptations provide filmmakers a chance to creatively reinterpret and rework pre-existing narratives, effectively bringing them to life using the visual and storytelling techniques unique to cinema. Successful adaptations, whether they faithfully recreate classic novels or reimagine historical events, provide fresh perspectives on old stories. They invite viewers to interact with timeless themes and characters in innovative ways. Nevertheless, the process of adaptation presents difficulties, as filmmakers must skilfully manage the intricate task of respecting the original source material while simultaneously making artistic decisions that are suitable for the medium of cinema. Straying excessively from the original material might potentially alienate fans, while adhering too closely may restrict the film's capacity for creativity and innovation.

Appropriation in films, especially when it entails taking from cultures or traditions different from one's own, has ignited discussions on cultural portrayal, genuineness, and morality. Although cultural interchange and cross-cultural influences have enhanced the film industry, appropriation may sometimes result in the distortion, stereotyping, or exploitation of marginalised cultures. Filmmakers must approach appropriation with compassion, respect, and a dedication to genuine portrayal, while honouring the voices and viewpoints of the culture being appropriated.

Over the last several years, conversations on adaptation and appropriation in films have gotten more sophisticated, indicating a heightened understanding of the moral and artistic consequences of these actions. Filmmakers and viewers are actively participating in important discussions on the conscientious and considerate reinterpretation of established storylines, as well as the ethical implications of cultural appropriation and portrayal.

Case Studies:

The paper examines several instances of adaptation and appropriation in films. Adaptation and appropriation in films provide filmmakers with a potent storytelling tool, allowing them to draw inspiration from many sources and reinterpret storylines for fresh audiences. Nevertheless, these techniques also include the need to engage with the original material and cultural influences with integrity, empathy, and a dedication to promoting tolerance and comprehension. Given the continuous development of the film industry, it is crucial for filmmakers to use intentional and self-reflective approaches when adapting and appropriating information. It is important for them to recognise the impact of their artistic decisions on the broader cultural context. An exemplary instance of adaptation is the cinematic masterpiece *The Shawshank Redemption*, helmed by Frank Darabont and adapted from Stephen King's novella *Rita Hayworth and Shawshank Redemption*. The film adeptly conveys the concepts and characters from King's literary work to the medium of cinema, thereby capturing the spirit of the tale. It utilises the visual and emotional language of film to immerse spectators in a captivating narrative. The adaptation keeps true to the fundamental aspects of the novella while making required modifications for the move to the screen, showcasing the creative capacity of adapting tales across various media platforms.

Conversely, the act of incorporating narratives and cultural components may be seen in films such as *The Lion King*, which drew inspiration from William Shakespeare's *Hamlet* and traditional African folklore. The film used Shakespearean motifs of betrayal, family relationships, and redemption within a storyline situated in the African savannah, effectively assimilating various inspirations to create a unique and cherished tale that resonates across many

cultures. The incorporation of Shakespearean ideas into a different cultural setting has sparked discussions, yet *The Lion King* demonstrates how adapting well-known stories can create fresh and captivating storytelling experiences.

A further instance of appropriation in the realm of cinema may be seen in the film *Crouching Tiger, Hidden Dragon*, helmed by the renowned director Ang Lee. The movie incorporates the visual and thematic aspects of ancient wuxia literature and martial arts films, blending them with a modern sensibility and a global appeal. *Crouching Tiger, Hidden Dragon* demonstrates the power of appropriation to create a distinct and culturally meaningful cinematic experience by combining ancient Chinese storytelling and martial arts traditions with cinematic narrative methods.

Both adaptation and appropriation include the innovative reinterpretation of pre-existing tales, enabling filmmakers to provide new viewpoints and analyses of well-known themes, therefore captivating viewers via unique approaches. Nevertheless, it is crucial for filmmakers to engage in these activities with reverence, perceptiveness, and a dedication to genuine portrayal, especially when including aspects from many cultures or traditions. The process of adapting and appropriating stories in films highlights the dynamic and always changing nature of storytelling. It also demonstrates how films have the ability to revitalise classic narratives and connect different cultures via the medium of cinema. As filmmakers push the limits of adapting and appropriating, they may provide a platform for significant discussions and comprehension across many tales and cultures.

In his essay "Adaptation, or the Cinema as Digest," André Bazin discusses the issue of digests and adaptations, which is often examined in the context of literature. However, literature is simply a small component of a much wider phenomena. Consider the art of painting, for example. An art museum may be seen as a compilation, since it houses a curated assortment of artworks that were originally meant to be shown in a distinct architectural and ornamental setting. However, these pieces of art remain unique. However, let us now consider the hypothetical museum put out by Malraux. Through photographic reproduction, the artwork is fragmented into many facets, refracting its original form. In turn, it replaces the original picture with easily available images of varying proportions and colours. Photography, in essence, serves as a contemporary alternative to engraving, which historically served as the only imprecise

"modification" accessible to art enthusiasts. It is important to acknowledge that the adaptation and summarization of original works of art have become very common and regular to the point where it is almost difficult to challenge their presence in today's world. To illustrate my point, I will use examples from the field of movies. (Bazin, André-19-27)

André Bazin asserts that multiple writers, critics, and filmmakers have questioned the artistic rationale behind adapting novels into films. However, there are few instances of people who actively oppose this practice, refusing to sell their own books or adapt the works of others, or declining to direct such adaptations when presented with enticing offers from producers. Therefore, their theoretical argument does not seem entirely warranted. Typically, they assert the singularity or distinctiveness of each genuine literary piece. (Bazin, André-19-27)

Renowned novelist Virginia Woolf emerged as one of the discerning critics who expounded upon the subject of film adaptation in the year 1926. In her literary discourse, she astutely observed that the cinematic renditions of the most celebrated novels of our time often traverse their narrative terrain in a rather clumsy and inelegant manner. Thus, the words are articulated in monosyllabic form, inscribed in a manner reminiscent of the crude penmanship of an uneducated adolescent" (Woolf Virginia, 3).

Linda Costanzo Cahir posits that when appraising cinematic adaptations of literary works, it is imperative to recognise their inherent nature as translations of the source material. It is of utmost importance to grasp the fundamental distinction that exists between the lexical entities denoted by the terms "adaptation" and "translation." The categorization of films that draw inspiration from literature as "adaptations" is a commonly employed term. However, it is imperative to discern that the term "adapt" itself conveys a more nuanced significance, denoting the act of modifying the framework or operation of a given entity with the intention of enhancing its prospects of endurance and proliferation within a novel milieu. In order to undergo adaptation, an entity must undergo a transition to a novel environment. During the course of adaptation, the fundamental organism remains unaltered while undergoing modifications, which frequently encompass notable mutations, with the aim of more effectively aligning with its novel environment. (Por Linda Costanzo Cahir 14)

The act of adapting a cinematic work or embarking upon the art of filmmaking represents a pivotal and forward-thinking juncture in the ongoing development of humanity as a whole. The cinematic medium possesses a distinct ability to depict individuals hailing from diverse societal echelons, effectively capturing the intricacies of their respective trials and triumphs. The

inclusion of such an image serves to augment the palpability and verisimilitude of literary compositions. Films possess a profound allure due to their captivating visual and auditory spectacles, even though they can convey the same content as written text. A literary encounter epitomises a solitary, unisensory endeavour, while the act of engaging with cinema fosters a communal, multimodal experience that accentuates the present instant. There is an irrefutable truth that films serve to augment one's visual literacy, while literature, on the other hand, serves to enhance one's verbal literacy. One can posit a cogent argument establishing a correlation between the realms of literature and film. To categorise the art form of cinema as a subsidiary division of the realm of literature. The medium of film can be regarded as a historical artefact rather than an abrupt phenomenon that materialised within society. Throughout history, people have observed the practice of transposing an image from its original source material, rendering it far from a novel occurrence. Since the inception of the film industry, it has been in existence.

All film adaptations of books are essentially transformations, since they convert a written work from one medium to another, possibly reaching new or expanded audiences. However, many adaptations, whether they be of novels or other generic forms, sometimes include additional levels of transposition. These adaptations not only change the genre of their original texts, but also alter their cultural, geographical, and chronological contexts. (Sanders Julie, 25)

Film adaptations predominantly centre their attention on the task of transposing literary or theatrical compositions into the medium of motion pictures. Nevertheless, it is worth noting that a plethora of adaptations have emerged from a diverse array of sources, encompassing both renowned works of fiction and non-fiction literature, comic books, and various other origins. Famous literary and theatrical works have been the mainstay of many nations' cinema industries since the silent era, and this pattern has persisted throughout the 20th and 21st centuries. But one could posit that William Shakespeare holds the distinction of being the most frequently adapted literary figure. Shakespeare's theatrical works have transformed into cinematic productions of notable distinction. An example of such adaptation is a grandiose epic tale that takes place in mediaeval Japan, named *Kumonosu-jo/Throne of Blood* (Japan, 1957), deftly directed by Akira Kurosawa. Another noteworthy example of the diverse adaptations that have been brought to fruition is the lively and exuberant Bollywood musical rendition of his work, known as *Angoor* (India, 1982). The phenomenon of adaptations frequently occurs within specific temporal and spatial parameters, as exemplified by the British heritage cinema of the 1980s. Numerous

cinematic works exemplify a discernible degree of introspection pertaining to the intricate process of adaptation.

Julie Sanders, in her book "Adaptation and Appropriation," contends that appropriation often results in a notable divergence from the original text, giving rise to the formation of an entirely new cultural product and sphere. This metamorphosis is often accomplished via the mechanisms of interpolation and criticism, as well as the shift from one genre to another. Sanders argues that appropriations have a more complex and interconnected relationship with their intertexts than a straightforward film rendition of a well-known classic would suggest. (Julie Sanders, 34).

Julie Sanders astutely underscores the interdependence of adaptation and appropriation upon the literary canon, which serves as a collective reservoir of narratives, motifs, personages, and ideas, from which artists draw inspiration to craft their imaginative reinterpretations. In order to fully appreciate the reshaping or rewriting of an adapted text, the spectator or reader should be able to engage in the interplay of similarities and differences between the original sources or inspiration. However, it is not necessary for the spectator or reader to have prior knowledge of this in order to have their own experience of the adaptation. Nevertheless, many collections of written works and primary sources, such as myths, fairy tales, and folklore, inherently rely on this mutual understanding and availability. These forms and genres have a readership and audience that spans many cultures and frequently different time periods. They consist of stories and tales that transcend cultural differences and are passed down through generations, although they may undergo changes and translations along the way. They actively engage in a communal knowledge network and hence serve as valuable resources for adaptation and revision. (Julie Sanders, 57).

Film adaptation allows filmmakers to creatively rework and remake an existing work in a visual and cinematic format. It enables the examination of various narrative methods and the conversion of literary components into audio-visual encounters. Film adaptations have the potential to faithfully replicate the source material, effectively capturing the fundamental qualities of the original work while remaining loyal to its storyline, characters, and ideas. These adaptations often connect with fans of the original and provide a fresh viewpoint via the use of

visual narrative. Notable instances of accurate adaptations are *To Kill a Mockingbird* (1962), *Pride and Prejudice* (2005), and *The Lord of the Rings* trilogy (2001-2003).

But during the first phase of Indian cinema, several filmmakers made efforts to adapt the works of Shakespeare, and these films played a crucial role in familiarising the Indian film industry with Shakespearean literature. Mehdi Ahsan's 1935 Indian film *Khoon Ka Khoon* was an adaptation of Shakespeare's *Hamlet*, while J. J. Madan's 1941 Hindi film *Zalim* was based on *The Merchant of Venice*. Sanjay Leela Bhansali's *Goliyon Ki Rasleela Ramleela* (2013) is a Gujarati interpretation of *Romeo and Juliet*. *Angeer* is a cinematic adaptation of the Bengali comedy film *Bhrantibilas* (1963), which in turn was derived from a play of the same title by Ishwar Chandra Vidyasagar. Vidyasagar's play was directly inspired by Shakespeare's *The Comedy of Errors*. *Hamshakals*, directed by Sajid Khan, was a cinematic adaptation of the classic film *Angeer*.

Conclusion

The foundation of my paper on literature and cinema will rely on Sanders' perspective on "adaptation" as a novel modality that has the capacity to reach diverse or supplementary audiences. However, numerous adaptations of novels and other generic forms often involve additional levels of transformation. These adaptations not only change the genre of the source texts, but also alter their cultural, geographic, and temporal contexts. In many cases, the process of "appropriation" leads to a complete departure from the original text, resulting in the creation of an entirely new cultural product and domain. This transformation is often achieved through the inclusion of additional content and critical analysis, as well as the transition from one genre to another.

My paper has significant potential to understand the dynamics of adaptation and appropriation that was done in Indian Cinema through the adaptations of Shakespeare's plays. Shakespeare's effect on Bollywood and other Indian tales has been significant from its inception, with Shakespeare's works deeply ingrained in the imagination of the Indian people. My paper examines four film adaptations to make this argument. Vishal Bhardwaj's films *Maqbool* (2004), *Omkaara* (2006), and *Haider* (2014), which are cinematic adaptations of Shakespearean plays, namely *Macbeth*, *Othello*, and *Hamlet*, respectively. Hemanta Kr Das' debut film, *Othello*, incorporates some elements from Shakespeare's play *Othello*. The Assamese cinematic

production entitled *Othello* diverges from the canonical text penned by Shakespeare, yet the discerning scriptwriter places significant emphasis on two fundamental aspects within this cinematic endeavour. Firstly, the exploration of racial discrimination within our societal fabric is deftly portrayed through the nuanced depiction of diverse skin tones. Secondly, the strategic utilisation of Shakespeare's literary oeuvre serves as a narrative device, effectively illuminating the intricate socio-political milieu that characterises the region of Assam.

This paper aims to illustrate the modifications, reconstruction, and reinterpretation of William Shakespeare's plays worldwide, as well as the incorporation of Shakespeare into Indian cinematic discussions from the beginning of Indian cinema. Shakespeare has been assimilated into the cultural and social fabric of India, turning him into a prominent figure in the country. Shakespeare's themes have transcended linguistic and cultural boundaries in contemporary times, attaining a worldwide status that extends beyond the Western world. This study aims to analyse the interpretation of Shakespeare in Indian popular culture.

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SUSTAINABLE CONSTRUCTION SOLUTIONS: EVALUATING THE USE OF RECYCLED PLASTIC IN PAVER BLOCK

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Abstract

Waste is often seen as something negative, unwanted, and harmful. It includes materials that are discarded after use, like plastic waste, which not only harms the environment but also affects our daily health and productivity. Plastic waste, or plastic pollution, takes a long time to decompose more than 400 years. This project aims to reduce the cost of paver block production by replacing cement with plastic waste, helping both to cut costs in construction and to promote a cleaner environment. In this process, waste plastics, mainly LDPE (Low-Density Polyethylene), were collected from waste pickers, sorted carefully, and mixed with stone dust to create paver blocks in specific moulds. The study found that using locally available materials like plastic waste can make construction more affordable. The study recommends large-scale collection and production of plastic waste materials, raising public awareness about the use of plastic waste in construction. This could also help in the fight against climate change by reducing plastic pollution.

Kew words: Plastic Waste Recycling, Paver Blocks, Environmental Impact, Cost Efficiency

Introduction

Waste is anything that is discarded after its main use or has lost its value. What may be waste to one person might be useful to another. For example, scrap metal sent to a landfill is wrongly considered waste because it can be recycled. The word "waste" often brings up feelings of negativity and harm. Generally, waste is seen as unwanted by-products of human activities within the environment. Globally, about 2.01 billion tons of municipal solid waste is produced every year, and this number is expected to rise to 3.40 billion tons by 2050. Poor waste management harms the planet by polluting oceans, blocking drains, and causing floods. It also affects our health, productivity, and the cleanliness of our surroundings.

Waste management is an issue that impacts everyone, from individuals managing their waste to governments handling waste disposal services. With the rise of urbanization and economic development, the World Bank predicts a sharp increase in global waste generation. Currently, around 33% of the world's waste is mismanaged, amounting to about 2.47 billion tons per year, and this is expected to grow to 4.28 billion tons by 2050. Human activities have always produced waste, but the amount of waste started to grow significantly during the Industrial Revolution when people moved to cities in large numbers. This population growth led to an increase in both the quantity and diversity of waste, including materials like plastic, metal, and glass. Plastics, in particular, have become a major part of waste streams.

Plastic waste, or plastic pollution, refers to the accumulation of plastic objects such as bottles and packaging materials in the environment. This waste harms wildlife, habitats, and human health. In many countries, especially developing ones, plastic waste often ends up in the oceans, endangering marine life. While plastic is cheap and durable, it takes more than 400 years to degrade, which makes it a huge environmental problem. Reducing plastic usage and promoting recycling are crucial steps in solving this issue.

In developing countries, poor waste management is often due to a lack of sanitation awareness. Waste management involves different concepts and methods, including the "**3 Rs**"—Reduce, Reuse, and Recycle which aim to minimize waste. Waste management also involves scientific and technological approaches to properly handle waste from collection to disposal, ensuring minimal harm to human health and the environment.

The problem of plastic waste is becoming overwhelming, and the planet is struggling to cope with the increasing amounts of plastic produced. In response, this project focuses on converting plastic waste into useful materials. The goal is to replace cement with plastic waste in the production of paver blocks, which will lower the cost of construction and promote environmental cleanliness. This project involved collecting LDPE (**low-density polyethylene**) plastics, melting and mixing them with coarse aggregates, and comparing the cost of constructing paver blocks using plastic waste versus cement.

The Theory of Waste to Wealth

Waste-to-Wealth refers to transforming waste from being seen as useless into something valuable and desirable. This concept involves taking waste that has served its purpose and finding ways to give it new value. In engineering, this transformation requires energy, while in economics, it involves production factors (Adetola et al., 2021). The key point is that waste is not considered wealth;

otherwise, people would not discard it. Wealth creation involves costs, and not all waste can be transformed into something valuable. However, the idea behind Waste-to-Wealth is that waste management should go beyond just disposing of waste and instead focus on turning it into something useful, such as energy (Egun, 2012).

When waste is collected with care and processed properly, it can become a resource that boosts local revenue, creates jobs, supports business growth, and strengthens the economy. According to the Clark County Solid Waste Management Plan (2015), sorting and processing recyclables create 10 times more jobs than simply dumping waste in landfills or burning it. The biggest economic benefit comes from turning old products into new ones. Recycling-based manufacturing provides more jobs and better wages than just sorting recyclables. Additionally, reusing, recycling, and composting can save a lot of resources and energy that would otherwise be used in producing, distributing, and selling new products.

The Concept of Sustainable Development

Development is described as a process where human abilities grow, enabling people to create new systems, solve problems, adapt to change, and work toward new goals (Peet, 1999, as cited in Du Pisani, 2006). Reyes (2001) explains development as a social condition in which a nation meets the needs of its population through the rational and sustainable use of natural resources.

Todaro and Smith (2006) further define development as a multi-dimensional process that involves significant changes in social structures, attitudes, and institutions, alongside economic growth, reducing inequality, and eliminating extreme poverty. Sustainable development, therefore, is crucial because it ensures that development today does not prevent future generations from enjoying similar opportunities. In simple terms, sustainable development is a type of growth that can continue over time without exhausting resources or limiting future prospects (Stoddart et al., 2011).

Literature Review

Waste can come from various sources, including domestic, industrial, chemical, biological, or toxic origins. Human activities, driven by rapid population growth and the exploitation of resources, significantly impact the environment by increasing waste production (Seik, 1997). The environment poses complex challenges, and humans must solve these problems to ensure their survival. One such challenge is environmental waste, which poses a threat to human health

and well-being (Hilson, 2002). Efforts are being made globally to address this waste issue and ensure environmental sustainability (Courchamp et al., 2017).

Waste is generally seen as undesirable and worthless material. In many developing countries, including India, poor waste management is often due to a lack of sanitation education (Asunogie, Momoh & Osagioduwa, 2022). Waste management covers various approaches and methods, involving scientific, artistic, and technological strategies to control, dispose of, and convert waste into useful materials that benefit both humans and the environment. The core principle of waste management is built on the "3 Rs": reduce, reuse, and recycle, which prioritize minimizing waste (Bassey & Akpan, 2020).

Sanitation and waste management are closely connected. Effective waste management seeks to extract the most value from products while producing the least amount of waste (Bassey & Akpan, 2020). Proper management involves organizing waste-related actions at the right time and with the right tools to achieve effective results. It encompasses the entire process from waste generation to its final disposal, including collection, transportation, treatment, and monitoring (Ivanova et al., 2016). The ultimate goal is to lessen the negative impacts of waste on health, the environment, and overall aesthetics.

Low-density polyethylene (LDPE) bonded sand offers a resource-efficient solution by transforming wasted LDPE, such as water sachets, into a valuable local resource. Water sachets made from LDPE are particularly problematic due to limited recycling options, which pose public health and environmental risks. However, by using LDPE in combination with sand, a durable, lightweight material can be produced. This technology does not require water in the production process, making it more environmentally friendly. In Cameroon, for instance, a simple method has been developed to produce LDPE-bonded sand blocks and pavers, which serves as an example of a community-driven waste management solution. By converting plastic waste into a usable product, this initiative holds the potential to address the global plastics waste crisis.

In developing countries, solid waste management is often inadequate, marked by low collection rates and the disposal of waste primarily through dumping (Wilson et al., 2015). Nevertheless, waste materials in such contexts provide livelihoods to the informal sector, which thrives on entrepreneurial opportunities (Wilson et al., 2006). Plastic waste management, in particular, has become an urgent environmental and public health concern. Recycling infrastructure for plastic waste is often lacking, leading to uncontrolled disposal, especially in waterways. This causes severe problems, such as blocked drainage systems, urban flooding, and the spread of waterborne diseases like malaria due to stagnant water becoming a breeding ground for mosquitoes.

In India, for example, 56,000 tons of plastic waste were generated as of 2017, much of which polluted

the environment, affecting both humans and animals. To mitigate the detrimental effects of plastic pollution, proper disposal and recycling in line with government regulations are crucial. Using plastic waste as a replacement for cement in construction materials not only offers an environmentally friendly solution but also presents significant economic benefits by reducing reliance on traditional materials and providing a sustainable alternative.

Plastic, despite being one of the most remarkable human inventions, poses serious environmental challenges due to its non-biodegradable nature (Bawar et al., 2023). Plastic pollution is now considered one of the most significant threats to modern society, contributing to environmental degradation and causing economic harm (Saikia and De Brito, 2012). The accumulation of plastic debris in the environment threatens marine life and disrupts efforts toward sustainability.

Research into plastic paver blocks (PB) made from low-density polyethylene (LDPE) and other recycled materials has demonstrated their potential as an eco-friendly alternative to traditional construction materials. Studies have shown that the compressive strength of LDPE-sand paverblocks can be improved by using finer sand particles. Specifically, sand with a diameter smaller than 0.42 mm significantly enhances compressive strength compared to coarser sand (Bawar et al., 2023).

Additionally, research by Nivetha et al. (2016) examined the reuse of quarry dust, fly ash, and polyethylene terephthalate (PET) in plastic paver blocks. Their study revealed that PET could be reused effectively by combining it with 50% quarry dust and 25% fly ash, producing a paverblock with acceptable strength levels. Six cubes were cast to measure compressive strength, and the results supported the feasibility of using solid waste materials for construction purposes.

In a related study, Joel and Ravikant (2015) explored the use of fly ash and waste glass powder as partial replacements for cement in rural road paver blocks. Their findings indicated that these materials could substitute cement without significantly compromising the strength of the blocks, offering an effective solution for sustainable construction in rural areas.

These studies highlight the growing potential of plastic paver blocks as a viable construction material that contributes to waste management while reducing environmental impacts.

Plastic pollution has evolved from a minor environmental issue into a major global concern, drawing increasing attention from researchers, media, and policymakers. In 2019, the United Nations labelled it a "planetary crisis" due to the widespread and lasting impact of plastics on the environment (MacLeod et al., 2021; Villarrubia-Gomez et al., 2018). The world generates around 2.01 billion tons

of municipal solid waste annually, and this number is projected to reach 3.40 billion tons by 2050, with plastic waste being a major component (Kristina, 2023).

Canada stands out as the world's largest per capita producer of waste, generating an estimated metric tons of waste per person annually, most of which comes from industrial sources (Tiseo, 2023). Poor waste management systems not only pollute land and marine ecosystems but also disrupt daily life by clogging drains and contributing to health hazards.

The interconnectivity of aquatic ecosystems with terrestrial environments means that plastic waste in water systems can have cascading effects. Aquatic ecosystems are severely impacted by plastic litter, which, due to its durability and ease of transport by currents and wind, persists for long periods in the ocean (Eriksen et al., 2014). Plastic waste, which can reach counts of five trillion pieces weighing over 260,000 tons globally, threatens marine life at every level, from apex predators to plankton (Rahman et al., 2023). Marine animals ingest plastics, which cause physical harm such as blockages in digestive systems and internal damage, leading to reduced growth and even death (Naidoo & Glassom, 2019; Haetrakul et al., 2009).

Moreover, plastics can leach harmful chemicals into the marine environment (Rochman, 2015). Microplastics, which can penetrate body cells and even reach the brains of marine animals, pose severe health risks (Mattsson et al., 2017; Prüst et al., 2020). The issue of plastic pollution cannot be viewed in isolation, as it compounds other threats to marine ecosystems, such as ocean warming, acidification, habitat destruction, and noise pollution (Rahman et al., 2023). Coral reefs and mangroves, vital ecosystems that provide essential services to both marine life and humans, are particularly vulnerable to plastic pollution in combination with these other stressors (Gall & Thompson, 2015).

As plastic pollution continues to rise, addressing the crisis will require concerted global efforts in waste management, environmental protection, and sustainable resource use.

This study outlines a process for creating paver blocks using recycled Low-Density Polyethylene (LDPE) and quarry dust. Here's a summary of the process and findings based on your description:

Materials and Properties

1. LDPE (Low-Density Polyethylene):

- **Plastic Bag Thickness:** About 50 microns.
- **Properties:**

- **Melting Point:** 150°C
- **Thermal Coefficient of Expansion:** $100-200 \times 10^{-6}$
- **Density:** 0.910 - 0.940 g/cm³
- **Tensile Stress:** 0.20 - 0.40 N/mm²

2. Quarry Dust:

○ Properties:

- **Specific Gravity:** 2.62
- **Grading Zone:** Variable depending on soil
- **Fineness Modulus:** 2.952
- **Water Absorption:** 1.80%

Process Overview

1. Collection and Sorting:

- Waste plastics were collected by scavengers without a fixed perimeter area, sorted carefully to ensure only LDPE was used.

2. Melting Process:

- **Drum Specifications:** 80 cm wide and 50 cm deep.
- **Temperature Control:** Kept below 85°C to prevent burning.
- **Procedure:**
 - Plastics were melted for about 20 minutes until they became liquid.
 - A measured amount of quarry dust was gradually added to the melted plastic while stirring continuously until the mixture resembled cement.

3. Molding and Curing:

- **Mold Preparation:** Molds and tables were oiled to prevent sticking.
- **Molding Process:**
 - The mixture was poured into block molds and leveled to ensure uniform block sizes and weights.
 - Blocks were set in the mold for two minutes before removal.
- **Curing:** Blocks were allowed to cure for 12-24 hours before use.

This process offers a practical solution for utilizing waste LDPE and quarry dust, transforming them into durable paver blocks suitable for construction purposes. It addresses the challenge of plastic waste

by recycling it into a valuable material, thereby contributing to waste management and environmental sustainability.

Findings

The study aimed to replace cement with plastic waste in paver blocks to reduce production costs and promote environmental cleanliness. Here are the key findings:

1. Plastic Waste Composition:

❖ Types of Plastics Collected:

- 56.3% were used/empty bottles
- 23.1% were plastic plates and rubbers.
- 13.9% were nylon waste.
- 6.7% fell into other categories.

2. Usefulness of Plastic Waste:

- ❖ 72.1% of the collected waste was very useful.
- ❖ 19.4% was partially useful.
- ❖ 8.5% was not useful due to melting temperature requirements.

3. Environmental Impact:

- ❖ Recycling 1 ton of plastic cleans approximately 300 m² of land by 45%.
- ❖ Thus, 87.5 tons of plastic could clean around 26,250 m².
- ❖ A 7% reduction in plastic waste in water bodies improves the survival and health of aquatic animals.

Conclusion

1. Cost Efficiency:

- ❖ Using plastic waste in construction can be economically viable and supports sustainable development goals by reducing reliance on traditional building materials and addressing climate change.

2. Environmental Benefits:

- ❖ Recycling plastic waste for construction can significantly benefit both the environment and human health by reducing plastic pollution and conserving cement.

Recommendations

1. Mass Collection and Production:

- ❖ Establish a system for large-scale collection and production of plastic waste paver blocks. Government incentives, such as low-interest loans and grants, should be offered to encourage investment in this sector.

2. Public Awareness Programs:

- ❖ Increase public awareness about the benefits of using plastic waste for construction. Promote the environmental and economic advantages of paver blocks made from recycled plastics.

3. Incentives for Paver Blocks Use:

- ❖ Provide tax rebates and exemptions for businesses producing or using plastic waste paver blocks. This will help maintain the business and reduce plastic waste in the environment.

4. Sorting Incentives:

- ❖ Implement financial incentives for sorting plastic waste at collection points. Encourage households and small-scale collectors to properly separate plastics from other waste materials.

This approach will not only help manage plastic waste effectively but also support the development of sustainable construction materials.

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प्रकरण

ग्रामीण एवं शहरी क्षेत्र के विद्यार्थियों की सामाजिक बुद्धि का तुलनात्मक अध्ययन।

डॉ समीना कुरैशी

असिस्टेंट प्रोफेसर

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संक्षेपीकरण (Abstract) :- सामाजिक बुद्धि को प्रभावित करने वाले कारकों में व्यक्तिगत कारक वातावरण संबंधी कारक और मनोवैज्ञानिक कारक सम्मिलित हैं। परिवार बच्चे को मानव का सर्वप्रथम सम्पर्क प्रदान करता है। उसके व्यक्तित्व प्रतिमान को स्वरूप देने में परिवार प्रमुख भूमिका निभाता है। अच्छे परिवार सुसमायोजित व्यक्ति उत्पन्न करते हैं। बच्चे के व्यक्तित्व में स्कूल, समाज, परिवार, आस-पड़ोस का प्रत्यक्ष एवं अप्रत्यक्ष प्रभाव पड़ता है। संक्षेप में सामाजिक रूप से बुद्धिशाली दूसरों को सहयोग देकर, दूसरों को अपना मित्र बनाकर अच्छी परिष्कृत रुचियों और शिष्टाचार का प्रदर्शन करके तथा अपने संवेगों पर नियंत्रण करके सामाजिक बुद्धि का परिचय देता है। सामाजिक बुद्धि से तात्पर्य व्यक्ति का दूसरे व्यक्ति तथा समाज के साथ व्यवहार तथा सामाजिक संबंधों के निर्वाहन से है।

महत्वपूर्ण शब्द (Key Words) :- ग्रामीण एवं शहरी क्षेत्र, विद्यार्थी, सामाजिक बुद्धि।

1. **परिचय (Introduction) :-** सामाजिक बुद्धि, बुद्धि का एक प्रकार है जो किसी व्यक्ति में अन्य व्यक्तियों एवं सामाजिक संबंधों के प्रति व्यवहार में निहित होता है। सामाजिक परिपक्वता के अंतर्गत सहयोग एक आवश्यक कारक है। सामाजिक परिपक्व व्यक्ति सदा सहयोग प्रवृत्ति का होगा। दूसरों के साथ मिलजुल कर कार्य करने की इच्छा उसमें सदा रहती है और वह इस कार्य में प्रसन्नता का अनुभव करता है। बच्चे का सामाजिक विकास का एक आवश्यक तत्व है, अतः जो व्यक्तित्व या बालक जितना अधिक बुद्धिमान होगा उतना ही अधिक कवह सामाजिक रूप से विकसित होगा। सामाजिक विकास में विभिन्न धार्मिक संस्थाएँ विशेष योगदान करती हैं। सामाजिक विकास में मनोरंजन तथा सूचना प्रदान करने वाले साधनों का भी महत्व होता है। सांवेगिक असंतुलन और चिंता आदि भी मानसिक विकास को प्रभावित करते हैं।

2. **संबंधित साहित्य की समीक्षा (Review Related Literature) :-**

- प्रहलाद (1982), भारद्वाज (1986), शर्मा (1986) ने, विभिन्न प्रकार के कॉलेजों के छात्रों की सामाजिक बुद्धि का अध्ययन किया। कला व विज्ञान व वाणिज्य, कला व वाणिज्य के छात्रों की सामाजिक बुद्धि में अंतर पाया गया।
- गिर व शर्मा (2006) ने 9-12 वर्ष के ग्रामीण क्षेत्र के छात्र एवं छात्राओं की सामाजिक परिपक्वता की तुलना की। उन्होंने पाया, कि इस वर्ष के सभी विद्यार्थियों में सामान्य स्तर की सामाजिक परिपक्वता पाई गई। इस कार्य हेतु चुने गए छात्रों में छात्राओं की अपेक्षा उच्च सामाजिक परिपक्वता पाई गई।

- किरिंग (1978) ने अपने अध्ययन में यह पाया कि सामाजिक बुद्धि एवं संवेदना के मध्य संबंध या उच्च स्तर के शैक्षिक मूल्यों एवं सामाजिक योग्यता के मध्य अधिक समानता पायी गई।

3. उद्देश्य एवं परिकल्पना (Objective And Hypothesis) :-

अध्ययन का उद्देश्य (Objective of the Study) :-

- ग्रामीण एवं शहरी क्षेत्र के वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि का मापन करना।
- शहरी क्षेत्र के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि का मापन करना।
- ग्रामीण एवं शहरी क्षेत्र के विज्ञान संकाय एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि का मापन करना।

अध्ययन की परिकल्पना (Hypothesis of the Study) :-

H₁ – ग्रामीण एवं शहरी क्षेत्र के वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

H₂ – शहरी क्षेत्र के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

H₃ – ग्रामीण एवं शहरी क्षेत्र के विज्ञान संकाय एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

4. प्रणाली एवं प्रक्रिया (Methodology And Procedure) :-

विधि (Method) :- प्रस्तुत शोध अध्ययन में ग्रामीण एवं शहरी क्षेत्रों के विद्यार्थियों का चयन उद्देशीय न्यादर्श विधि द्वारा किया गया है।

जनसंख्या (Population) :- प्रस्तुत शोध अध्ययन के लिए शोधकर्ता ने दुर्ग-भिलाई शहर के ग्रामीण एवं शहरी क्षेत्र के विद्यार्थियों का चयन किया है।

न्यादर्श (Sampling) :- प्रस्तुत लघु शोध में उद्देशीय न्यादर्श विधि द्वारा 80 ग्रामीण एवं 80 शहरी क्षेत्र के विद्यार्थियों का चयन किया गया है।

विस्तार एवं सीमांकन (Scope And Delimitation) :- इसमें दुर्ग-भिलाई शहर के ग्रामीण एवं शहरी क्षेत्रों के विद्यार्थियों को सम्मिलित किया गया है। यह अध्ययन में सामाजिक बुद्धि के मापन हेतु सामाजिक बुद्धि मापनी का प्रयोग किया गया है।

उपकरण (Tools) :- इस शोध अध्ययन में विद्यार्थियों की सामाजिक बुद्धि को जानने हेतु डॉ. एन.के. चड्ढा द्वारा निर्मित सामाजिक बुद्धि मापनी का प्रयोग किया गया है।

सांख्यिकीय प्रविधि (Statistical Techniques) :- इस शोध अध्ययन में मध्यमान, प्रमाणिक विचलन एवं 'टी' मूल्य का प्रयोग किया गया है।

5. विश्लेषण एवं चर्चा (Analysis and Discussion) :-

प्रमाणित कल्पनाएँ (Verification of Hypothesis) :-

H_1 – ग्रामीण एवं शहरी क्षेत्र के वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

उपरोक्त परिकल्पना के परीक्षण हेतु ग्रामीण क्षेत्र के 40 तथा शहरी क्षेत्र के 40 विद्यार्थियों को न्यादर्श के रूप में चयनित किया गया एवं सामाजिक बुद्धि मापनी की सहायता से प्राप्त मूल प्राप्तांकों का मध्यमान, प्रमाणिक विचलन तथा 'टी' मूल्य की गणना की गयी है। जिसका विवरण अग्रलिखित तालिका में दिया गया है।

क्र.	तुलनात्मक समूह	प्रदत्तों की संख्या	मध्यमान	प्रमाणिक विचलन	'टी'—मूल्य
1	ग्रामीण क्षेत्र के वाणिज्य संकाय के विद्यार्थी	40	103.88	14.22	0.94
2	शहरी क्षेत्र के वाणिज्य संकाय के विद्यार्थी	40	107.02	15.74	
Df = 78, P > 0.05 सार्थक अंतर नहीं है।					

उपरोक्त सारणी से यह स्पष्ट है कि वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि के अंतर्गत ग्रामीण एवं शहरी क्षेत्र के विद्यार्थियों की सामाजिक बुद्धि का मध्यमान 103.88 व 107.02 है तथा प्रमाणिक विचलन 14.22 व 15.74 प्राप्त हुआ तथा दोनों के मध्य 'टी' मूल्य का मान 0.94 प्राप्त हुआ। जो कि स्वतंत्रता की कोटि 78 पर सार्थकता पर 0.05 पर सार्थक अंतर नहीं है, जो यह प्रदर्शित करता है कि हमारी परिकल्पना स्वीकृत है।

H_2 – शहरी क्षेत्र के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

उपरोक्त परिकल्पना के परीक्षण हेतु शहरी क्षेत्र के विज्ञान संकाय के 40 तथा वाणिज्य संकाय के 40 विद्यार्थियों को न्यादर्श के रूप में चयनित किया गया एवं सामाजिक बुद्धि मापनी की सहायता से प्राप्त मूल प्राप्तांकों का मध्यमान, प्रमाणिक विचलन तथा 'टी' मूल्य की गणना की गयी है। जिसका विवरण अग्रलिखित तालिका में दिया गया है –

क्र.	तुलनात्मक समूह	प्रदत्तों की संख्या	मध्यमान	प्रमाणिक विचलन	'टी'—मूल्य
1	शहरी क्षेत्र के विज्ञान संकाय के विद्यार्थी	40	106.90	14.30	0.04
2	शहरी क्षेत्र के वाणिज्य संकाय के विद्यार्थी	40	107.02	15.74	
Df = 78, P > 0.05 सार्थक अंतर नहीं है।					

उपरोक्त सारणी से यह स्पष्ट है कि विद्यार्थियों की सामाजिक बुद्धि के अंतर्गत शहरी क्षेत्र के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि का मध्यमान 106.90 व 107.02 एवं प्रमाणिक विचलन 14.40 व 15.74 प्राप्त हुआ तथा दोनों के मध्य 'टी' मूल्य का मान 0.94 प्राप्त हुआ। जो कि स्वतंत्रता की कोटि 78 सार्थकता स्तर पर 0.05 स्तर पर सार्थक अंतर नहीं है, जो यह प्रदर्शित करता है कि हमारी परिकल्पना स्वीकृत की जाती है।

इससे यह निष्कर्ष निकलता है कि शहरी क्षेत्रों के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

H_3 – ग्रामीण एवं शहरी क्षेत्रों के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अंतर नहीं पाया जाएगा।

उपरोक्त परिकल्पना के परीक्षण हेतु ग्रामीण एवं शहरी क्षेत्रों के विज्ञान संकाय के 80 एवं वाणिज्य संकाय के 80 विद्यार्थियों को न्यादर्श के रूप में चयनित किया गया एवं सामाजिक बुद्धि मापनी की सहायता से प्राप्त मूल प्राप्तांकों का मध्यमान, प्रमाणिक विचलन तथा 'टी' मूल्य की गणना की गयी है। जिसका विवरण अग्रलिखित तालिका में दिया गया है –

क्र.	तुलनात्मक समूह	प्रदत्तों की संख्या	मध्यमान	प्रमाणिक विचलन	'टी'—मूल्य
1	ग्रामीण क्षेत्र के विज्ञान संकाय के विद्यार्थी	80	85.47	15.12	0.54
2	शहरी क्षेत्र के वाणिज्य संकाय के	80	84.80	15.07	

	विद्यार्थी				
df = 158, P > 0.05 सार्थक अंतर नहीं है।					

उपरोक्त सारणी से यह स्पष्ट है कि विद्यार्थियों की सामाजिक बुद्धि के अंतर्गत ग्रामीण एवं शहरी क्षेत्रों के विज्ञान संकाय एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि का मध्यमान 85.47 व 84.30 है तथा प्रमाणिक विचलन 15.12 व 15.07 प्राप्त हुआ तथा दोनों के मध्य 'टी' मूल्य का मान 0.54 प्राप्त हुआ। जो कि स्वतंत्रता की कोटि 158 सार्थकता स्तर पर 0.05 स्तर पर सार्थक अंतर नहीं है, जो यह प्रदर्शित करता है कि हमारी परिकल्पना स्वीकृत है।

इससे यह निष्कर्ष निकलता है कि ग्रामीण एवं शहरी क्षेत्रों के विज्ञान एवं वाणिज्य संकाय के विद्यार्थियों की सामाजिक बुद्धि में सार्थक अन्तर नहीं पाया जाएगा।

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PERFORMANCE EVALUATION OF MACHINE LEARNING ALGORITHMS FOR HEART ATTACK PREDICTION

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Abstract: Machine learning is a branch of artificial intelligence that generates predictions without requiring explicit programming instructions. Machine learning techniques such as Artificial Neural Network (ANN), Decision tree, K-Nearest Neighbors (KNN), Naïve Bayes, Support Vector Machine (SVM), Random Forest, Logistic Regression, Multi-layer perceptron etc, are used to predict the heart disease. This study offers an analysis of the existing algorithm, provides a comprehensive overview of the previous research and evaluate the performance of the machine learning modals. In the study, patients with a low and high probability of having a heart attack were examined. The results indicate that methods Logistic Regression algorithms outperform traditional classifiers in terms of prediction accuracy and generalization.

Keywords: Machine learning (ML), Logistic Regression, Confusion matrix, K-nearest neighbors, Data mining.

1. Introduction

Artificial intelligence in the form of machine learning makes it possible for programs to predict outcomes more accurately. The goal of machine learning is to create apps or models that can identify a model's accuracy by using data. The quality of information that the system receives from the outside world is a key factor in machine learning. Learning is an additional process that converts external data into knowledge, which is then stored in a repository. Several categorization methods are employed to balance the data and forecast future results. Machine learning (ML) focuses on the study of algorithms and statistical models that enable computers to perform tasks without explicit instructions. Instead, these systems learn from data and progressively improve their capabilities. To process data and generate predictions or judgments, machine learning (ML) uses a variety of algorithms. Machine learning algorithm like linear regression, support vector machine (SVM), logistic regression, random forest, decision tree, naïve bayes, k-nearest neighbors and so many algorithms use to classify the data. The use of machine learning is to work on different models that learn from a training set and define

the accuracy

Heart disease, primarily heart attacks, is one of the leading causes of death globally, causing millions of deaths each year. Lowering death rates and improving the results for patients depend on early detection and prevention of heart attacks. Traditional risk assessment methods, which generally depend on statistical methods, find it difficult to handle the nonlinearities and complexity seen in clinical data. But new developments in machine learning (ML) offer strong answers to these problems by using large datasets to identify patterns that more conventional approaches could overlook.

2. Literature Review

S. Seema et al,[1] focuses on data mining techniques that can predict chronic disease. They used Decision tree, Naïve Bayes, Support Vector Machine(SVM) and Artificial Neural Network(ANN). From this experiment, SVM gives highest accuracy, whereas for diabetes Naïve Bayes gives the highest accuracy.

Ashok Kumar Dwivedi et al, [2] used different algorithms like Naive Bayes, Classification Tree, KNN, Logistic Regression, SVM and ANN. The Logistic Regression gives better accuracy compared to other algorithms Sairabi H.Mujawar et al, [3] used k-means and naïve bayes to predict heart disease. This paper contain 13 independent variables for building the system. To extract knowledge from database, data mining techniques such as classification, clustering, classification methods can be used. 13 attributes with total of 300 records were used from the Cleveland Heart Database. This model is to predict whether the patient have heart disease or not based on the values of 13 attributes.

MeghaShahi et al, [4] suggested Heart Disease Prediction System using Data Mining Techniques. They used WEKA software for automatic diagnosis of disease and to give qualities of services in healthcare centres. The paper used various algorithms like SVM, Naïve Bayes, Association rule, KNN, ANN, and Decision Tree. The paper recommended SVM is effective and provides more accuracy as compared with other data mining algorithms.

Boshra Brahmi et al, [5] developed different classification techniques like J48, Decision Tree, KNN, SMO and Naïve Bayes to evaluate the prediction and diagnosis of heart disease. After this, evaluating some performance in measures of accuracy, precision, sensitivity, specificity are evaluated and compared. J48 and decision tree gives the best technique for heart disease prediction.

Kumar Dwivedi [6] used SVM and KNN for heart disease prediction and found that SVM obtained 82% accuracy. Similar for that R. Sharmila et al, [7] used SVM and gave 85% accuracy and M. Kumari et al.

[7] used SVM with 84.12% accuracy.

Moloud Abdar, et al (2015)[9] applied and compared five data mining techniques to predict the rise of

heart disease such as C5.0, Naive Bayes, Support vector Machine, Logistic Regression and Multilayer Perceptron with accuracy measures as: 93.02, 86.05, 88.37, 80.23 and 85.22 using 13 attribute independent medical variables.

G.Purusothaman and P.Kirshnakumari (2015)[10] had cited various data mining prediction models namely Decision Table, Association Rule, KNN, Artificial Multilayer Perceptron, Naïve Bayes and Hybrid models with accuracies as 76%, 55%, 58%, 85%, 69%, 86% and 96%. Hybrid data mining has outperformed other data mining heart disease diagnosing techniques.

K.Aravintan and Dr. M. Vanitha (2016)[11] did a comparative study on prediction of heart disease using and they were used Naive Bayes Algorithm, J48 Algorithm, Multilayer Perceptron Algorithm on 305 instances with 14 medical attributes. The accuracy measures of Naive Bayes, J48 and Artificial Multilayer Perceptron are as 81.3021%, 80.099%, and 82.56.

N Paras et al [12] used SVM and K-NN for the prediction of heart attack and demonstrated that K-Nearest Neighbors is much suitable and efficient for predicting the likelihood of heart attack prediction.

3. Methodology

Machine learning algorithms are used to predict the categorical outcomes. They can recognize patterns in labeled data and forecast fresh, unseen data. These models are frequently applied in many different domains, including disease prediction, spam detection, real/fake prediction and many more. Logistic regression, decision trees, random forests, support vector machines, and naive Bayes are examples of common classification techniques. The selection of algorithm depends on factors like the nature of the data, the complexity of the problem, and the desired performance metrics.

I. Dataset Source

This paper will use a CSV file dataset from the online repository Kaggle. The shape of the dataset is (300, 14) that contain attribute such as age, gender, chest pain etc.

II. DATASET AND MODEL DESCRIPTION

Data Gathering and Preparation

1. Data Gathering: Gather or collect the heart attack dataset from the specified repository.
2. Data Exploration: To comprehend the variables, missing values, and structure of the dataset, perform a preliminary analysis.
3. Feature Engineering: To enhance model performance, add new features or modify current ones as needed (e.g., interaction terms, normalization).
4. Data Splitting: To construct a model, split the dataset into training and testing sets.

Model Selection and Training

1. Algorithm Selection: Based on the parameters of the dataset and the nature of the problem, select appropriate classification algorithms. Algorithms such as support vector machines, decision trees, random forests, and logistic regression, k-nearest neighbors.
2. Model Training: Train the selected model to learn patterns and relationships within the data.

Model Evaluation

1. Performance Metrics: Evaluate model performance using confusion metrics such as accuracy, precision, recall, F1-score analysis.
2. Comparison: Compare the performance of different models to identify the best-performing one.

Results and Discussion

1. Interpretation: Discuss the ramifications of the findings after analyzing the data.
2. Limitations: Recognize the study's shortcomings, including those related to generalizability, model assumptions, and data quality.
3. Future Directions: Provide possible directions for further investigation, such as examining new features, enhancing model functionality, or resolving drawbacks.

4. Confusion Matrix & Measures Derived

Confusion matrix is a binary classification predicts test data sets as positive and negative, and they produce four outcomes : True positive, true negative, false positive, false negative(Fig 1).

		Predicted	
		No	Yes
Actual	No	True Negative	False Positive
	Yes	False Negative	True Positive

Fig 1: Confusion matrix [13]

Accuracy: The ratio of all accurate predictions to the entire number of true/false, positive/negative predictions is known as accuracy. One represents the best accuracy, and zero represents the lowest.

$$\text{Accuracy} = \frac{(\text{True Positive} + \text{True Negative})}{\text{Total Predictions}}$$

(True Positive + True Negative+ False Negative+ False Positive)

Sensitivity/ Recall/ True positive rate: Sensitivity is the ratio of true positive predictions and the total no. of Actual positives. The best Sensitivity is 1 and the worst is 0.

$$\text{Sensitivity} = \frac{\text{True Positive}}{(\text{True Positive} + \text{False Negative})}$$

Precision: Precision is the ratio of true positive predictions and the total no.Of predictive positives. It is also called positive predictive value. The best precision value is 1 and the worst is 0.

$$\text{Precision} = \frac{\text{True positive}}{(\text{True positive} + \text{False positive})}$$

5. Conclusion

This paper examined different machine learning algorithms for the prediction of heart attacks. The objectives of our paper were to analyze the Heart Attack dataset by evaluating Machine Learning predictions algorithms. For this research paper, we used Decision Tree, Random Forest, Logistic Regression, K- Nearest Neighbors, Adaboost Classifier and we concluded that Logistic Regression has the highest accuracy rate for the prediction of heart attacks, with an Accuracy of 88 %. (Below result Table. 1 and Fig 2).

Algorithms	Accuracy	Precision	Recall	F1
Decision Tree	0.81	0.87	0.80	0.84
Random Forest	0.81	0.90	0.77	0.83
Logistic Regression	0.88	0.93	0.86	0.89
K- Nearest Neighbors	0.83	0.90	0.80	0.85
AdaBoost Classifier	0.83	0.88	0.83	0.85

Table 1: Accuracy/Precision/Recall /F1 rate of different algorithms

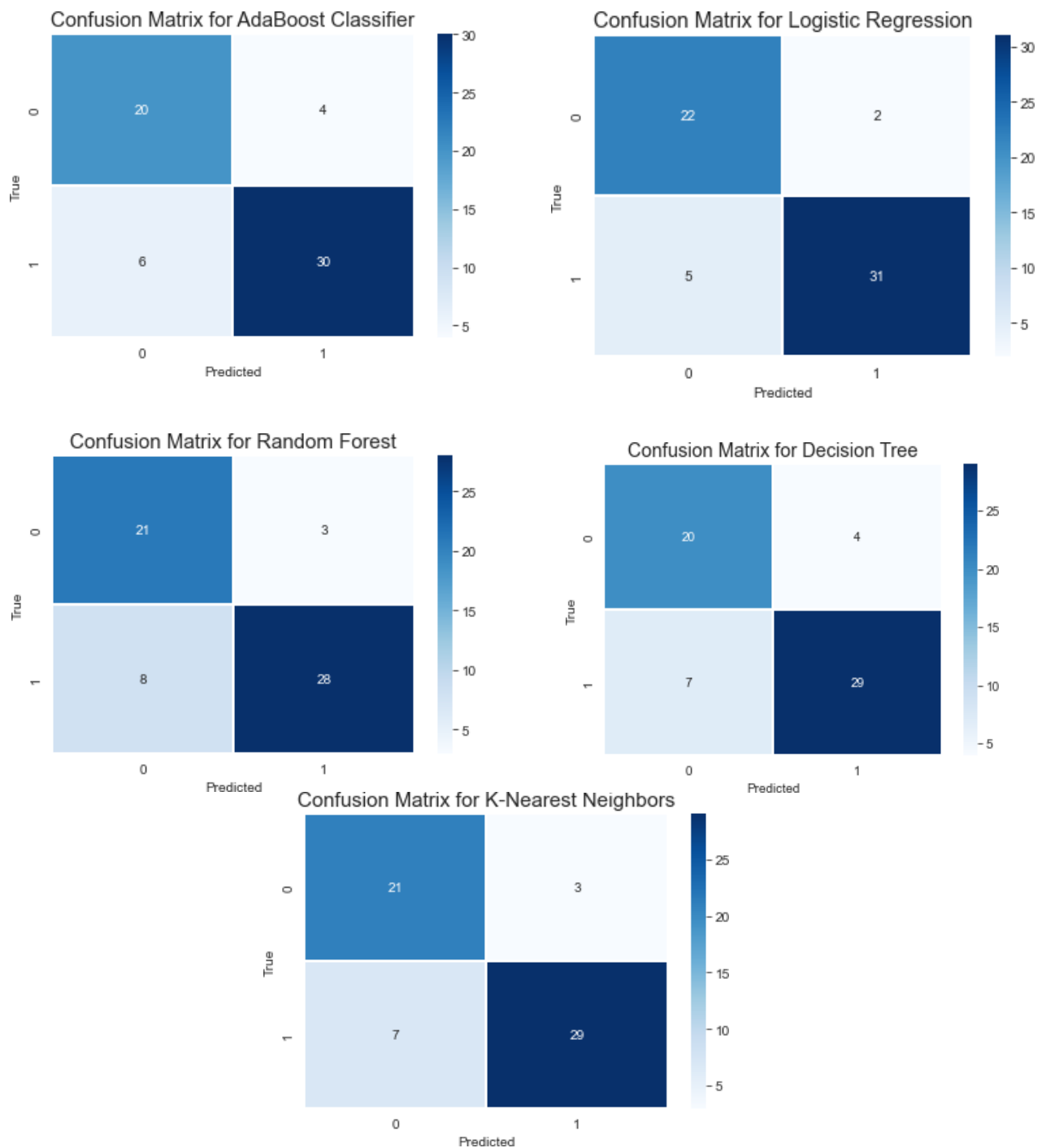


Fig 2: Confusion matrix of different Machine Learning Modals

6. Future Scope

- ❖ Future research focus should be enhancing these models' accuracy, transparency, and incorporation into clinical workflows should be the main goals of future research.
- ❖ Combining modals with other ML can create more robust and accurate predictive models.

- ❖ The accuracy of models can be improved by utilizing more data preprocessing techniques.
- ❖ Using More accurate training set can improve model performance.

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THE IMPACT OF THE PTOLEMAIC RULE IN EGYPT AND HOW CLEOPATRA LOST HER THRONE TO ROME

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ABSTRACT

Since the discovery of King Tutankhamun's tomb in 1923, Egyptian culture has been celebrated as one of the richest cultures. It has impacted other world cultures, marking its place in Rome and Greece. The role of Ptolemies is crucial in building up the ties between neighboring countries, the trust of the people, and the monarch. The research paper has both philosophical and literature goals. The philosophical goal is to understand the belief of the non-Egyptian pharaohs to rule the nation. The literature goal is to know how the Ptolemies' monarchy was better than the previous rulers of Egypt and how well they were able to cooperate with other nations in maintaining military garrisons and investments, including Cleopatra's diplomacy in creating a pact with Rome by luring the generals of the Rome. This research paper delves into the reign of the Graeco-Macedonian pharaohs in Egypt for years together. The Ptolemies were Macedonian pharaohs ruling over Egypt, including Alexandria. As good as they were as kings and queens, they also made many contributions to Egypt, including the construction of the famous Library of Alexandria. The Ptolemies were also responsible for introducing the Greek language and Hellenistic culture to Egypt. Their relationship with its neighbors was also meaningful, as they maintained peace between Egypt and its neighbors. They also established a strong military to protect Egypt from foreign invaders. What matters is how Rome and the Greeks could interfere in the monarchy of Egypt right from the Old Kingdom. This was possible due to Egypt's weak military and reliance on Rome and Greece for military support. This allowed Rome and Greece to gain control over Egypt's resources and eventually annex it.

KEYWORDS: Ancient History, Ptolemaic Egyptian History, classical archaeology, Ancient Egyptian Military History, classical civilization, Greek History, Hellenistic Dy- nasty.

1. INTRODUCTION

The Book of the Dead, written and translated on papyrus, shows how fascinating the burial practices were and how magnificently the Egyptians preserved their dead. They believed in life after death and that all the objects kept in the coffins would be helpful to them. Pharaoh was the title used for both male and female rulers. To show that they belonged to the royal family, they wore masks and artificial beards to represent royalty. The pyramids were built to represent power. They were a resting place for the kings, queens, and loyal officials. The funerary and burial practices during the Hellenistic dynasty were Greek and Egyptian-based. The funerary act was performed in Alexandria, Thebes, and Abydos. The Ptolemaic era focused primarily on Macedonian-Greek and Egyptian religion and mortuary practices. From Ptolemy I of Lagos to Cleopatra VII Thea Philopator, the title of pharaoh was widely used amongst these foreign rulers to represent power and authority over Egypt. The Ptolemies are said to have flourished the Egyptians by adding new systems based on Greek ideology. However, the Romans found their good luck around the corner once the Ptolemies' arrived in Egypt, which meant a clear path for them to bring their demands to Egypt. Alexander: The Great had a significant influence and control over its conquered regions; however, it was not the same with the Ptolemy I of Lagos. The Ptolemies' reign occurred after Alexander The Great's death in 30 B.C. Being one of the loyal generals in Alexander's army, he was well aware of the regions that could be easily conquered. He was Macedonian by nationality but was well-adapted to Egyptian rituals and beliefs. Egyptian locals at first believed that he loved and respected the Egyptian culture and power. He began to take control by worshipping the gods and making sacrifices to the gods, especially Amon, those who built various temples at Thebes and Karnak. His acts later resulted in gaining the local's trust and investing in harvest methods to popularise wheat and barley, which was the staple diet of the Egyptians. Democracy and Justice systems also flourished during his reign. Scribed and painted by many scholars and noble people of the Ptolemaic period, the Hellenistic period was one of the most flourishing periods of the Egyptian pharaohs. Remember, it's flourished, not successful! The monarchy and power were maintained until Ptolemy VIII's reign. The Ptolemies' efforts were crushed when Cleopatra failed to acquire her land back from the Romans. Cleopatra VII, the last ruler of Egypt, is said to have attempted suicide because Rome humiliated her after her defeat in the war with Octavius. Julius Caesar considered one of Cleopatra's lovers, is said to have betrayed her for the sake of power. Even after the successful conquest of Egypt, Julius Caesar was killed by his loyal followers. The thirst for power led to trust issues between the kings. However, it is equally important to know how the kingdoms were formed. The previous rulers were nothing less than successful. Khufu was the first Pharaoh to

build an actual step pyramid, which seemed more inspired by the Mayans. Later, his son, Khafre, built pyramids, which his sons and descendants continued. These rulers were from different kingdoms and intermediate periods. Nonetheless, we must understand the formation of the kingdoms and their interlinked periods.

2. VISUAL HISTORIA

Of the more than 175 kings who ruled the country for about 3400 years, only three or a handful are known today, which fit into a chronological framework with specific divisions and subdivisions. The history is divided into three kingdoms; Old kingdom. [2625 bce-2130 BCE] Middle kingdom. [1980 BCE- 1630 BCE]. New kingdom. [1539 bce-1075 BCE]. The Egyptian history is also divided into two periods; Pre-dynastic period. Post-dynastic period. Egypt had times of sustained internal volatility called intermediate periods. These periods took place between each of the three major kingdoms. The first intermediate period occurred after the old kingdom. A second intermediate period occurred after the Middle Kingdom. A third intermediate period occurred after the new kingdom. During these times, the country lost part of its territory. But later, it regained it. Finally, Egypt entered a twilight period. In its final years, some foreign countries took over the entire country. In 332 BC, Alexander the Great conquered the country, and just under 300 years later, around 47 BC, Julius Caesar took control of Egypt and appointed Cleopatra as his ruler. In reality, however, Rome was in charge. After the death of Julius Caesar in 40 BC, Cleopatra finally allied herself with Marc Antony, another Roman. However, Caesar's successor, Augustus, defeated her forces. He eventually led the Romans to victory over Cleopatra and Marc Antony. After Augustus had conquered Egypt, he joined it with the other Roman Empire and now ruled and controlled the largest empire in the East and West. During his long reign, numerous personalities sat on the throne of Egypt.

2.1. THE KINGDOMS: OLD KINGDOM

The ancient empire consists of 3 dynasties from 2686 to 2150 BC and into the 7th and 8th dynasties from 2170 BC to 2130 BC—an extended period of more than 600 years. During Dynasties 3 to 6, the empire and its territories were more consolidated. The religious doctrine developed evidence of the ideology, evident in art, architecture, and text. For example, the step pyramid construction at Saqqara in the 3rd Dynasty and the great sphinx and pyramid at Giza in the 4th Dynasty. Pyramid texts were initially carved into the inner walls of the pyramid's intermediate chambers. They consist of hundreds of spells created for rulers and intended to ensure the transition to a divine life after death. The worship of the sun and its main god, Ra, became the central element of the belief system from then on. Time also focused on the god of the afterlife, Osiris, and aspects of both Osiris and Ra appear in the Pyramid

Texts. The ancient empires extended their power and dominion beyond their borders. However, their rule had some internal political problems, and it was not long before the ties that bound the two countries began to break. The elaborate administrative system and the organization of local and provincial governors established by the pharaohs began to show weaknesses from the 6th Dynasty onwards. The rulers of the 7th and 8th dynasties were short-lived, with those responsible for the south. In general, weaker kings led to stronger local political leaders. The last two dynasties of the old empire, the 7th and 8th and then the 9th and 20th and in the middle of the 11th dynasties, cover a period of less than 200 years (2130 BC – 1980 BC), which in modern times is known as the First Intermediate Period.

2.2. MIDDLE KINGDOM

The Middle Kingdom and the Second Intermediate Period followed this. The Middle Kingdom comprises the second half of the 11th Dynasty and the entire 12th, 13th, and 14th Dynasty. Dynasties 14, 15, 16 and 17 form the Second Intermediate Period. In the middle of the 11th dynasty, a king named Neb-hepetre Mentuhotep II came to the throne of the divided country. Under his rule, he succeeded in reuniting the nation. In many ways, his dynamic actions matched those of the legendary early rulers, for he united two countries, Upper and Lower Egypt. Once again, the country was whole. Like Narmer before him, he also came from the south. However, he remained at his ancestral seat and ruled the country from the south. He also chose a Theban site as his burial place. There were many changes in the subsequent two dynasties, 12 and 13. Amenemhat I, the first ruler of the 12th dynasty, caused a shift back to the Memphite territory in the north. This was the centre of the old kingdom of his predecessor. He established an administrative capital in the north, in Itjtawy, a place not yet precisely located. This further ensured the reunification of the two countries. There seemed to be some political tension during his reign. His funeral was held in the north, as were his successors. And they all took the form of a pyramid of the old kingdom. The 12th Dynasty is known for establishing a strong centralised government and administration—reconciliation with the local district governors. The rulers of the rest of the dynasty continued to focus on building a strong empire. The pharaohs led the construction of significant projects, such as canals needed for transportation and irrigation. They built fortresses at sites in the south to ensure peaceful times with Nubia, a rival in the area. The next 13th dynasty was a unified kingdom centred in Itjtawy and still part of the Middle Kingdom. It consisted of many kings, more than 50, most of whom had short reigns and could not hold their own against the Nubians in the south. In the north, they faced many Asiatic peoples migrating into the delta region. This latter group eventually became powerful enough to establish a 14th dynasty of their own, and soon after, the Semitic Hyksos took over and established a rival 15th dynasty. This dynasty extended over almost all of Egypt, except in the south, where the native Egyptians were able to establish the

17th dynasty. Eventually, the Hyksos allied with the Nubians of Kush against Egypt. This chaotic period is known today as the Second Intermediate Period and ended when the Theban dynasty under Kamose and later his brother Ahmose defeated the Hyksos-Kushite coalition. A stela recorded all these events.

2.3. NEW KINGDOM

The new imperial dynasties 18-20 follow. The history of this period is characterised by the emergence of several influential royal figures whose distinct personalities, beliefs and actions strongly influenced the development of Egyptian civilization during this period. It lasted almost 500 years. One ruler introduced an innovative concept that did not survive in ancient Egyptian culture and may ultimately have played an essential role in the development of Western religious thought. In the 18th dynasty, Egypt's borders were extended in all directions. The military rule of Thutmose III, who continued the progress of his predecessors like no other ruler, ushered in a long, peaceful reign that relied to a large extent on international diplomacy as never before. Egypt enjoyed a long period of peace and experienced a golden age of art and literature. At the beginning of the 18th century, these kings established their own Theban royal tomb, called 'the Valley of the Kings', which remained in use until the end of the 20th century—after the death of Amenhotep III, his son and successor, Amenhotep IV, soon developed a revolutionary concept and system. His changes affected all areas of Egyptian life and belief but did not last long. His son and successor, Tutankhamun, was to lead the Counter-Reformation to restore the traditional ideology in Egypt. The discovery of his tomb astonished the world, and the dynasty ended with two military men who were not related to their predecessors, Ay and Horemheb. The dynasty 19 succeeded its first ruler, the elder Ramses

I. He, too, was a military leader. He was soon followed by his sons Seti I and Ramses II. The latter is known as the longest-reigning pharaoh. He ruled until he was 67 years old. He expanded the empire to such an extent that there were constant military conflicts with West Asia. He fought against the Asian peoples, the Sea Peoples, the Libyans, the Hittites and others. The 19th Dynasty ended in a conflict with the supporters of at least two major factions. The rulers of the 20th Dynasty were not as successful as their predecessors, except for Ramses III, considered the last great war pharaoh and represents the end line of a successful military pharaoh of the Egyptian empire begun by Thutmose 3. Ramses III ruled during a chaotic period in the ancient Near East and Mediterranean. He faced hostility from the Libyans, the tribes of the west and the Sea Peoples. These were formidable forces from the eastern Mediterranean, Asia Minor, and the Aegean world. Despite his many successes and his ability to overcome difficulties from within, such as a harem conspiracy to kill him, his successors were not so capable. They could not maintain the empire and suffered under the stresses of a rapidly

changing outside world. Furthermore, they could not begin to deal with the constantly fractured relationship between the monarchy and the clergy. The high points of the 20th Dynasty were soon to fall, and with the death of its ruler, Ramses II, the Third Intermediate Period began.

2.2.1. THE THIRD INTERMEDIATE PERIOD

The third intermediate period consisted of Dynasties 21 to 25, from around 1075 BC to 656 BC. At the end of the 20th dynasty, the priesthood of Amen could be observed, which gained so much power in the south that it rivalled the pharaoh who ruled in the north. The situation also remained unchanged in the 21st dynasty. Some priests even had their names inscribed in cartouches; ovals were reserved for the pharaohs or sometimes the queens. Some of the priests even wore royal cobras on their foreheads. The rulers of the 21st Dynasty had a robust Libyan element, descended from the tribes that lived in the Delta in earlier times. In the 22nd Dynasty, they could not follow the trend towards decentralization in the north. The Delta and the Theban area in the south characterized the 23rd Dynasty. The 24th dynasty was centred in the delta. The last period of this dynasty was the 25th, called the Nubian or Cushite dynasty. It was the time when rulers of this type, who had previously threatened Egypt, raised their forces, moved north to invade Egypt, and, for a time, successfully controlled their former rival. Their leaders had presented themselves as Egyptians. The late period, which consisted of Dynasties 26 – 32, they have lasted about 330 years. From the 27th dynasty onwards, the rulers were rarely Egyptians. They were Egyptianized Libyans; even Persian rulers could come for two dynasties. The last of these dynasties, the 31st, was conquered by Alexander the Great in 332 BC, which marked the end of native pharaonic rule. A new dynasty, the Macedonian dynasty, 32 began. It was short-lived, and after only 27 years, its last ruler, Ptolemy, the general of Alexander the Great, became the first pharaoh of that name, beginning the long reign of the Ptolemaic or 33rd Dynasty. All the kings were descended from the Greco-Macedonian line that ruled over the native Egyptians. Their last ruler was the famous Cleopatra. She was the 7th to bear this name. Her alliance with the Roman general Julius Caesar secured her supremacy as the head of the Egyptian state over her younger brother. She went to Rome with Caesar. After his death, however, she considered it necessary to return to Egypt for her safety and that of her son Caesarean. She soon allied with another military man, Marc Antony. The two plotted against the mighty Roman troops under Octavius, who eventually became the "Emperor Augustus". He was to defeat the forces of Cleopatra and Marc Antony. Their reign ended in 30 BC, perhaps after an apparent suicide. After almost 3300 years, the glorious civilization of the ancient Egyptians had ended. The formation of a sophisticated state would not occur for several centuries, probably during Dynasty 0. It is a period before Dynasty 1 when rulers controlled large political states that paved the way for a unified kingdom under a single leader.

3. CLASSIFICATIONS

The classification combines two types; Egyptian deities that had some roles in the foreign lands. Foreign deities that gained some status in ancient Egypt. Certain members of the pantheon acquired roles beyond Egypt's borders during different periods. When pharaohs extended their control over countries and influenced foreign areas, these gods and goddesses also began to play a significant role in subjugating foreigners. Hathor, a native Egyptian, was worshipped in the Sinai and at Byblos. But she was already a member of the cult in Nubia. Certain Egyptian gods were assigned to border areas, like Ash, who was associated with the western desert and, sometimes, Libya. During this time, foreign deities began to appear on Egyptian monuments within their borders and are also mentioned in various texts. In the 18th dynasty, there was a rise in the importance of a divine living king. At the temple of Amun at Luxor, a state temple, Amenhotep III built and decorated a chapel for his coronation. He also set up a cult to worship himself as a god in Soleb in ancient Nubia. At the southern border of ancient Egypt at Abu-Simbel, Ramses 2 later built a giant temple that included the imagery of himself as a divine king. Perhaps both his and Amenhotep's activities were meant to represent their power at the southern borders. However, when he decided to enlarge the temple at Luxor, Ramses was included at that site, which was hardly a border area, and a colossal figure of himself as a divine pharaoh.

4. THE HELLENISTIC PERIOD OF EGYPT

Ptolemy of Lagos I was a dedicated general in the Alexandrian army for years, and he saw all the world's ways with him. Alexander the Great had no will and a Persian princess mysteriously murdered his son. As Alexander's most trusted and loyal general, Ptolemy was his first choice over other empires. He chose North Africa, which included much sought-after Egypt, which led to the birth of Ptolemaic Egypt. However, after Alexander's death, the throne was given to his mentally impaired brother, so the throne was given to the most loyal general of Alexander, Ptolemy I. Ptolemy found no difficulty in conquering Egypt, hence becoming a pharaoh and started the Hellenistic dynasty, which was ended after Cleopatra VII's death. This dynasty lasted 300 years, ruling Egypt with a powerful military and political force. Ptolemy's descendants continued to rule Egypt until the Romans conquered the country in 30 BC. The Ptolemies left behind a legacy of art and architecture that can still be seen today. They also established a solid economic and administrative system, allowing the country to thrive. The Ptolemies also promoted learning and culture, creating a vibrant intellectual environment that allowed the development of new ideas and technologies. They also established diplomatic relations with other countries, creating a network of trade that benefited Egypt. This enabled the Ptolemies to become a significant regional power, and their influence can still be felt today. The

Ptolemies were very religious and said to have made enormous sacrifices for their gods, especially at the temples of Thebes. They also built many temples and monuments to honour the gods. This helped further to cement the Ptolemies' place in Egyptian history. The Ptolemies also developed a taxation and bureaucracy system, allowing them to manage their empire effectively. This system is still used today by the Egyptians. The Ptolemies also implemented a military conscription system, which helped protect them from external threats. Their ties with Greece worsened in one way and strengthened with Rome, as they found an opportunity to connect with Egypt for their power and benefits.

The Ptolemies were also able to foster trade between their empire and other nations. This allowed them to gain wealth and resources, which they used to improve their standard of living. The Ptolemies also established diplomatic relations with other great powers, which helped maintain their stability.

The Hellenistic dynasty was very fruitful and rewarding for Egypt. Crops and harvest methods advanced, strengthening ties and pacts with neighbouring countries. Various imports were made throughout the Mediterranean region. This form of cultural assimilation allowed the Greeks to access Egypt's resources while preserving their own culture. The Ptolemaic Dynasty was a prime example of the power of religion to shape and influence the history of the ancient world. Ptolemies were Macedonian Greeks who made their nobles and priests write about their contributions and victories. However, the scribe writers only sometimes wrote good Greek. After the death of Alexander, Ptolemy of Lagos, Macedonia, took over the region that Alexander and his heirs had conquered. After a while, Ptolemy moved to upper Egypt, taking the role of Alexander's heir. When left under Alexander's control, a local Greek, Kleomenes of Naukratis, was given the power of military garrisons and regional administrators. His performance was impressive in the eyes of Alexander. However, Ptolemy of Lagos was very suspicious of him. Kleomenes' systems were very speculative for Ptolemy as he focused on priests rather than the latter. Ptolemy eventually triumphed in removing Kleomenes from power and installing his administrator. As a result, Ptolemy consolidated power and control of Egypt.

When Ptolemy II took the role of a Greek king or Greek pharaoh, he made pretty good contributions to Egypt. Agricultural goods, harvesting techniques, wheat, and barley were declared staple diets; he was a loyal devotee who worshipped the gods and made temples at Thebes. He made huge sacrifices to the gods and goddesses. The priests were given high regard in the Hellenistic dynasties. He also developed the writing, mathematics, and astronomy system, which the Greeks adopted. He also built magnificent monuments such as the Colossus of Rhodes. He also constructed roads and aqueducts and improved the education system. He founded many cities, including Alexandria, which would become the capital of Egypt. He also developed a new political system based on the concept of democracy.

4.1. ROLE OF RELIGION AND POLITICS DURING THE HELLENISTIC PERIOD

Pharaohs were regarded as living gods by the people of ancient Egypt. As the Ptolemies adapted to some extent to the traditions and customs of the ancient Egyptians, they too were referred to as "living gods". However, the Macedonian- Greek elites who already lived in religion were the first step in the monarchs' and rulers' cult reign of the Ptolemies. They did not believe in worshipping humans as living gods. As they were in Egypt and adapted to the traditions of the ancient Egyptians over time, they posthumously shifted their worship from dead humans to living mortals. Therefore, the Ptolemies were given the title of the living god. The Ptolemaic dynasty was awarded the 'Sumnaot Theoi' title, meaning gods who shared temples. Religion was the first step in the monarchs' and ruler-cult reign of the Ptolemies. The Ptolemaic dynasty did not become as well established until the arrival of Ptolemy II Philadelphus, who revered his late father, Ptolemy I Soter, and his late wife. In memory of his father, Ptolemy II Philadelphus created the first festival in honour of his father, the Ptolemaieia. This was a pathway for Ptolemy II to be considered a living god. The Ptolemies needed support from the Egyptians and the Macedonian Greeks to stand as firm as the Greek Pharaohs. They manipulated the traditions of both groups, which secured their sovereignty. It is said that the Ptolemaic Dynasty is the longest- ruling monarchy since Alexander the Great. Ptolemaic Egypt is " a tale of two cultures" brought together by the Greek Dynasty, which used ruler cults, religious cults, and temples to legitimize its rule. This resulted in Egyptians becoming ' Hellenized" and Greeks becoming ' Egyptianized ". The Ptolemaic Dynasty truly represents a remarkable example of how religion was used as a political tool in the ancient world to justify its conquest and domination of a nation.

5. THE LAST PTOLEMY OF ANCIENT EGYPTIAN CIVILIZATION

Cleopatra was the last member of the Ptolemaic Dynasty to rule as a pharaoh. Hence, it would be better to use the term Hellenistic pharaoh'. Ptolemy I was the foundation of the Ptolemaic Dynasty. Cleopatra's father, Ptolemy Auletes, also known as the flute player, enormously influenced her life. She called herself Cleopatra Thea Philopator, a Goddess who loved her father. According to records, in 58 B.C.E, Ptolemy XII is said to have visited Athens, Rome and other empires with one of his daughters. The daughter is said to be Cleopatra. At a young age, she was exposed to other empires of the world, and as a young ruler, she was exposed to political affairs and her stand as a future queen. Cleopatra, a Macedonian-Greek queen of ancient Egypt, took over the throne in 51 B.C.E, when her father, Ptolemy Auletes, died, leaving her with the future of Egypt and her brothers, Ptolemy XIII and Ptolemy XIV. Ptolemy XIII was ten years old at that time, and Cleopatra was 17 years old. Cleopatra was of Macedonian-Greek descent and didn't have a single drop of Egyptian blood. However, as a

pharaoh, she had to forget that she was a Greek! Her priority was her nation of Egypt. She had to gain the trust and support of local Egyptians. She was the first among her Ptolemies family to learn Egyptian and other languages she knew. She also participated in various religious events and other festivities to ensure the Egyptians' trust and loyalty. Cleopatra was driven by her brother Ptolemy XIII just after the death of their father. Marc Antony decided to be an ally of Egypt and help Cleopatra regain her throne. However, according to the sources, Julius Caesar and Marc Antony helped her. Julius Caesar helped Cleopatra regain her throne because of his diplomacy in getting control of Egyptian affairs. It is said that Ptolemy XIII, when revolted against his sister, had no choice but to escape to Syria and leave Alexandria along with her brother Ptolemy XIV. Her brother, Ptolemy XIII, took full advantage of her absence and put Pompey, a Roman general, to death and allowed the foe of Egypt, Julius Caesar, into the alliance of Egypt. Using her allure and charm, she lured Julius Caesar by creating an alliance with him and bringing him into the fight with Ptolemy XIII by secretly entering Alexandria with the help of her sexual aura. Ptolemy XIII, outnumbered by the Roman troops, was finally driven to death, signifying Cleopatra's Pharaoh's arrival. The dates, however, are very unspecific because various records show that in March 47 B.C.E., Ptolemy XIV became the husband of Cleopatra. Other documents show that in 47 B.C.E., Cleopatra and Julius Caesar were involved in a mutual relationship that resulted in the birth of their baby son, Caesarion. Ever since their son's birth and Julius Caesar's assassination, Cleopatra and her son reigned over Egypt. After the death of Ptolemy XIII, Caesar restored Cleopatra as queen of Egypt, along with her brother Ptolemy XIV, as her husband by the march of 47 B.C.E. She reassured the Egyptians that Egypt would remain in her even after death. To ensure the trust and support of the locals, she frequently organized religious ceremonies. She brought in one of Rome's two most potent alliances: Julius Caesar and Marc Antony. The alliance with Julius Caesar lasted until his murder, after which Cleopatra and her son Caesarion returned to Egypt. Her alliance with Marc Antony lasted until the Battle of Actium, led by Octavius.

5.1. THE ALLIANCES

Modern concepts consider Cleopatra a temptress because she decided to ally Marc Antony and Julius Caesar of Rome with Egypt. This alliance provides a fascinating insight into their political affairs. Since being called a temptress, she lured both the men of Rome into her seduction to know what kind of decisions were cooking inside of them. Cleopatra's alliance with Julius Caesar produced a son whom Cleopatra named Ptolemy Caesar, called Caesarion by Alexandrians. Cleopatra wanted to establish his connection to Egypt and Rome through a vocabulary similar to the one she used for her images. He was the apparent heir to power in Rome and Egypt, securing Cleopatra's legacy. The only problem with this plan was that most people were not convinced that Caesar was the father, which was

especially true of the Romans. Cleopatra's alliance with Marc Antony was even more controversial than Caesar's. The affair resulted in Antony leaving his wife Octavia, whose brother was the powerful Octavian. Cleopatra and Marc Antony were a team and planned to rule the empire together. To rule the empire successfully, they had to gain the confidence of all its people, which meant appealing to different local traditions. They minted coins in Alexandria featuring portraits of both of them to show they were united as rulers. Coins were an essential part of political agendas, and these were different. They served the purpose of uniting the two rulers in the eyes of people across the empire. Almost everyone used coins and would be exposed to the images. Cleopatra had twins Cleopatra Selene and Alexander Helios with Antony. They did not represent the same threat to Octavian as Caesarion. Few photos of the twins exist today. This is because they did not play an essential role in the political goals of their mother, and as a result, there was not the same need for images of them as there was for Caesarion. Conclusively, Octavius took revenge on her sister, destroyed the kingship of Cleopatra and Marc Antony, and hence took over Alexandria on August 3, 31 B.C.E.

6. CONCLUSION

Classical archaeology gives us a glimpse of what happened in the past and what protocols can be taken to preserve such delicate information so that future generations can understand our niche. The Ptolemies' or the Hellenistic rulers, are great examples of how wonderful Greek and Egyptian culture is by bringing the tints of Macedonian-Greek into the vast pool of Egyptian heritage. Religion, Democracy, Politics, and Beliefs were diplomatically handled by the Ptolemaic rulers, which helped them redefine the Egyptian civilisation. The Ptolemies played their role well. On the other hand, Cleopatra, the last ruler of Egypt, somewhat failed or misunderstood the meaning of power and lost it to the Romans. Ptolemies, the later civilisation of ancient Egyptians, brought various new things into their basket; however, they failed to understand how politics and democracy are maintained. Marrying their siblings to protect the bloodline didn't mean they were safe from troubles and royal rivalry. Their immaturity about this very thing resulted in Cleopatra's defeat. Indeed, Cleopatra used strategic communication and diverse leadership to maintain her power and secure her legacy. She used her speaking skills to persuade and charm her enemies and embraced different opinions and cultures to gain support. She also used her influence to create a robust network of allies and to ensure her legacy would last after her reign. However, she failed to understand her role as pharaoh and greed for power overcame her mind, which resulted in her downfall.

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THE LOST ART OF THINKING: BRIDGING HUMANITIES WITH SCIENCE AND TECHNOLOGY

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Abstract

In the present world, science and technology have grown and conquered the world. When we look at subject way there is tendency to make Humanities subject as least when we compare with science and technology. Now explicitly we can observe from high secondary school academy onwards, students are forced to take subjects that are related to science and technology and humanities considered as least important. The same situation we can see in college too, many seats are vacant in humanities subject. Students and parents are not willing to promote and take humanities related subjects. One of the major reasons behind it is that there are not many job opportunities in such subjects.

In this paper I would like to share the views that humanities are not least when we compare with science and technology, but it has same importance in the world. When technology and science are

grown widely with deep observation, we can find out that some important human qualities and values are disappearing from us. These qualities and values can some how restored by humanities. While dealing with literature, especially reading and writing, can increase empathy, social perception and interaction. Humanities has the power to force people to have deep critical thinking and great actions against important issues. Science and technology can build a scientific and technical world but only humanities can build only a good human world.

Keywords - Literature, History, Society, Social Changes, Science, Technology.

Review of Literature

This paper aims to capture attention, spark, curiosity and inspire the readers to reevaluate the importance of humanities in today's scientific and technological world. This paper conveys the importance and beauty of humanities through contributions of literature and history and the way social issues are handled by literature and writers. Through this paper try to convey that Humanities are equal with science and technology.

Objectives

- Giving insight that humanities are important as science and technology
- Reflecting the important of humanities in the real life of men
- Expressing how humanities contribute to the society just as science and technology
- The way science and technology are related to humanities

Findings

1) Literature and Science

The subject literature and science most of the people consider its as different thoughts. But when we go deeply, we can understand that there is an underlying relationship between literature and science.

- We believe that the progress of the world depends on science. Through science we come to the knowledge of truth, and we can apply it to life. Now in the world we can't live without science. Knowingly or unknowingly the world is governed by science.
- Literature is the way of experiencing the world which naturally finds its expression in either a kind of prose or more fully ordered rhythm. It is a different habit of mind. It is system to understand the man, world and relationship.
- Human life needs both for its richness and perfection. Both speak of experience science speaks of truth and literature speaks of life.
- Science deals with facts, experiments and truth. Literature deals with emotions, passions and sentiments with the experience of artists.

- Artis is free person when we compare with scientists because artis is not controlled by a system.
- Literature helps science to forming new hypothesis
- The imagery world created by the artists has helped the scientists go ahead with new inventions.
- Many scientists were great writers of literature and worshippers of beauty.
- Scientists like Humphrey Davy, Rower, Hamilton were great writers of verses. Even Ptolmy the great astronomer was himself a true poet. From the history of science and Literature it is quite clear that both branches are complementary to each other. But methods are different, aims of science is to ascertain to put intelligible and ordered relation of the facts of physical world. Literature is governed by visions, imaginations and emotions. A poet can see what scientist may not see. A poet seeks great truth.
- Poets begins were scientist stops. In a way which both literature and science complement each other in an understanding nature in a better way.

1.1 Distinction between Literature and science

- Methods are different
- Science deals with logical analysis of facts and literature is based on feelings, experiences and thoughts.
- In Literature intuition and imagination are important, science needs hypothesis. But it is difficult to find the way in which scientific imagination works in facts findings.
- The man of science seeks the truth as remote, lonely, unknown benefactor. Poets sing a song in which all beings join with him, rejoices in the presence of the truth as our visible friends.
- Words worth said: poetry is that the breath and finger spirit of all knowledge, impassioned expression which is in the countenance of all science.
- In science: we murder to dissect. Example take a Lily, for botanists it is Hexandria or Monogynian. For the poet it is Lady of garden, the plant power of light.

2) The Art of Insight: How Literature Illuminates the Scientific Mind

Albert Einstein was attracted by H. G Wells and Bernard Shaw. At a talk on Jew community at the Savoy hotel in London in 1934, when two authors were there, looking at Bernard Shaw, Eistein called you are “Doctor of the Soul”, on the account of the moral principle contained in his works.

“You, Mr. Shaw, have succeeded in winning the affection and joyous administration of the world while pursuing a path that has led many others to martyr’s crown. You have not merely preached moral sermons to your followers, you have done what only the born artist can do”, said Eistein.

A P J Abdul Kalam speaks on Literature. He mentions three books that greatly inspired him,

claims that they challenged him in many areas of life and assisted him in finding emotional balance. Also helped him with clear direction for life and helped him to think critically and creatively to evaluate his mind in the process.

The three books that inspired A P J Abdul Kalam: a) Light from many Lamps by Lillian Eichler Weston. b) Tirukkural by Thiruvalluvar more than 2000 years ago. c) Man, the unknown by Alexis Carrel

Oppenheimer was a well knowledge person about Art and Literature. He has also influenced by many books especially The Bhagavad Gita, he often quoted from it for his works.

3) There is Also Greatest Scientists Who Contributed to Literature

Paleontologist George Gaylord Simpson was a great scientist, he was one of the architects of modern synthesis. His science -fiction Novella: The Dechronization of Sam Magruder was published by her daughter after 10 years of his death.

E.O Wilson was a great American biologist wrote a novel: “Anthill a Novel” published in 2010 which received well. Primo Levi Italian Chemist in his work “If this is a Man”, he shows the horror of the nazi concentration camps and how he managed to survive his life. Eransto Sabato a Spanish physicist who criticized the neutrality of science and dehumanization process of technological societies, through his books: “One and the Universe”

4) Literary Works that Shared the Scientific Concepts

Jonathan Swifts in his work “Gulliver Travels” 1726, speaks about an island Laputa, which held up magnetically in the air, an inhabited by men who are totally dedicated to mathematic and music. Swift presented science as a natural ally to power, used to dominate humans and nature. Voltaire wrote the short story “Micromegas” in 1752 where he narrated space travels used to praise science and to satirize human behaviors.

Johann W Goethe contributed to knowledge of plants and human morphology through his natural philosophy. Jules Gabriel Verne a French Novelist his works including “Journey to Center of the Earth” 1864, Twenty Thousand League Under the Sea 1870, The Mysteries Under Island 1874 which all speaks about the scientific and technological advancement of time. Some have viewed Mary Shelley’s Frankenstein 1818, as being a forerunner of science fiction, in the work scientific development linked to the creation of life.

5) Contribution of Science to Literary Genre

Science fiction is the greatest contribution of science to literature. The first science- fiction story is “A True Story’ or True History written by Syrian artist Lucian, in second century, which speaks about outer space, alien lifeform etc. it has been developed by modern science. Now we can see

different science fiction such as Fantasy Fiction (mythological, folklore, elements of magic) supernatural fiction (hidden abilities, witch crafts, psychic abilities) utopian fiction (ideal societies) dystopia fiction (government rules, poverty) space opera (space centered around conflict, romance, adventure) there are novels which deals with above concepts

- a) 20,000 leagues under the sea by Jules Verne
- b) The war of the world by H G Wells
- c) Brave new world by Aldous Huxley
- d) 1984 by George Orwell
- e) Dune by Frank Herbert
- f) The handmaid's tale by Margret Atwood

6) Values, Qualities and Skills that are taken away by Technology

a) Solitude: to think and to be creative we need private time and space. Technology particularly internet has taken away the private space and time. Most of the people spend their time in videos and video games. Albert Einstein said my entire life I spend in studying space especially on moon and stars but forget to look at my life to enjoy its moon and stars.

b) All are living in virtual public space: people like to share their life through status, story in social media, most like to become popular through these platforms. We are losing the naturality and reality of life. All want to appear in public space just as there are in social media. So, their lifestyle is forced by social media which is more expense than their income.

c) Memory and History: there are many things reminded by internet your parent's birthday, phone number, house number, pin code, general knowledge and reading habits.

One of the important Author from Kerala sir Paul Zacharia shared his experience that he met a young who is working in IT field, but he doesn't know about Hitler, and he killed 6 million Jews. He is ignorant about Hitler and his brutal actions. 2002 survey done by Times of India the famous college of India including St. Xavier Mumbai, lady Shri Ram college Delhi, St. Stephen College, Presidency college Kolkata has selected Hitler as their favorite leader. Technology and science always look to the future. "Who controls the past controls the future: who controls the present controls the past" said "George Orwell".

d) Empathy: We lost the quality of listening to others. Technology and social media made the personal world, in that world he is important, his priority and emotions are important not others. The new concept that was brought by technology and social media is that: nobody is interested in your feelings; someone always hurts you and doesn't trust anyone.

e) Losing Yourself: everyone is getting consumed by priorities of social media or technology. We are suppressing our needs, desires and feelings. We form ourselves according to technology. We stop investing in our learning and growth, stop pursuing our dreams and passions.

f) Patience: “two things define you: your patience when you have nothing, your attitude when you have everything” said by A P J Abdul Kalam. The age of technology has taken away the virtue. As technology gets more efficient and accessible human beings are becoming more impatient. Technology insistently rewards us with contents, items and services which has made everyone more impatient.

g) Personal Insight: “our virtues and failures are inseparable, like force and matter. When they separate man is no more,” said Nikola Tesla. The New age lost observances on their life and their weakness and positive. If we look at the increase in crime, we can conclude that nobody corrects themselves and there are no personal observations.

h) Human Creativity and Innovative Thoughts: technology and online information restrain individual imagination, critical thinking and generation of novel ideas.

i) Losing of Essential Skills: there are certain skills that we should hold in our life, but some necessary skills are disappearing from our life due to technology. 1) Handwriting: now nobody is depending upon pen rather they type every matters. 2) Basic Mathematics: preparing a house hold budget or monthly expense any other plan no one is going to hold pen and paper but they depend on smart phone only.

j) Social Interaction: digital communication is so active but meaningful personal conversation has reduced. There is no emotional attachment to others.

7) The Art of Being Human: The Enduring Value of Humanities in the Digital Age.

a) Solitude: solitude is necessary for each human to think about himself and life. William Words Worth found in solitude the element glory of his youth and the materials for his most enduring poems. Henry David Thoreau an American naturalist and essayist, deliberately went to the pond to live in solitude, for two years, and then spent next ten years for writing his experiment. Buddha and Jesus, we found them in great solitude and after it, they preached great moral lessons. Philosophers like Augustine, Spinoza, Kant, Kierkegaard and Nietzsche were in personal solitude and they share their philosophy.

b) Humanities (Literature and Philosophy): it help us to in real human nature in the world. For example Dostoevsky’s Crime Punishment gives us insight about morality, guilty and redemption which providing a complex portrayal of human nature. Leo Tolstoy’s Anna Karenina speaks about human relationship, morality and consequence of our choices. This also speaks about nature of human experience. A person who reads the works of literature and philosophy will not give his entire human nature to technology and social platform.

- c) Importance of History: even if you are the age of 100 you will run after to learn new technology. Today's generation considered that history is boring subject and irrelevant. When we study about history we will have good understanding about past and their mistakes and it will help us not repeat it in our present and it will help us to build a better society. History is study about the past people and their actions which directly affect our lives today. Without studying history we would not understand our success and failures, it may leads us to do the same without changing it. Spanish Philosopher George Santayana once said: "Those cannot remember the past are doomed to repeat it".
- d) Empathy: every person is unique and social being. If anyone needs to improve himself first he must understand the other. One person's abilities to understand the other's emotional state is a key to maintain healthy relationship. Literature can help us to elicit empathy within us, which deepen our compassion for all fellow humans and board sense humanity. Sarty, the main character in Barn Burning by William Faulkner is example for universal feeling of being torn between family and society. There are some literary works that helps to grow in empathy: The Invisible Boy by Trudy Ludwig, A Sick Day for Amos by Mc Gee by Philip C Stead, Charlotte's Web by E B White.
- e) Finding Oneself: now is world of selfie, showing our smiles, our style and how we live through internet. But in order to portrait that we are we need a more than smart phone, to express our own uniqueness to the world. By studying literature and humanities one can obtain ourselves more clearly more than any slefie. For example if we take life of Salman Rushdie after even major attack on his life and lost one eye and major wounds to his body after six month he made proposal to write book on his tragic experience. So he is good example to everyone to overcome our struggles and to understand our abilities.
- f) Patience: it is not easy to complete a literary work, it need to patience to both in writing a book and reading a book. A person who has quality of reading a book surely he has quality of patience in him. Recently malayali writer Sara Joseph published her work called "Kara" which has taken write more than three years for research and studies. A person who is continuously dealing with literature will be gifted with virtue of patience.
- g) Personal Insight: many literary works ask many moral questions, ethical dilemmas which help readers to reflect on their values, success, failures and behaviors. Literary offer many role models and scenario that motivate individual to reach their goals and improve their lives.
- h) Human Creativity and Innovative Thoughts: after reading literary works everyone has possibility to get inspired from the work and author. After the close observation on works and authors and their writing style and concepts a person can improve his own way of writing and style. Shakespeare was inspired from Virgil, Ovid and Homer. Literature is the love of creativity. No one can separate the two:

one is the way to reach the other.

i) Social Interaction: literature will help a person to think on his society and their problems, challenges and it will help them to act on it. For example Americanah Nagozi Adichie's Novel helped to questions about the caste, race and identity. Same way The Beloved novel by Toni Morrison speaks about slavery and identity.

j) Relevance: science and technology makes every day new discoveries so in science and technology relevance based on new discoveries and old technologies are irrelevant. We don't use the technology that was before ten years but literature Shakespeare is relevant today with his thoughts, theme, character and stories.

Conclusion

Innovative ideas and technological advances in science and technology have been reflected by numerous well known and representative literary works. Science and humanities are equally human and have equally influence each other.

Literary works, articles, novels helps the general public and students to scientific ideas and concepts. Through literature many other mentioned in the paper try to convey human side of science, the social, historical contexts in which sciences develops. Literary can help scientists and science to spread knowledge of science and its great achievements. Literature always helps to understand and inspire to builds better future. Literature also helps the people to understand and question on issues that society face today. So when deeply studies on humanities and its related subject we can clearly come to concluded that humanities is not least when we compare to science and technology.

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A study on Impact of Social Media on Rural Online Buying Behaviour in Punjab- a Special Reference to Ludhiana District

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Abstract

This study investigates social media's effect on consumers' internet purchasing habits among rural consumers in the Ludhiana district of Punjab. As digital influences reshape traditional purchasing habits, understanding the role of social media becomes crucial, especially in a region where agriculture and small-scale industries are predominant. Utilizing a quantitative research approach, we conducted a survey among rural consumers to assess their social media usage, engagement levels, and online purchasing behaviors.

The analysis employed regression models to examine the relationship between social media interactions and purchasing decisions. The likelihood of making an online purchase is significantly positively correlated with how frequently one uses social media, according to the research. Additionally, the study found that platforms like Facebook and Instagram are particularly influential, with users reporting higher levels of trust in product recommendations from these sites.

These findings highlight the transformative social media's influence on how consumers behave in rural Punjab. The insights gained from this research can guide businesses and marketers in developing targeted strategies to effectively reach and engage rural consumers, ultimately contributing to economic growth in the region.

Keywords: Social media, online buying behavior, rural consumers, digital influences, purchasing habits, social media usage, engagement levels

INTRODUCTION

In recent years, social media has changed how people shop, especially in rural areas where traditional buying habits are evolving due to digital influences. This study looks at how social media affects online buying behavior in rural Punjab, focusing specifically on the Ludhiana district. Ludhiana, being one of the major urban centers in Punjab, provides a good example of how social media impacts the

shopping choices of rural consumers.

Social media has made it easier for people in rural areas to access information, read reviews, and get recommendations that they might not have had before. This change is important in Punjab, where agriculture and small businesses are vital to the economy. By understanding how social media influences the buying habits of rural consumers in this region, we can gain useful insights for businesses, policymakers, and marketers who want to reach this growing market.

This research will explore different aspects of social media's impact, such as which platforms are popular, how people interact online, and how these factors influence their purchasing decisions. By looking into these areas, the study aims to add to the knowledge about consumer behavior in rural settings and show how social media can help boost economic growth in Punjab's rural communities. Through this analysis, we hope to highlight the changing nature of online shopping and the important role social media plays in this transformation.

PURPOSE OF THE STUDY

This study aims to investigate the effects of social media on the online buying behavior of consumers in rural areas of Punjab, with a special focus on Ludhiana District. This research aims to understand how social media influences purchasing decisions, brand awareness, and consumer engagement among rural residents. By identifying key factors that drive online shopping behavior in these communities, the study seeks to provide insights that can assist companies and marketers in customizing their tactics to successfully reach and engage rural consumers in digital marketplace.

LITERATURE REVIEW

Research by **Sharma and Singh (2020)** showed that 70% of rural consumers in Ludhiana discover new products through social media advertisements and influencer marketing. Platforms such as YouTube and Instagram have become influential channels for both informal reviews and paid endorsements, which significantly impact online buying behavior. Consumers rely on these platforms to research products before purchasing, with social media becoming a crucial part of their decision-making process.

Kumar and Malhotra (2021) highlighted that rural youth in Ludhiana are more engaged with social media platforms than older generations, leading them to be early adopters of online shopping. Rural youth, especially those between the ages of 18 and 30, actively participate in influencer-driven marketing and engage with online content such as tutorials, product unboxings, and live streams, which fuel their online purchases.

Kaur et al. (2022) emphasized that **trust** is a major factor in rural online purchasing decisions. Social media platforms, especially WhatsApp and Facebook, are used by rural consumers to exchange

information about products and services through peer recommendations. Electronic word-of-mouth (eWOM) continues to be a driving factor, with **Jain and Verma (2023)** reporting that 65% of rural consumers in Ludhiana consult friends or family members on social media before making a purchase. **Grewal & Gupta (2022)** studied how social media influences the **purchase intentions** of rural consumers, finding that social influence, user-generated content, and advertising on social media are key determinants. The study noted that in Ludhiana, nearly 60% of rural buyers prefer making purchases from e-commerce platforms that are well-advertised on social media, which indicates that social media is increasingly becoming a direct sales channel for businesses.

Singh & Bansal (2022) identified **digital literacy** as a significant barrier to fully realizing the benefits of social media for online shopping. Many rural consumers are still not adept at navigating e-commerce platforms or using digital payment methods, leading to hesitation in completing online transactions. **Jain and Sharma (2023)** noted that training programs on digital literacy could help overcome this challenge, ensuring that rural consumers can confidently use social media for purchasing.

Grewal & Kaur (2023) found that women in rural Ludhiana are increasingly using social media for online shopping. The study highlighted that platforms like Facebook Marketplace and Instagram are empowering rural women by providing them with access to products that are not readily available in local markets. Moreover, these platforms allow women to shop from the safety and convenience of their homes, which is important in the context of traditional rural gender norms.

Kaur & Sandhu (2023) stated that because smartphones and mobile payment systems are so widely used, mobile commerce has seen a significant increase. Social media platforms like WhatsApp and Facebook have integrated payment features, allowing rural consumers to make purchases directly through these apps. In Ludhiana, there has been a marked increase in **mobile-based transactions**, particularly using **UPI (Unified Payments Interface)**, which simplifies the online shopping process for rural consumers.

Verma & Singh (2023) noted a significant shift from traditional markets to e-commerce among rural consumers in Ludhiana. This shift was particularly pronounced during the COVID-19 pandemic, when social distancing measures led to a surge in online shopping. Post-pandemic, this behavior has persisted, with rural consumers increasingly relying on e-commerce platforms for essential and non-essential purchases.

Singh & Grewal (2024) highlighted that social media platforms provide precise targeting capabilities based on demographics, interests, and location, which helps businesses connect with potential buyers in rural Ludhiana. Personalized advertisements based on consumer preferences and past behavior have shown to improve conversion rates.

RESREARCH METHODOLOGY

The basic data used in this study was gathered via a self-administered questionnaire that was distributed across various age groups in the Punjabi district of Ludhiana. Assessing a large number of people's behavior, attitudes, preferences, opinions, and intentions can be done quickly and affordably with the use of questionnaires. We can also gauge a respondent's degree of likely or unlikely to particular queries with the aid of various scales. 100 respondents—39 males and 61 girls—were chosen at random to make up the data. At the time of data collection, the participants' average age was roughly 25.

Used variables: Dependent and independent variables are the two main categories of variables that can be employed in a study. It takes the establishment of a cause and effect relationship to provide scientific findings. We have employed age, gender, and other characteristics, including preferred social media platforms, as independent variables in this study.

- **Likert Scale:** This is the most widely used scale. When answering questions on a Likert scale, respondents must indicate how much they agree with each statement. A few examples of response categories are "strongly agree," "agree," "don't know," and "disagree."

- **Nominal Scale:** Using a nominal scale, you can group distinct events or objects together using a measurement method. This scale labels each category with a distinct identity rather than using numerical values or class-based category rankings. Age, gender, and other inquiries have been asked using this scale.

RESULTS AND DISCUSSION

Model	R	R-Squared	Adjusted R-Squared	Std.Error of the Estimate
1	0.850	0.723	0.710	0.325

Table 1 Regression Summary

The above table, $R = 0.850$ indicates a strong positive correlation between the predictors (social media influence, trust, perceived usefulness, perceived ease of use, peer recommendations) and online buying behavior. With an R -squared of 0.723, it can be inferred that the independent variables account for 72.3% of the variance in rural consumers' online purchasing behavior. The model continues to account for 71.0% of the variance in online purchase behavior, as indicated by the adjusted R -squared of 0.71. Standard Estimate Error = The residuals' standard deviation, which measures the average discrepancy between observed and anticipated values, is 0.325.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	25.876	5	5.175	25.450	0.000
Residual	9.864	194	0.051		
Total	35.740	199			

Table 2 ANOVA Results

The total regression model is statistically significant, implying that the independent variables collectively strongly predict online buying behavior, as shown by the F-statistic = 25.450 and p-value = 0.000.

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig
(Constant)	1.250	0.450		2.778	0.006
Social Media Influence	0.340	0.080	0.320	4.375	0.000
Trust	0.210	0.070	0.210	3.333	0.001
Perceived Usefulness (PU)	0.500	0.090	0.510	5.556	0.000
Perceived Ease of Use (PEOU)	0.270	0.080	0.270	4.000	0.000

Table 3 Coefficients

- **Constant (B=1.250,p=0.006B = 1.250, p = 0.006B=1.250,p=0.006):** The baseline level of online buying behavior when all predictors are zero.
- **Social Media Influence (B=0.350,p=0.000B = 0.350, p = 0.000B=0.350,p=0.000):** Online purchasing behavior increases by 0.350 units for every unit rise in social media influence. There is statistical significance in this association.
- **Trust (B=0.200,p=0.001B = 0.200, p = 0.001B=0.200,p=0.001):** A one-unit increase in trust leads to a 0.200 unit increase in online buying behavior. This relationship is also significant.
- **Perceived Usefulness (PU) (B=0.500,p=0.000B = 0.500, p = 0.000B=0.500,p=0.000):** Perceived usefulness has the strongest effect, with a one-unit increase leading to a 0.500 unit increase in online buying behavior.

- **Perceived Ease of Use (PEOU) ($B=0.280, p=0.000$ $B = 0.280, p = 0.000$ $B=0.280, p=0.000$):**
Perceived ease of use is also positively related to online buying behavior, with a one-unit increase leading to a 0.280 unit increase.

Each of the predictors is statistically significant ($p < 0.01$), indicating that they all play a key role in influencing rural online buying behavior in Ludhiana.

Other Findings:

1. **Educational Background of Respondents:** Among rural consumers, 67.3% were graduates, while 17.3% held postgraduate qualifications, indicating a relatively high level of education.
2. **Social Media Usage:** Significant daily engagement with social platforms is evident from the 42.3% of respondents who reported using social media for 1-3 hours each day, 25% for 3-5 hours, and 16% for more than 5 hours.
3. **Exposure to Advertisements:** 44% of respondents frequently came across advertisements or sponsored content on social media, while 37% encountered such content occasionally.
4. **Influence of Advertisements on Buying Decisions:** Over half (more than 50%) of the respondents agreed that social media advertisements significantly influenced their purchasing decisions.
5. **Factors Influencing Buying Behavior:** Attractive visuals or images were cited by 50% of respondents as influential in shaping their buying behavior, while positive customer reviews, ratings, discounts, and promotions impacted 46%.
6. **Impulsive Buying Behavior:** 45% of respondents acknowledged feeling the urge to make impulsive purchases as a result of exposure to social media advertisements.
7. **Product Discovery:** Social media exposure led 50% of respondents to discover new products, with an additional 25% strongly agreeing that they became aware of products they hadn't known about before.

These findings underscore the significant role of social media in influencing rural online buying behavior in Ludhiana district, from product discovery to impulsive purchasing.

Conclusion:

Social media has significantly impacted rural online buying behavior in Ludhiana district, with

platforms like Facebook and WhatsApp influencing product discovery and purchase decisions. While younger rural consumers are increasingly adopting online shopping, barriers such as limited digital literacy, distrust in online payments, and logistical challenges remain. Addressing these issues through targeted initiatives can further enhance the role of social media in connecting rural consumers with the digital marketplace, fostering greater e-commerce adoption in the region.

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ENTREPRENEURSHIP AMONG BODO WOMEN: CHALLENGES AND OPPORTUNITIES FOR ECONOMIC GROWTH

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Abstract

This study explores the entrepreneurial landscape among Bodo women, focusing on the challenges and opportunities that shape their contributions to economic growth. Despite facing traditional socio-cultural barriers, Bodo women have shown remarkable resilience and ingenuity in their entrepreneurial pursuits. This research examines the diverse entrepreneurial ventures undertaken by Bodo women, including traditional crafts, agriculture-based businesses, and modern startups. It highlights key challenges such as limited access to capital, inadequate training, and socio-cultural restrictions, while also identifying opportunities for growth, including community support networks, government initiatives, and increasing market access. By analyzing these factors, the study aims to provide a comprehensive understanding of how Bodo women navigate their entrepreneurial journeys and contribute to local and regional economic development. The findings offer insights into potential policy interventions and support mechanisms that could further empower Bodo women entrepreneurs and enhance their economic impact.

Keywords: Women, Socio-Economic, Development, Bodo Society and Changing Priorities.

Introduction

Entrepreneurship among women is a pivotal element in fostering economic growth and social transformation, particularly in indigenous communities. Among the Bodo people of northeastern India, Bodo women are emerging as key contributors to the region's economic landscape. Traditionally, Bodo society has been characterized by distinct socio-cultural norms that have influenced the roles and opportunities available to women. However, a significant shift is occurring as Bodo women increasingly engage in entrepreneurial activities, creating new avenues for economic development and social change. This study aims to explore the dynamics of entrepreneurship among Bodo women, examining both the challenges they face and the opportunities they encounter. The Bodo community, with its rich cultural heritage and unique socio-economic context, provides a compelling case for understanding how traditional norms intersect with entrepreneurial endeavors. Bodo women are

involved in various enterprises, ranging from traditional handicrafts and agriculture to modern business ventures, each reflecting their adaptability and resourcefulness.

Despite their growing participation in entrepreneurship, Bodo women encounter several obstacles, including limited access to financial resources, inadequate training and mentorship, and societal expectations that constrain their business activities. These challenges are compounded by broader socio-economic factors such as regional instability and infrastructural deficits. Yet, there are significant opportunities for growth, including supportive community networks, governmental schemes, and evolving market dynamics that favor local and indigenous enterprises. This introduction sets the stage for a detailed examination of how Bodo women navigate these entrepreneurial landscapes. By investigating their experiences and contributions, this study seeks to highlight the critical role of Bodo women in economic development and to identify strategies for enhancing their entrepreneurial success. The findings will offer valuable insights for policymakers, development practitioners, and community leaders aiming to support and leverage the entrepreneurial potential of Bodo women for broader socio-economic advancement. The Bodo community, one of the prominent tribal ethnic groups in North East India, is distinguished by its unique cultural heritage and social structure. Traditionally, Bodo society operates within a patriarchal framework; however, Bodo women hold a significant and influential role within their families and communities. Contrary to the notion that patriarchy stifles women's progress, Bodo women have managed to carve out substantial authority in both domestic and societal spheres. Their involvement in decision-making processes, although indirect in many cases, demonstrates their integral role in Bodo society. Historically, rural Bodo women have been central to the local economy, contributing significantly through agriculture, livestock management, and cottage industries. Their participation spans across various sectors, including crop production, weaving, poultry, piggery, and traditional crafts such as handicrafts and wine preparation. Despite the traditional and socio-cultural constraints, Bodo women have shown remarkable resilience and adaptability, leading to gradual empowerment and active involvement in economic activities. The economic contribution of Bodo women is pivotal, particularly in rural areas where agriculture remains the dominant activity. However, income generation in these regions has been slow, with limited productivity in traditional farming methods. Despite these challenges, Bodo women have sustained and enhanced their livelihoods through diverse activities, including weaving, poultry farming, piggery, and traditional industries. These activities not only preserve cultural heritage but also provide respectable incomes, although the overall financial impact is still modest compared to modern agricultural practices. This study seeks to delve into the entrepreneurial landscape of Bodo women, examining their roles and contributions within this socio-cultural and economic context. By

understanding the challenges they face and the opportunities available, the research aims to highlight how Bodo women navigate their entrepreneurial journeys and contribute to the broader economic development of their communities. The insights gained will be instrumental in identifying strategies to further empower Bodo women and enhance their economic impact, offering valuable implications for policy-making and development initiatives.

Objectives

1. To examine the participation of women in economic development efforts within Bodo society.
2. To understand the economic activities of Bodo women and analyze their current status concerning self-employment.

Methodology

The Analytical method is employed for collecting data and mainly based on primary and secondary sources. The data have been collected as primary information from the field survey in Bodo areas of Assam. Secondary data have been collected from the websites, journals, books, magazines, govt. reports and articles etc.

Discussions and Analysis

The Bodo economy has traditionally been sustained by agriculture, with support from additional activities like farming and hunting. The socio-economic system in Bodo society is closely linked to everyday life, social practices, culture, and religion. In the past, women in Bodo society were often economically disadvantaged and relied on men for financial support. However, this has changed over time, and today women are recognized as valuable economic contributors who help improve their family's financial situation. Approximately 75% of Bodo women participate in the informal labor force in both rural and urban areas. They are involved as home-based workers, managing family businesses, and working as self-employed entrepreneurs. Some women also work outside the home in sectors such as manufacturing, domestic services, and as street vendors. Historically, Bodo women have played a significant role in the economic development of their society, participating in a range of activities including household tasks, agriculture, horticulture, and animal husbandry, which are vital to their traditional way of life.

In rural Bodo communities, women are responsible for various day-to-day tasks such as gathering vegetables and edible foods from forests, cooking, and collecting firewood. In agriculture, Bodo women actively support their male counterparts, especially in planting paddy, harvesting, and reaping, which are considered primary duties. There is an equal participation rate of male and female workers in agricultural activities in rural areas, but the percentage of women engaged in agriculture is lower in urban areas. When it comes to traditional socio-economic activities such as livestock rearing,

forestry, fishing, and cottage industries, a higher percentage of women are involved compared to men. Additionally, in sectors like manufacturing, processing, servicing, and other socio-economic household industries, women tend to outnumber men in both rural and urban settings. Despite their involvement in these various sectors, women's participation rates in administrative, executive, professional, technical, and economic managerial roles remain low in Bodo society.

Agriculture Sector

Agriculture is the foundation of the Bodo society's livelihood and economy. More than 85% of the Bodo population depends on agriculture, working as farmers or agricultural laborers to sustain their livelihoods. This sector continues to support over 75% of the community, either directly or indirectly, and provides employment for more than 50% of the workforce. Compared to other communities in Northeast India, the Bodos' annual income is primarily derived from agriculture. As a rural tribal community, the Bodos rely heavily on natural resources, and the majority of households continue to engage in traditional agricultural occupations, which form the backbone of their economic life. While rural Bodos often stick to traditional methods of production, Bodo elites are adopting more modern, progressive agricultural practices. Common crops include mustard seeds, jute, and a variety of vegetables such as potatoes, cabbage, cauliflower, cucumber, gourd, green leafy vegetables, spices, chili, onion, and ginger. Historically, these crops were grown mainly to meet daily food needs, but today they are also produced for domestic consumption and sold in markets. About 30% of women participate in agricultural activities, particularly in rural areas. Castor plants are cultivated to produce Endi cocoons, a practice tied to both cultural traditions and home industries in spinning and weaving, especially for women. However, small and fragmented landholdings pose a significant challenge, leading to low productivity, as these holdings do not support the efficient use of modern agricultural technologies, such as machinery, chemical fertilizers, and hybrid seeds.

Farming Sector

Farming is another vital socio-economic activity for Bodo women, who significantly contribute to their families' economic well-being through farming. The farming sector can be categorized into animal husbandry and poultry. These have been crucial to the economic development of Bodo society since ancient times. Farming activities are key to generating self-employment and play a significant role in income generation for both rural and semi-urban communities. Traditionally, Bodo women raised common domestic animals such as pigs, goats, chickens, and ducks for food and for use in religious and social ceremonies. However, with the influence of globalization, Bodo women have increasingly become involved in commercial farming activities to support sustainable family economic development. Today, most domestic animals and poultry are raised for commercial purposes, with

products being sold in markets to generate individual income. About 95% of Bodo households rear domestic animals and poultry mainly for commercial purposes, and 25% of rural Bodo women actively participate in the farming sector to enhance their family's economic status and contribute to community development.

Sericulture and Weaving Sector

Sericulture is a crucial economic activity for Bodo women, known for its low investment and high returns within a short period, making it an attractive option for income enhancement and year-round employment. The Bodo community cultivates three major types of sericulture: Endi (eri), muga, and mulberry. Because of its profitability, a significant number of households are involved in sericulture activities, including sowing seeds, planting and maintaining host plants, plucking leaves, spinning and reeling yarn, weaving fabrics, and marketing cocoons and finished cloths. About 20% of rural women actively maintain sericulture and weaving as both a traditional practice and a source of income. Weaving holds a prestigious place as both a socio-economic and cultural activity among Bodo women, who are traditionally skilled in this craft. Weaving is considered dignified work and an essential cultural identity marker. Bodo women produce various types of traditional clothing, such as Dokhona, Fali, Aronai, Gamcha, and Hisima. Many Bodo women weavers are now engaged in handloom industries, driven by the need for economic development. The adoption of modern weaving technology has increased production rates and household incomes in both rural and urban areas. Weaving has thus become a primary livelihood for Bodo women, contributing to their economic empowerment.

Business Sector

The Bodo community benefits from its location in a region rich in natural resources, which offers advantages in trade and commerce. Rural Bodo women are more engaged in business activities than their urban counterparts, focusing on self-empowerment and socio-economic development. Many own micro, small, and medium enterprises, which significantly contribute to the community's economic growth by generating income and self-employment opportunities. Handloom industries and handicrafts provide golden opportunities for rural women to establish micro-enterprises, fostering local economic development. In the context of sericulture, Bodo women spin cocoons into yarn to weave cloth, and they also sell cocoons in the market to generate household income. Hand-woven cloths command a good price in the market. Bodo women are involved in small-scale businesses, such as producing and selling traditional rice beer, vegetables, traditional cloths, rice cakes, dry fish, and other locally made goods. Through the commercialization of locally demanded products, Bodo women are increasingly contributing to the economic development of their families and the community.

Service Sector

The service sector is another area where Bodo women are making socio-economic contributions. Historically, few Bodo women depended on service jobs for economic advancement. Currently, only about 5% of Bodo women work in the service sector, which includes both government and private employment. In government service, Bodo women are engaged in fields such as education, healthcare, banking, and other financial services. Many Bodo women also work in private sector roles, including hotels, restaurants, industries, companies, and real estate.

Co-operative Society and Self-Help Groups (SHGs)

Co-operative societies and Self-Help Groups (SHGs) play a significant role in the economic empowerment of Bodo women, especially in rural areas. These groups are voluntary associations of men or women with similar economic backgrounds. Members make small savings, accumulating enough capital to start lending within the group. Some women entrepreneurs, SHGs, and registered co-operative societies have established industries such as weaving, food processing, pig farming, and poultry farming in rural areas. These groups serve as vehicles for improving the livelihoods of the poor and marginalized, helping women engage in entrepreneurial activities. The success of co-operative societies and SHGs can lead to greater economic independence for women, enhancing their empowerment within society. Currently, Bodo women are becoming increasingly self-reliant, contributing to their family economies through these non-governmental groups.

Findings and Conclusion

- Rural Bodo women play a significant role in socio-economic development, more so than their urban counterparts.
- Agriculture, farming, weaving, business, and SHGs are the primary income sources for Bodo women.
- Due to a lack of skills and vocational training, Bodo women have not fully developed their potential in the socio-economic sector.
- The proportion of women who are self-employed in the private and public sectors is higher than those in the government sector.

It should be noted that low levels of education and skills, limited capital resources, low incomes, and high levels of segregation contribute to increasing unemployment. Bodo women's per capita incomes remain underdeveloped due to restrictions related to social norms, lack of market information, dependence on intermediaries, and other barriers. Despite these challenges, Bodo women participate

in various economic activities both within and outside their homes in rural and urban areas. However, seclusion and mobility constraints limit their access to information, training, credit, and opportunities. The impact of modern technology is gradually increasing women's economic participation, leading to improvements in education, rural incomes, and productivity among the Bodo community. The fields of agriculture, farming, weaving, and sericulture remain crucial for income generation and are deeply embedded in the socio-cultural fabric of the Bodo society.

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A Comparative Study of the Scaled Boundary Finite Element Method (SBFEM) and the Finite Element Method (FEM)

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Abstract

This paper presents a comprehensive comparison between the Scaled Boundary Finite Element Method (SBFEM) and the traditional Finite Element Method (FEM) in the context of structural and civil engineering applications. FEM has been widely used for decades in solving problems related to structural analysis, but SBFEM, as a relatively newer approach, offers several advantages, especially in dealing with unbounded domains, singularities, and problems with complex geometries. This study provides a detailed analysis of both methods, examining their theoretical foundations, computational efficiency, accuracy, ease of implementation, and versatility. Key aspects such as mesh generation, solution procedures, and handling boundary conditions are discussed. The results highlight the strengths and limitations of each method in various contexts, and the conclusion outlines the scenarios where SBFEM offers clear benefits over FEM, particularly in handling complex boundary problems with fewer computational resources.

Key Words: FEM, SBFEM, Unbounded Domains, Structural Analysis, Boundary Discretization

1. Introduction

The Finite Element Method (FEM) has long been regarded as a robust numerical method for solving partial differential equations (PDEs) in engineering, particularly in solid mechanics, fluid dynamics, and heat transfer. However, the emergence of the Scaled Boundary Finite Element Method (SBFEM) has provided an alternative approach, particularly effective in addressing certain limitations inherent in FEM. SBFEM, developed by Wolf and Song in the late 1990s, is a semi-analytical approach that combines elements of both FEM and boundary element methods (BEM), offering advantages in modeling unbounded domains and handling singularities.

This paper aims to explore the differences between these two methods in terms of their mathematical

formulation, computational complexity, accuracy, and practical applications. While FEM is well-established and widely adopted, SBFEM is gaining traction due to its capability in addressing certain types of problems more efficiently. This comparison will help engineers and researchers understand when SBFEM may be a better choice over FEM and viceversa.

2. Methodology

To compare the two methods, we will examine their mathematical formulations, computational procedures, and application scope. The study will focus on key areas such as:

- a) **Mathematical Formulation:** The mathematical formulation of the **Finite Element Method (FEM)** and the **Scaled Boundary Finite Element Method (SBFEM)** begins with discretizing the governing equations for structural mechanics problems, typically described by partial differential equations (PDEs) derived from continuum mechanics (e.g., equilibrium equations for static problems, equations of motion for dynamic problems).

FEM Mathematical Formulation

- i) **Discretization of the Domain:** In FEM, the domain is divided into smaller, simpler shapes called finite elements (e.g., triangles, quadrilaterals in 2D, tetrahedrons, and hexahedrons in 3D). Each element is connected at discrete points called nodes. These elements form a mesh that covers the entire geometry.
- ii) **Shape Functions:** Within each finite element, the solution (e.g., displacement, stress) is approximated by shape functions, which are typically low-order polynomials. The solution is expressed as:

$$u(x) = \sum_{i=1}^n N_i(x) u_i$$

Where, $u(x)$ is the approximated displacement, $N_i(x)$ are the shape functions, and u_i are the nodal values of the unknown variable (e.g., displacements).

- iii) **Weak Form of the Governing Equations:** To solve the PDEs, FEM uses the weak form (integral form) of the governing equations, which is derived using the method of weighted residuals or variational principles (such as the Principle of Virtual Work in structural mechanics). This leads to a system of algebraic equations of the form:

$$[K]\{U\} = \{F\}$$

Where, $[K]$ is the global stiffness matrix, $\{U\}$ is the vector of nodal unknowns (e.g., displacements), and $\{F\}$ is the global force vector.

SBFEM Mathematical Formulation

- i) **Subdomain Representation:** SBFEM does not discretize the entire domain into small elements. Instead, it divides the domain into subdomains where the boundaries of the subdomains are discretized. Each subdomain has a scaling center, and the solution is treated analytically along the radial direction from the scaling center and numerically in the tangential direction.
- ii) **Scaled Boundary Coordinates:** The subdomains are transformed into a local coordinate system where the radius ' r ' is scaled from the scaling center to the boundary. The governing PDEs are expressed in terms of these scaled boundary coordinates, reducing the original problem to a boundary-only discretization.
- iii) **Semi-Analytical Solution:** In the radial direction, the solution is obtained analytically, while in the tangential direction (along the boundary), numerical techniques are used. This hybrid approach allows for exact treatment of problems with singularities (e.g., crack tips) and semi-infinite domains.
- iv) **Boundary Matrices:** The discretized boundary in SBFEM leads to a system of equations in the form:

$$[A(r)] \frac{\partial^2 u(r, \theta)}{\partial r^2} + [B(r)] \frac{\partial u(r, \theta)}{\partial r} + [C(r)] u(r, \theta) = 0$$

Where, r is the radial distance and θ represents the tangential coordinates. The matrices $[A]$, $[B]$, $[C]$ depend on the boundary conditions and the geometry of the problem.

b) Computational Aspects

FEM

- i) **Mesh Generation:** In FEM, a mesh is created over the entire domain, dividing it into finite elements. The quality of the solution depends on the mesh density and the quality of the elements. For complex geometries, mesh refinement is needed, especially in regions with high stress gradients or singularities (e.g., near crack tips).
- ii) **Handling of Boundary Conditions:** Boundary conditions in FEM are applied directly to the nodes on the boundary. This can involve applying displacements, forces, or other

constraints. In some cases, creating a mesh that conforms well to the boundary is challenging, especially for complex geometries, and may require additional effort in mesh generation.

- iii) **Solution Algorithm:** FEM typically leads to a system of algebraic equations, which are solved using numerical techniques such as direct methods (e.g., Gaussian elimination) or iterative methods (e.g., conjugate gradient). The size of the system depends on the number of nodes and elements, and the computational cost increases with mesh density.

SBFEM

- i) **Mesh Generation:** Unlike FEM, SBFEM discretizes only the boundary of the subdomains, not the entire domain. This significantly reduces the number of elements and nodes required for the solution. For problems with infinite or semi-infinite domains (e.g., soil-structure interaction, acoustic wave propagation), this leads to reduced computational costs because only the boundary needs to be meshed.
- ii) **Handling of Boundary Conditions:** SBFEM simplifies the application of boundary conditions, as they are applied to the boundary of the subdomains. The method naturally incorporates boundary conditions at infinity, which is particularly useful for unbounded domains. This avoids the need for artificial boundary truncation, as in FEM.
- iii) **Solution Algorithm:** SBFEM results in a semi-analytical solution for the radial direction, while the tangential direction is treated numerically. This hybrid approach reduces the number of degrees of freedom compared to FEM. The resulting system of equations is typically smaller than in FEM, allowing for faster computations and easier handling of large-scale problems.

c) Practical Applications

FEM Applications

FEM is widely used in a variety of engineering fields for solving problems related to structural mechanics, fluid dynamics, heat transfer, and more. Some typical applications include:

- ❖ **Stress analysis in structures:** FEM is used extensively to calculate stress, strain, and deformation in structures under various loading conditions.
- ❖ **Vibration analysis:** FEM is used to calculate natural frequencies and mode shapes in mechanical and civil engineering systems.
- ❖ **Thermal analysis:** FEM is applied to solve problems involving heat transfer in solid

bodies, including conduction, convection, and radiation.

Example:

In structural engineering, FEM is used to analyze a bridge under dynamic loading (e.g., traffic or wind loads). A detailed mesh is created over the entire structure, and the stresses and displacements are calculated at each node. If the mesh is too coarse, the accuracy of the solution will suffer, particularly near stress concentrations (e.g., at support points).

SBFEM Applications

SBFEM excels in specific applications where FEM might struggle, such as problems with singularities, unbounded domains, or highly complex geometries. Some typical applications include:

- ❖ **Crack propagation:** SBFEM is particularly useful for fracture mechanics problems because it handles stress singularities at crack tips more efficiently than FEM.
- ❖ **Soil-structure interaction:** In geotechnical engineering, SBFEM can model infinite domains (e.g., soil extending to infinity) without artificial truncation of the domain, as is required in FEM.
- ❖ **Wave propagation:** SBFEM is effective in solving problems involving acoustic or elastic wave propagation in unbounded domains.

Example:

In fracture mechanics, SBFEM is applied to simulate crack propagation in a material under cyclic loading. Unlike FEM, which would require fine mesh refinement around the crack tip, SBFEM can accurately represent the stress singularity at the crack tip using its semi-analytical solution in the radial direction. This leads to a more efficient simulation with fewer elements and faster computational times.

Both FEM and SBFEM have their strengths and weaknesses. FEM is a versatile and well-established method, suitable for a wide range of applications. However, its reliance on fine meshing can make it computationally expensive for problems involving singularities or unbounded domains. SBFEM, by contrast, provides significant computational advantages in these areas, particularly for problems involving crack propagation, infinite domains, and stress singularities.

3. Comparative Analysis: SBFEM vs FEM

3.1 Mathematical Formulation

The FEM discretizes the entire domain into small finite elements, where the solution is approximated

over each element. In FEM, the domain is subdivided into small finite elements, and the governing equations are solved for each element. The accuracy of FEM depends on the number and quality of the elements. Typically, FEM is used to solve a wide variety of boundary value problems, and it excels at providing accurate solutions for complex geometries with well-defined boundaries.

SBFEM, on the other hand, represents a hybrid approach that uses a combination of finite and boundary element methods. In SBFEM, the problem domain is divided into subdomains, and within each subdomain, a scaling center is selected. The boundary of the subdomain is discretized, and the governing equations are solved in the radial direction analytically, while the tangential direction is solved using numerical techniques. This allows SBFEM to handle singularities and infinite domains more efficiently than FEM.

3.2 Mesh Generation

One of the key differences between FEM and SBFEM is in mesh generation. FEM requires a fine mesh throughout the entire domain to achieve high accuracy, particularly in regions of high stress gradients or where singularities are present. This can result in a significant computational cost, especially in three-dimensional problems.

In contrast, SBFEM requires discretization only along the boundaries of subdomains, reducing the number of elements and degrees of freedom. This is particularly advantageous in problems with infinite or semi-infinite domains, such as soil-structure interaction problems or unbounded acoustic fields. As a result, SBFEM can achieve comparable or even superior accuracy to FEM with fewer elements, reducing the computational effort required.

3.3 Singularities and Infinite Domains

FEM struggles with singularities, such as stress concentrations at crack tips or sharp corners. To capture these singularities accurately, FEM often requires mesh refinement in the regions surrounding the singularity, which increases the computational cost.

SBFEM excels at handling singularities because it allows for an analytical representation of the solution in the radial direction from the scaling center. This makes it particularly suitable for problems involving cracks or other geometric discontinuities, where FEM may require extensive mesh refinement. Additionally, SBFEM is well-suited for problems involving infinite or semi-infinite domains, where FEM would need to artificially truncate the domain and apply approximate boundary conditions.

3.4 Handling Boundary Conditions

In FEM, boundary conditions are applied directly to the nodes on the boundary of the mesh. For complex boundary geometries, generating an appropriate mesh that aligns with the boundary conditions can be challenging and time-consuming.

SBFEM simplifies the application of boundary conditions by discretizing only the boundaries of the subdomains. This allows for greater flexibility in handling complex boundary geometries and reduces the difficulty of mesh generation. Additionally, SBFEM naturally incorporates boundary conditions at infinity, making it more efficient for problems with unbounded domains.

3.5 Computational Efficiency

FEM is generally computationally intensive, especially for three-dimensional problems or problems with complex geometries. The need for fine meshing in regions of high stress gradients or singularities increases the computational effort, both in terms of memory usage and solution time.

SBFEM offers significant computational advantages, particularly in problems with infinite domains or singularities. By reducing the number of elements required and focusing on boundary discretization, SBFEM can achieve comparable accuracy to FEM with a lower computational cost. This makes SBFEM an attractive option for large-scale problems or problems where computational efficiency is a critical factor.

3.6 Accuracy and Convergence

Both FEM and SBFEM are capable of providing accurate solutions to engineering problems. However, the accuracy of FEM is highly dependent on the quality and density of the mesh, particularly in regions of high stress gradients or singularities. In cases where the mesh is not sufficiently refined, FEM may produce inaccurate results.

SBFEM, due to its semi-analytical nature, is able to achieve high accuracy with fewer elements, particularly in problems involving singularities or infinite domains. The method's ability to represent the solution analytically in the radial direction allows for better handling of stress concentrations and other singularities without the need for extensive mesh refinement.

4. Results

The results from the comparative study demonstrate the strengths and weaknesses of both methods. In benchmark tests involving stress analysis in complex geometries and unbounded domains, SBFEM outperforms FEM in terms of computational efficiency, requiring fewer elements to achieve

the same level of accuracy. Additionally, SBFEM's ability to handle singularities and infinite domains without extensive mesh refinement makes it a more efficient option for certain types of problems.

However, FEM remains a robust and versatile method, particularly for problems with well-defined boundaries and regular geometries. In such cases, FEM provides highly accurate results with well-established algorithms and software implementations.

5. Conclusion

The comparison between SBFEM and FEM highlights the advantages and limitations of each method. FEM is a well-established and versatile numerical method that excels in solving a wider range of engineering problems, but it requires fine meshing and can be computationally expensive for problems involving singularities or infinite domains.

SBFEM, on the other hand, offers a semi-analytical approach that provides significant computational advantages in problems involving complex geometries, singularities, and infinite domains. Its ability to achieve high accuracy with fewer elements makes it an attractive alternative to FEM in certain applications. However, SBFEM is not yet as widely adopted or implemented in commercial software as FEM, which may limit its accessibility to engineers and researchers.

Future research and development of SBFEM could lead to wider adoption of the method, particularly in large-scale engineering problems where computational efficiency is a key factor.

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THE TRENDS OF JUVENILE DELINQUENCY IN ARUNACHAL PRADESH

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Abstract: Children are the greatest resource and very important asset of the nation. They are the life veins of society. If nurtured and taken care of, the children would bring development in the state and steer the country to the right direction. Wrong company and harmful surroundings can spoil the innocent soul and turn the child into a delinquent. But we know that to think of crimeless society is a myth, as man by nature is a fighting animal. The recent rise in crime is alarming. What is more surprising is the rise in crime committed by the juveniles in the Tribal State like Arunachal Pradesh. The JJA 2015 was signed and made into law by the president on 31st December 2015. After coming of the Juvenile Justice Act, the Juvenile Justice system in Arunachal Pradesh has drastically changed. The Juvenile Justice Board has been delivering the justice needed for the welfare of children is.

INTRODUCTION

Arunachal Pradesh, meaning the 'the land of rising sun' and popularly known also known as the 'Land of Dawn lit Mountains' is situated in the extreme North-East of India. The word 'Aruna' means charioteer of Sun god and 'Achal' means Mountain. In this state Sun appears first in India. It was formed from the North-East Frontier Agency (NEFA) region, and India declared it as a state on 20 February 1987.¹

The **North-East Frontier Agency (NEFA)**, originally known as the **North-East Frontier Tracts (NEFT)**, was one of the political divisions in British India and later the Republic of India until 20 January 1972, when it became the Union Territory of Arunachal Pradesh and some parts of Assam. Its administrative headquarters was Shillong (until 1974, when it was transferred to Itanagar). It received the status of State on 20th February 1987.²

The total area of Arunachal Pradesh is 83,743 square kilometers (32,333 sq mi). The State is bounded by independent countries on three sides and by Assam and Nagaland states by one side. There are Bhutan, Tibet, China and Myanmar to the west, north-east, north and east of this state respectively, and to the south it sharing its boundaries with Indian states like Assam and Nagaland. It is the largest North Eastern states in the country. Arunachal Pradesh is situated in the north-eastern tip of India

approximately between the latitudes 26.28° N latitude 91.20° E and 97.30° E.³

Arunachal Pradesh is home to dozens of distinct ethnic groups, most of which are in some ways related to the peoples of Tibet and the hill region of western Myanmar. More than two-thirds of the state's people are designated officially as Scheduled Tribes, a term that generally applies to indigenous peoples who fall outside of the prevailing Indian social structure. There are total of 28 districts in the state of Arunachal Pradesh please refer to Table No.4.

Arunachal Pradesh has 1283727 population with 26.00 percentage of decadal growth rate

2001-2011. The Sex ratio is 938(females per 1000 males) and the literacy rate is 65.38 as per the census of India 2011.⁴

At present there are 28 districts in the state of Arunachal Pradesh.⁵ As per the Ministry of Development of North East, the number and diversity of languages/dialects spoken in Arunachal Pradesh are not conclusively known. 30, possibly 50, distinct languages/dialects in addition to innumerable dialects and sub-dialects coinciding with tribal areas are in use. Some of them are Nyishi, Apatani, Miji, Adi, Galo, Wancho, Tagin, Monpa, Nocte, Aka, Tangsa, Khamti,. Vast majority of them belong to the Tibeto – Burman. language family. Hindi is making constant inroads. Nagamese is fairly widely used as a link language in some areas.

As per the report of The Technical Group by the National Commission, the population of Arunachal Pradesh is projected to be 1,565,000 or 1.57 million or 15.65 lakhs as of July 1, 2023. Arunachal Pradesh is the 26th most populous state in India. In 2023, the sex ratio of the total population in Arunachal Pradesh is 105.650 Males per 100 females. There are 8,04,000 males and 7,61,000 females in Arunachal Pradesh. Arunachal Pradesh has 43,000 more males than females.⁶

2 METHODS OF ANALYSIS:

The various methods are used for analyzing the crime distribution of this state. These methods have developed the researchers to reach the correct conclusion. The raw data have been processed and a percentage of juvenile crimes to total crimes have been calculated using the area. On the basis of intensity and magnitude, the ranking of offences from highest intensity to lowest intensity has been made. Columns are being drawn to show age, sex wise distribution.

The Tables are being prepared to depict crime head wise as received from Arunachal Pradesh Police. In this chapter, the juvenile delinquency analysis is made as follows:

1. Overview of the crimes occurred in the state of Arunachal Pradesh.
2. Age and sex wise, contribution of the Crime.
3. The chapter includes crime wise ranking of offences.

The nature and statistics of Juvenile delinquency are published by the National Crime Record Bureau (NCRB), Delhi. It is the main source of data from where the researcher has collected the maximum data. Juvenile statistic is usually hard to find as the family hardly disclose the name of the juvenile offender. The crime committed by Juvenile goes mostly unnoticed by the court and police. And most of time even parents don't want to disclose the crime committed by the delinquents as a matter of prestige.

3 ARUNACHAL PRADESH AND JUVENILE DELINQUENCY

The Society has many problems in today's modern era. Among various problems, one of the major problems is the Juvenile delinquency. The Children is the asset of the state. And if the children are going astray or out of the normal path, it is a major cause of concern. Arunachal Pradesh has received the status of State on 20th February 1987. Compared to other mainland states, Arunachal Pradesh is still in its nascent period and developing day by day on its own pace.

Juvenile Delinquency is a major security problem in the North East in general and Mizoram and Arunachal Pradesh in particular. It can become a major security/law and order problem at a later date if it is not addressed at right time, as a petty thief at tender age may become a hardcore criminal/dreaded terrorist in days to come. It is definitely easier to address Juvenile Delinquency in the embryonic stage itself rather than being confronted by hardened and totally motivated militants/hardcore criminals in the future.⁷

To study the gravity of the Juvenile Crime in Arunachal Pradesh, the researcher has collected data related to the child population of India and Arunachal Pradesh along with the Juvenile Crimes. The figures have been prepared in the tabulation for easier understanding.

Also, the crime data has been collected from the sources such as the National Crime Report Bureau, Govt of India's portal. The analysis of the data has been made to the various crime committed by the Juveniles in the state. And the crimes are categorized one by one.

I. Child Population of India.

Table 4.2All India Child Population							
0-6 years		0-14 years		0-18		Total Population	
Male	Female	Male	Female	Male	Female	Male	Female
857522 54	787629 99	1943513 75	1780927 41	2474893 56	2246221 21	6232702 58	58758447 19
Total - 164515253		Total- 372444116		Total - 472111477		Total-6499114977	
Source: Census of India 2011, Registrar General of India							

II. Child Population of Arunachal Pradesh.

Table: 4.3 Child Population of Arunachal Pradesh							
0-6 years		0-14 years		0-18		Total Population	
Male	Female	Male	Female	Male	Female	Male	Female
107624	104564	249602	243759	315516	308093	713912	669815
Total- 118188		Total-268719		Total-623609		Total-780727	
Source: Census of India 2011, Registrar General of India							

As per the Census of India 2011 report, percent share of the Child population of total population in India is 3.9 %. The total percent of child population in Arunachal Pradesh is 45.1%. The male consists of 44.2% and the Females consist of 46.0%. Female population is higher than the male population. With the projected Child population, the Juvenile resources have to utilized in the right manner. The Children are hope of the future

III. Incidence Rate of Juvenile Crimes from the year 2017-2022 in India and Arunachal Pradesh.

The Times of India reported that the state of Arunachal Pradesh records 9% drop in the cognizable crimes in the year in 2022⁸. In the year 2022, the State recorded, 2308 cases registered under the Indian Penal Code, in comparison to 2,626 recorded in the year 2021. The drop in overall IPC crime was pleasant news for the State. But the Juvenile related crime has increased over the time, which is a cause of concern. The children are the future of the state, so, it reflects the kind of future the state will have. The Arunachal Pradesh is a tribal State with a close knitted family and community system. The current trend of modernization as well as urbanization has brought about many untold stories which have directly or indirectly affected that society. Every now and then there is a report in the social media, press relating to Juvenile delinquents.⁹

Table No.4.4 depicts the crime rate of Arunachal Pradesh compared to the crime rate of all India. The crime in India was highest in 2017 with 33606 crimes being committed by the Juveniles. From 2017-2022, the highest rate of crime committed by the Juveniles. Arunachal Pradesh was in the year 2018 with crime rate rising to 6.6 percent. From the year 2017 to 2022 as per NCRB total of 141 crimes was committed by the Juveniles in the state of Arunachal Pradesh.

Table No. 4.4 Incidence Rate of Juvenile Crimes per 100000 Pop. From the year 2017-2022 in India and Arunachal Pradesh.							
Sr. No	Year	India Crime committed by Children	Actual Children in Population of India(in Lakhs)	Rate of Total Crime against Juveniles	Crime Committed in Arunachal Pradesh	Actual Children in population of Arunachal Pradesh (in lakhs)	Rate of Total Crime by Juveniles (2022)
1	2017	33606	4458.0*	7.5	48	4.7	10.3
2	2018	31591	4458.0*	7.1	31	4.7	6.6
3	2019	32269	4458.0*	7.2	24	4.7	5.1
4	2020	29768	4441.5**	6.7	15	5.9	2.5
5	2021	31170	4441.5**	7.0	8	5.9	1.4
6	2022	30555	4441.5**	6.9	15	5.9	2.5
	Total	188959			141		
*Estimated Mid- year population of children (below18 years) of the year 2014.							
** (Actual Population of Children as per the Population Census 2011							
<i>Sources: NCRB Report 2017-2022 Crime in India</i>							

IV. Crime head wise categorization by the Juvenile Delinquents in Arunachal Pradesh.

The total Juvenile apprehended is 141 from the year 2017-2022. The highest number of IPC case was reported in the year 2017 with 46 number of Juvenile apprehended followed by 31 in 2018 and 24 in 2019. In 2021, the total number Juvenile apprehended was 3, which marks the lowest from 2017 to 2022.

The SLL crime was highest in the year 2021 with 5 juveniles apprehended. From the year 2018 to 2020, the juveniles reported are nil. All total, 9 Juveniles have been apprehended from the year 2017 to 2022 under SLL crimes in Arunachal Pradesh.

Table: 4.5 Juveniles apprehended based on IPC and SLL in the year 2017-2022			
Sl. No	Year	Apprehended based on IPC Crimes	Apprehended based on SLL Crimes
1	2017	46	2
2	2018	31	0
3	2019	24	0
4	2020	15	0
5	2021	3	5
6	2022	13	2
	Total	132	9
<i>Sources: NCRB Report 2017-2022 Crime in India</i>			

V. Crimes committed by the Juveniles under Indian Penal Code.

The Total number of IPC Crime committed by the Juveniles from the Year 2017 to 2022 is 133. (Refer Table 5). Offences against the Property are greater than the offences against the body. The details of the crime and its gravity will be studied in detail.

Table 4.6 IPC Crimes category committed by Juveniles in Arunachal Pradesh.								
Sl. No.	Cognizable IPC Crimes/Year	2017	2018	2019	2020	2021	2022	Total
1	Offences Affecting the Human Body	10	11	14	5	2	4	46
2	Offences against State	0	0	0	0	0	1	1
3	Offences against public Tranquility	0	0	0	0	0	0	0
4	Offences relating to property	30	14	8	7	1	7	67
5	Offences against documents and property Mark	1	0	0	0	0	0	1
6	Miscellaneous IPC crimes	2	2	1	1	0	1	7
7	Other IPC crimes	3	4	1	2	0	1	11
	Total	46	31	24	15	3	14	133
<i>Sources: NCRB Report 2017-2022 Crime in India</i>								

Table: 4.7 Top IPC crimes Committed by the Juveniles under offences against body in the State of Arunachal Pradesh.								
Sl. No	Offences against the body as per NCRB 2022 report	2017	2018	2019	2020	2021	2022	Total
1	Hurt& Grievous Hurt	2	7	6	3			18
2	Attempt to Commit Murder (Sec. 307 IPC)	2						
4	Kidnapping and Abduction (Sec 363-369 IPC)	1	1	1			1	5
5	Murder (Sec 302 IPC)	2				1		3
6	Culpable Homicide not amounting to Murder				1			1
7	Rape (sec 376 IPC)			4		1	1	6
8	Attempt to Commit rape 376/511					1		
9	Causing Death by Negligence (304-A IPC)	1		1	1			3
10	Assault on Women with Intent to Outrage her Modesty (Sec. 354 IPC)	2	1	2			1	6
							Total	42
<i>Sources: NCRB Report 2017-2022 Crime in India</i>								

VI. Top IPC Crimes committed by Juveniles under offences against body in Arunachal Pradesh.

The rise in crime in the category of offences against body is cause of concern. According to Yamini Abde, a child rights campaigner, one of the driving motivations behind children being involved in horrible crimes like rape and murder is the desire to do something new, brave, unique, and thrilling. Peer pressure, a need for quick cash, and easy access to crime and pornographic images on the internet increased hostility and sexual activity among teenagers, as well as the awareness that they will not face criminal charges since they are minors, are also catalysts in the process of building a child offender. The lack of fear of punishment has resulted in an increase in the rate of criminality among minors.¹⁰

VII. Top IPC crimes Committed by the Juveniles under offences against property in the State

Table: 4.8 Top IPC crimes Committed by the Juveniles under offences against property in the State of Arunachal Pradesh.								
Sl. No	Offences against the Property	2017	2018	2019	2020	2021	2022	Total
1	Theft	10	10				6	26
2	Burglary (Sec-454 r/w Sec380 IPC)	14	4				1	29
3	Extortion & Blackmailing 389 IPC	4						4
3	Dacoity	1						1
4	Robbery (Sec.392/394/397 IPC)	1						1
5	Forgery Cheating & Fraud	1						1
6	Rash Driving on Public Way (Sec.279/r/w 336/337/338/other IPC)	2	1				1	4
7	Criminal Trespass Sec.447 to 452		1					1
	Total Crimes						67	
8	Miscellaneous IPC Crimes						1	1
9	Other IPC Crimes	3	41				1	45
<i>Sources: NCRB Report 2017-2022 Crime in India</i>								

A petty crime in general and heinous crimes in particular is being committed regularly in India by children. Crimes such as theft, burglary, snatching which are not so serious in nature or crimes such as robbery, dacoity, murder and rape, etc., which are relatively serious are on the rise in whole of the country. And the unfortunate thing is that all types of these crimes are also being committed by children below the age of 18 years.¹¹ The crimes by juveniles are studied one by one in details, so as to know and to get the firsthand knowledge of the kind of crime majorly committed by Juveniles in the State of Arunachal Pradesh.

The crimes by juveniles are studied one by one in details, so as to know and to get the firsthand knowledge of the kind of crime majorly committed by Juveniles in the State of Arunachal Pradesh.

a. Theft

‘Theft’ is defined under Section 378 of the Indian Penal Code, 1860, which states that any person with a dishonest intention to take any movable property out of the possession of a person without the person’s consent to whom it belongs moves that property is said to commit theft. Thefts come under offence against property. In simple word a theft means taking away someone’s belonging without his

or her consent. Theft is mostly money motivated. The Juvenile finds it easiest kind of crime, where no much of physical or muscle power is needed to commit such offence. If not caught, the thinks stolen adds to the benefit of young offenders. Basically, it is kind of easiest means of offence where risk factors are not much compared to other crimes. Most of the juveniles are a habitual shop lifter.¹²

b. Hurt

The Hurt, is defined in Section 319 of the IPC. It is an act of inflicting another person bodily pain, disturbance, or sickness. The term ‘hurt’ refers to the effect of an action that causes bodily anguish, discomfort, or injury to a person’s body, which may include pain, disarray, or even a temporary health issue. And the Grievous hurt refers to a type of bodily injury that is more severe in nature. Sections 320 to 338 of the IPC go into great detail on severe hurt. It includes a variety of particular injuries that are deemed more severe because they have the potential to inflict more injury, agony, or long-term implications to the person. The intensity of pain degree of pain inflicted is the difference in distinguishing Hurt and the Grievous Hurt.

Under “Offences against Body” of IPC Crimes, Hurt & Grievous Hurt are one of the dominant Crime in the State of Arunachal Pradesh.

c. Burglary

According to Section 446 of IPC, whoever commits house breaking after sunset and before sun rise, is said to commit house breaking by night. Basically, house breaking by night is termed as burglary.

This breaking can include actions such as forcing opening a door, or constructive, such as by fraud or threats etc. Entering means either physical entry by a person or any insertion of an instrument to remove property. It is an unlawful entry into a building or any other location with an intention of committing an offence. Mostly this offence is theft, but sometimes may jurisdictions include others within the ambit of burglary.¹³

The Burglary is one of the top-ranking crimes committed by Juveniles in the State of Arunachal Pradesh. The crime is mostly committed in the cities.

The Burglary is committed during night. The Juveniles finds it safer in the night time to commit the crime when the people are out of sight. Most of the item stolen are the electronic items such as Laptops, mobiles etc. Some of the Juveniles are habitual offenders but most of them commit in the heat of the moment.¹⁴

d. Extortion and Blackmailing (389 IPC)

According to IPC, Whoever, in order to the committing of extortion, puts or attempts to put any person in fear of an accusation, against that person or any other, of having committed, or attempted to

commit, an offence punishable with death or with imprisonment for life, or with imprisonment for a term which may extend to ten years, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

In simple words, extortion is an offence where a person forces another person to transfer his property or valuable security under the fear of an injury or threat. Extortion is punishable under Section 384 of the Code, 1860. In Arunachal Pradesh, from the year there are 4 reported numbers of extortions committed by the juveniles from the year 2017 to 2022.

From time-to-time cases of extortion of shopkeepers, mobile-snatching incidents from pedestrians and night burglary cases were reported in the Newspaper. For an instant, in a Telegraph India, there was a an official statement from the police, which that, 10 people were arrested for their alleged involvement in several cases of mobile snatching, burglary and extortion from various parts of Itanagar.¹⁵

e. Kidnapping and Abduction (Sec 363-369 IPC)

From 2017-2022, there are 4 numbers of the extortion case by Juveniles. But many cases go unreported due to various other reasons such as fear of being retaliated by the youngster. **Kidnapping and Abduction (Sec 363-369 IPC)**Section 362 says that whoever by force compels or by any deceitful induce any person to go from anyplace is said to abduct that person.

f. Rape (sec 376 IPC) & Assault on Women with Intent to Outrage her Modesty (Sec. 354 IPC):

Rape under Section 375 of the Indian Penal Code is defined as "sexual intercourse with a woman against her will, without her consent, by coercion, misrepresentation or fraud or at a time when she has been intoxicated or duped, or is of unsound mental health and in any case if she is under 18 years of age." There is total of 6 Rape case reported to be committed by the Juveniles from the year 2017 to 2022. The highest number of the cases was committed in the year 2019.

As per the Indian Penal Code, Assault on Women with Intent to Outrage her Modesty has been defined in Sec. 354 of IPC. Whoever assaults or uses criminal force to any woman, intending to outrage or knowing it to be likely that he will there by outrage her modesty, shall be punished with imprisonment of either description for a term which shall not be less than one year but which may extend to five years, and shall also be liable to fine. There are six cases of Assault on women reported from the year 2017-2022. These are the two of the most prominent crime committed by Juveniles against the Women as per IPC crime in Arunachal Pradesh.

g. Culpable Homicide, Murder (IPC 302) and Attempt to Commit Murder (Sec. 307 IPC).

Under Offences against the body as per NCRB report of Crime in India, Culpable Homicide not

amounting to Murder, Murder under 302 and Attempt to Commit Murder (Sec. 307 IPC) are the offences committed by the Juveniles.

The word “culpable homicide” refers to the act of killing another human. According to the provision, culpable homicide is committed when the act that causes death is done with the purpose to cause death or with the knowledge that it is likely to cause death. It also encompasses circumstances when the act is committed with the purpose to inflict bodily harm that is likely to result in death, or with knowledge that such bodily harm is likely to result in death.

Murder is one of the most serious offences under the IPC and is punished by life imprisonment or the death sentence. However, not all homicides are considered murder by the law. In some cases, a person may be charged with culpable homicide, which is a lower offence than murder.¹⁶

In Arunachal Pradesh from the year 2017-2022 there are 3 offences of Murder, 1 Culpable Homicide and 2 attempt to murder under 307 IPC reported.

The word “culpable homicide” refers to the act of killing another human. According to the provision, culpable homicide is committed when the act that causes death is done with the purpose to cause death or with the knowledge that it is likely to cause death. It also encompasses circumstances when the act is committed with the purpose to inflict bodily harm that is likely to result in death, or with knowledge that such bodily harm is likely to result in death.

Murder is one of the most serious offences under the IPC and is punished by life in prison or the death sentence. However, not all homicides are considered murder by the law.

h. Rash Driving on Public Way under Sec.279:

Rash Driving on Public way under Sec. 279, is also a common crime committed by the Juveniles in Arunachal Pradesh. When it comes to rash driving, in simple words, it can be described as driving a vehicle without following the safety rules and violating the driving rules. The careless behavior of the driver is often the cause of the rash and negligent driving. The young minds often get distracted while driving and most of the time lack of experience also tends to make the Juveniles commit the crime. The distraction caused by the mobiles and gadgets while driving is also one of the major factors in rash driving.

i. Causing Death by Negligence (304-A IPC).

Whoever causes the death of any person by doing any rash or negligent act not amounting to culpable homicide, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both. In the legal field ‘negligence’ can be defined as an act or omission that causes damages to the property of another person. Here in this Section of the Indian Penal Code the term rash or negligent act can be defined as an act that is the immediate cause

of death. There is a difference between these terms (rash and negligent) also. By ‘rash act’ we mean any act which is done restlessly. By the term ‘negligent act’ we mean a breach of duty due to omission to do something, which a reasonable man will do.¹⁷

There are three cases of causing death by negligence by the juveniles from the year 2017-2022.

I. Crimes committed by the Juveniles under Special Local Law.

Table 4.9 SLL crimes category committed by Juveniles (2017-2022)							
SL.No	Cognizable SLL Crimes/Year	2017	2018	2019	2020	2021	2022
1	Crime against Women-related Acts	0	0	0	0	0	0
2	Children Related-Acts	1(POCSO)	0	0	0	0	
3	Narcotic Drugs &Psync. Sub Act.					5	2
9	Environment&Pollution-Related Acts	1(The Wild life Protection Act, 1972)	0	0	0	0	
	Other SLL Crimes	0	0	0	0	0	
	Total cognizable crime	2	0	0	0	5	2
<i>Source: NCRB reports (2017-2022) Crime in India</i>							

The Special Local Law (SLL) has lesser number of Crimes compared to the IPC Crimes. In the SLL Crimes, maximum numbers of crimes are committed by Juveniles relating to Narcotic Drugs & Psych. Sub Act. And one case of Environment & Pollution Related Acts was reported in 2017.

Drugs are one of the major crimes of present time. It is prevalent everywhere especially in the Northeast India, due to its international boundary with country as Myanmar, Burma, Bangladesh etc. A significant portion of the population in Northeast India is young and vulnerable to drug abuse. Peer pressure, lack of awareness, and easy availability of drugs contribute to the rising number of drug users.

4.4 JUVENILE JUSTICE SYSTEM IN ARUNACHAL PRADESH.

There are no coded customary laws with regard to the punishments to the Juvenile delinquents in the State of Arunachal Pradesh. The simple case of thefts etc., were punished in the kinds or goods such as ornaments or animas (Mithuns). The Juvenile delivery system of Arunachal Pradesh mainly focuses around the Juvenile Justice Board (JJB) constituted under Sec. 4 of the Juvenile Justice (Care and Protection of Children) Act 2015.

The JJA 2000 introduced a revolutionary change in the constitution of the Juvenile Court, renamed it as the Juvenile Justice Board consisting of three members- One Magistrate designated as Principal Magistrate, and two social workers as the members of the Board vested with

the powers of the Magistrate. Similar Provision has been made in JJA 2015. In Arunachal Pradesh, the working of Juvenile Justice is guided by the “the Arunachal Pradesh Juvenile justice (care and protection of children) rules, 2020”.¹⁸

The JJB Board is functional in all the 25 districts of Arunachal Pradesh including the Itanagar Capital Complex(ICC).¹⁹ (except for the two newly created Keyi Panyor and Bichom), The Juveniles in Conflict with Law (Sec.2(i)) as soon as, is apprehended by the police, such child shall be placed under the charge of the special juvenile police unit or the designated child welfare police officer, who shall produce the child before the Board without any loss of time but within a period of twenty-four hours of apprehending the child excluding the time necessary for the journey, from the place where such child was apprehended.²⁰

As per the **Section 18** of JJA 2015 following orders are taken regarding child found to be in conflict with law:

(1) Where a Board is satisfied on inquiry that a child irrespective of age has committed a petty offence, or a serious offence, or a child below the age of sixteen years has committed a heinous offence,²¹ [or a child above the age of sixteen years has committed a heinous offence and the Board has, after preliminary assessment under Section 15, disposed of the matter] then, notwithstanding anything contrary contained in any other law for the time being in force, and based on the nature of offence, specific need for supervision or intervention, circumstances as brought out in the social investigation report and past conduct of the child, the Board may, if it so thinks fit, —

(a) allow the child to go home after advice or admonition by following appropriate inquiry and counselling to such child and to his parents or the guardian;

(b) direct the child to participate in group counselling and similar activities;

(c) order the child to perform community service under the supervision of an organization or institution, or a specified person, persons or group of persons identified by the Board;

(d) order the child or parents or the guardian of the child to pay fine:

Provided that, in case the child is working, it may be ensured that the provisions of any labour law for the time being in force are not violated;

(e) direct the child to be released on probation of good conduct and placed under the care of any parent, guardian or fit person, on such parent, guardian or fit person executing a bond, with or without surety, as the Board may require, for the good behaviour and child's well-being for any period not exceeding three years.

(f) direct the child to be released on probation of good conduct and placed under the care and supervision of any fit facility for ensuring the good behaviour and child's well-being for any period

not exceeding three years;

(g) direct the child to be sent to a special home, for such period, not exceeding three years, as it thinks fit, for providing reformatory services including education, skill development, counselling, behaviour modification therapy, and psychiatric support during the period of stay in the special home: Provided that if the conduct and behaviour of the child has been such that, it would not be in the child's interest, or in the interest of other children housed in a special home, the Board may send such child to the place of safety.

(2) If an order is passed under clauses (a) to (g) of sub-section (1), the Board may, in addition pass orders to :—

- (i) attend school; or
- (ii) attend a vocational training centre; or
- (iii) attend a therapeutic centre; or
- (iv) prohibit the child from visiting, frequenting or appearing at a specified place; or
- (v) undergo a de-addiction programme.

(3) Where the Board after preliminary assessment under section 15 pass an order that there is a need for trial of the said child as an adult, then the Board may order transfer of the trial of the case to the Children's Court having jurisdiction to try such offences.

4.5 NUMBER OF JUVENILE CASE DISPOSED FROM 2017-2022

Table 4.10 Disposal of IPC& SLL Juveniles Apprehended in the JJB from 2017-2022								
	Arunachal Pradesh	Year						
Sl.No		2017	2018	2019	2020	2021	2022	Total
1	Number of Juveniles whose Cases pending disposal at the beginning of the Year	13	73	100	92	38	57	373
2	Juveniles Apprehended during the year	98	62	39	33	25	33	290

	Total number of Juveniles Apprehended	111	135	139	125	63	90	663
4	Juveniles discharge during Investigation (Cases Un-Occurred/Quashed/Discharge by the Courts)	8	14	6	45	0	5	78
5	Juvenile sent home after advice or admonition	4	5	21	18	3	0	51
6	Juveniles Sent to Special Home or fit Institute	4	13	8	6	3	9	43
7	Juvenile dealt with fine	0	19	2	0	3	0	24
8	Juveniles awarded Imprisonment	0	0	0	0	0	0	0
9	Juveniles Acquitted or discharged	0	0	0	18	0	0	18
10	Percentage of Juveniles held Guilty	100.0	100.0	100.0	57.1	100.0	100	
11	Pending Disposal (2 to 8)	95	84	102	38	57	76	452

Source: NCRB reports (2017-2022) Crime in India

The National Crime Report Bureau has collected data from the state about the disposal of Juveniles arrested and presented every year. The study has been made from 2017-2022.

The number of Juveniles cases pending for disposal at Juvenile Justice Board is a serious problem faced by the State. There are total of 452 cases to be disposed of from 2017 to 2018. The Total number of Juveniles apprehended from the year 2017-2022 is **663** in numbers, which is alarming for the peaceful state like Arunachal Pradesh. The Highest being in the year 2019 with 139 Juveniles apprehended.

The total number of Juveniles discharge during Investigation (Cases Un-Occurred/ Quashed/ Discharge by the Courts) is 78 from the year 2017-2022. And the highest discharge was made in the year 2020.

The number of Juveniles that were sent home after advice or admonition is 51 from the 2017-2022. Every year, at least more than 2 juveniles were sent to the observation Home. From the year 2017-2022, 43 juveniles were sent for rehabilitation. As the number of crimes is increasing day by day, the cases in the court too are increasing.

Table No. 4.11 Education & Family Background of Juveniles apprehended in the State of Arunachal Pradesh from the Year 2017-2024								
Sl. No		2017	2018	2019	2020	2021	2022	Total
1	Illiterate	14	0	0	0	0	0	14
2	Upto Primary	20	13	9	2	0	7	51
3	Above Primary to Matric	71	45	27	23	24	14	204
4	Above Matric to Higher Secondary	3	1	3	8	0	8	23
5	Above Higher Secondary	0	3	0	0	1	4	8
	Total	108	62	39	33	25	33	300
6	Living with Parents	78	43	25	25	24	29	224
7	Living with guardians	20	10	12	8	1	4	55
8	Homeless	0	9	2	0	0	0	11
	Total	98	62	39	33	25	33	290

The Educational level of the Juveniles so presented before Juvenile Justice Board (JJB) from the year 2017-2022 shows that from total of 300 Juveniles apprehended both in IPC & SLL Crime, the

highest number of Juveniles from above Primary to Matric were 204 in numbers, up to the Primary level, had around 51 Juvenile delinquents, above matric had 23 Juveniles, 14 Juveniles who were Illiterate and 8 Juveniles above Matric respectively. The Data Shows that person with above matric had lowest crime rate, which means that good education matters a lot in the Juveniles life. But the person who were in between primary to Matric had highest number of delinquents. Every effort has to be made at primary level itself to retain the children once admitted and make them complete their studies.

The family background of the Juveniles is also very important. As per the NCRB report out of 290 Juveniles, 224 Juveniles arrested were living with their parents. 55 Juveniles were living with the guardians when arrested and only 11 were homeless from the year 2017-2022.

4.6 CONCLUSION

The tabulation of the reports from the NCRB data has been studied in this chapter. Crime such as Theft, Burglary, Hurt, Grievous Hurt are some of the highest intensity crimes committed by the Juveniles under Indian Penal Code. Theft is very common type of crime which is committed by both boys and girls. It is more frequent in the urban areas.

Burglary i.e., House breaking by night is also a common crime. The youth between 12 to 18 years are more involved in the Burglary. The present-day technologies, such as lap top, mobiles, Tv. Set, sound systems are the things most stolen by the Juveniles. Juveniles find the night time most suitable for committing crime as no one can see them. In Arunachal Pradesh, scooty, bike etc. has also been stolen and reported many a times in the newspaper. Kitchen items specially the gas cylinder is the most common thing to have been carried away by the Juveniles.

The IPC crimes affecting women are also one of the major crimes that has come up in the study. The Juveniles in this modern era, has an easy access to the mobile phones. They get easy prey to the pornography sites. The young minds get easy influence by the vulgarity shown in social media too.²² Thus, many instances of rape and assaults cases are reported now and then, which needs to be taken care of. Rape charges against juveniles are very complex and sensitive issue that demands a balanced approach. While it is essential to protect the rights of victims and ensure justice, it is equally crucial to offer a chance for reform and rehabilitation to young offenders. And utmost care should be taken when dealing with the offenders so that they may not become deviants in future.

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18. No WCD-90/2020-21(APJJR).— In exercise of the powers conferred by the proviso to sub-section (1) of section 110 of the Juvenile Justice (Care and Protection of Children) Act, 2015 (2 of 2016), and in supersession of the Notification No. WCD-27/2016-17(APJJR) dated 3rd May, 2017 whereby the State Government had adopted the Juvenile Justice (Care & Protection of Children) Model Rules, 2012 framed by the Ministry of Women and Child Development, GoI, except as respect to things done or omitted to be done before such supersession, the Government of Arunachal Pradesh is hereby pleased to make the following rules, namely:-

ARUNACHAL PRADESH JUVENILE JUSTICE (CARE AND PROTECTION OF CHILDREN) RULES, 2020.

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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH COCONUT SHELL

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ABSTRACT

The high cost of environmental construction material affects economy of structure. With increasing concern over the excessive exploitation of natural aggregates, lightweight aggregate produced from environmental waste is a viable new source of structural aggregate material. Recently in the environmental issues, restrictions of local and natural access or sources and disposal of waste material are gaining great importance. Today, it becomes more difficult to find a natural resources. Use of the waste materials not only helps in getting them utilized in cement, concrete and other construction materials, but also has numerous indirect benefits such as reduction in land fill cost, saving in energy, and protecting environment from possible pollution effect. It also helps in reduction the cost of concrete manufacturing. In the present work, coconut shell as partial replacement for coarse aggregate in concrete is studied.

Experimental investigation were carried out by preparing concrete block of 150×150×150mm and compressive strength tests were conducted on these blocks by replacing coarse aggregate in concrete mix by 10%, 20% and 30% with coconut shells. From this experimental investigation it was found that coconut shells can be used as an alternative in concrete mixes by adjusting the water cement ratio and admixtures contents of the mix.

Key Words: Coconut Shell, Concrete, Compressive strength, Construction Material

INTRODUCTION

Infrastructure development across the world created demands for construction material. In this constructed environment, the rising cost of building construction materials is the factor of great concern. The cost of building materials are raising day by day. Now a days most of the researchers have focus on use of the waste materials in concrete according to their properties. Fly ash, Rice husk, Slag and Sludge from the treatment of industrial and domestic waste water has been found suitable as a replacement for cement in concrete. The coconut shell is also a material used as a replacement for

cement in concrete. In this work we are partially replacing the coarse aggregate with coconut shell. This reduces the land fillings caused due to deposition of the waste material in concrete. Coconut shells show very high resistance to impact load when compared with conventional concrete. The main objective of this replacement work is to utilize the agro waste to produce light weight concrete. In addition, it is done to compare characteristics of M20 or other grades conventional concrete. The replacement is done by gradually increasing the percentage of addition of coconut shells to the coarse aggregate. India is a divine land in every occasion perhaps coconut is the main item of worshipping. So India produces a huge amount of waste from coconut. With the use of coconut shells as a replacement material in the construction history, indirectly reduce the costs production of concrete because of the characteristics found in it better than material that commonly used in production of concrete. Besides, coconut shell is potential materials for the development of new composite material in concrete mix design because of their high strength and modulus properties. By replacing coconut shells with coarse aggregate it develops its strength. And coconut shells concrete has better workability because of smooth surface of one side of the shell. The impact resistance of coconut shell concrete is high when compared with conventional concrete. Moisture retaining and water absorbing capacity of coconut shell are more compared to conventional concrete. Using alternative material in place of natural aggregate in concrete production makes concrete as sustainable and environment friendly construction material

LITERATURE REVIEW

The components of concrete include broken stone or gravel, sand, cement, and water. Concrete is a type of construction material. It is the second most used substance on the planet because of its versatility in being manufactured from locally accessible resources, its simplicity in shaping it into any form or size, and the cost-effectiveness of its production. Concrete is manufactured in greater quantities than any other man-made substance. Every individual on the globe receives one ton of annual output, which is a significant amount. It is extremely adaptable and may be found in virtually all major building projects due to its versatility. Aggregates are utilized in concrete for a variety of functions that are quite specialized. When it comes to concrete, aggregates generally account for 50 percent to 70 percent of the total volume of the mixture. Because they are the least expensive of all the elements used in concrete, the economic effect is substantial as well. Seventy-five percent of CO₂ emissions from buildings are created not by the manufacturing of the materials used in their construction, but rather by the electrical utilities required by the structure during its life-cycle. Concrete is less expensive to make than other equivalent construction materials, and it stays relatively inexpensive when compared to other comparable building materials. A research effort has been undertaken in order to meet the

needs of society in terms of trash disposal that is both safe and cost-effective. The utilization of waste materials helps to save natural resources and landfill space, while also contributing to the preservation of a clean environment. It is believed that the existing concrete building method is unsustainable since it not only consumes vast amounts of stone, sand, and drinking water, but it also consumes two billion tons of Portland cement each year, which emits greenhouse gases that contribute to global warming. There have been experiments done on a variety of waste materials, including rubber tires, e-waste, coconut shells, blast-furnace slag, waste plastic, destroyed concrete components, and waste water. Many nations have now established construction waste recycling facilities. However, these facilities only provide a partial answer to the waste problem. The depletion of aggregate reserves, environmental deterioration, and ecological imbalance are all negative effects of the rising demand for concrete, according to the World Bank. Because of the prospect of full depletion of aggregate supplies, the continuous use of aggregates for building is no longer economically feasible. Rapid development in the building sector results in the depletion of conventional natural aggregate sources at an alarmingly rapid rate. A common complaint about conventional concrete is that it is weak in tensile strength and brittle, and that it is easily erodible by chemicals and high-velocity water flow. A position in the concrete construction industry has been established as a result of the strong compressive and tensile strengths of epoxy resin, as well as its outstanding adhesive qualities. Recent years have seen a significant increase in the number of applications using the bonding of concrete to concrete in the restoration of damaged or degraded construction. Despite the fact that epoxy concrete, which is made by mixing an epoxy resin compound with concrete components, has high compressive and tensile strengths, it is not widely used. The demand for building materials has increased as a result of infrastructure development throughout the world. Concrete is the most widely used material in civil engineering. Concrete production necessitates the use of materials such as cement, aggregates, water, and chemical admixtures. Aggregates account for the majority of the total number of components. Approximately two billion tons of aggregate are generated in the United States each year. Production is anticipated to rise to more than a billion tons per year by next year in the same way as the consumption of primary aggregate in the United Kingdom increased from 100 million tons in 1960 to over 280 million tons in 2006. The use of natural aggregates at such a high pace raises the question of how long natural aggregate sources will be available for use. Apart from that, the operations related to the extraction and processing of aggregates are the primary sources of environmental pollution. This is reflected in the fact that, in current civil engineering construction, the use of alternative materials in place of natural aggregate in the manufacture of concrete results in concrete being a more sustainable and ecologically friendly building material. Coconut shell, being a durable and not readily degraded

material, if crushed to the size of sand, can be used as a viable alternative to sand in construction projects. At the moment, coconut shells are also being burned to generate charcoal and activated carbon, which are used in the production of food and carbonated beverages, as well as the filtration of mineral water. In certain areas, the coconut shell, on the other hand, is still underutilized. The coconut shell has a chemical makeup that is comparable to that of wood. It includes 34 percent cellulose, 40 percent lignin, 30 percent lignin, and 0.5 percent ash, among other things.

B. Damodhara Reddy and colleagues (2014) Presented in this study are the physical and chemical characteristics of coconut shell and coconut shell aggregate concrete, as well as the feasibility of using coconut shell aggregate in construction. When compared to conventional aggregate, the moisture content and water absorption were 4.20 percent and 24 percent, respectively. These values are higher than those of conventional aggregates. When crushed, the density of the coconut shell may be as high as 550-650 kg/m³, which is well within the boundaries of what is required for light weight aggregate.

Daniel Yaw Osei and colleagues (2013) According to the findings of his publication, there is potential for the use of coconut shell as a replacement for conventional aggregate in both conventional reinforced concrete and light-weight reinforced concrete. Coconut shell concrete aids in the protection of natural resources.

Yogesh Narayan Sonawane and colleagues (2016) In their diary, they talked about a variety of different topics. It has been discovered that coconut shell concrete offers greater workability due to the smooth surface on one side of the shell, which was discovered during the research. As long as the sugar is not in a free sugar form, the presence of sugar in the CS will have no effect on the setting strength of concrete. The shell does not disintegrate quickly due to the strong tissue that it is formed of, and it stays as a solid waste for many years.

Apeksha Kanojia and colleagues (2015) According to this publication, the coconut shell has the additional benefit of having a high lignin concentration. It increases the weather resistance of the composites, and because the coconut shell has a low cellulose content, it absorbs less moisture when compared to other agricultural waste. Because the coconut shell is readily accessible due to the fact that its shells are non-biodegradable and because of the smooth surface on one side of the shell, concrete created from coconut shell has greater workability than concrete manufactured from other materials. It can be used as a substitute for aggregates in the production of concrete hollow blocks.

Dr. B. Rajeevan and colleagues (2015) According to the authors of this article, when compared to conventional aggregate, coconut shell exhibits greater resistance to crushing, impact, and abrasion than the latter. Because of this, there is no need to prepare the coconut shell before using it as an aggregate, and the coconut shell has the potential to serve as a lightweight aggregate in concrete applications.

Additionally, utilizing coconut shell as an aggregate in concrete can help to minimize the cost of materials used in building.

Dewanshu Ashlawat and colleagues (2014) According to their findings, the coconut shell is classified as a lightweight aggregate in their research. When dried, the coconut shell includes significant amounts of cellulose, lignin, pentosans, and ash. The weights of the ingredients are used to determine the proportions of the materials. The water cement ratio is determined by the use of a variety of workability tests. Because of the high water absorption capacity of the coconut shell, it was necessary to soak them in water for 24 hours before combining them. According to their experimental setup, they came to the conclusion that, after 10% replacement, concrete achieved 18.91 N/mm², which was barely less than the minimum recommended for use as structural concrete according to the requirements. As the percentage of replacements grew, the strength of the system diminished. In proportion to the increasing surface area of the coconut shell, the amount of cement required for effective bonding increased. Because the cement concentration remained constant, there was no additional bonding and the strength decreased.

Yogesh Narayan Sonawane and colleagues (2016) In their diary, they talked about a variety of different topics. It has been discovered that coconut shell concrete offers greater workability due to the smooth surface on one side of the shell, which was discovered during the research. As long as the sugar is not in a free sugar form, the presence of sugar in the CS will have no effect on the setting strength of concrete. The shell does not disintegrate quickly due to the strong tissue that it is formed of, and it stays as a solid waste for many years.

Kakade et al. (2015) state that when coconut shell aggregates are capsulated into a concrete matrix, their sugar content does not affect the setting and strength of the concrete, as long as it is not in a sugar-free form. The conventional increase in strength also indicates that the coconut shell aggregate does not deteriorate once the coconut shell aggregates are capsulated into the concrete matrix, according to Kakade et al. Additionally, due to the increased porosity in the shell structure of the coconut shell aggregate, it has a higher water absorption rate. When compared to crushed stone aggregate, the aggregate impact value of coconut shell aggregates is significantly lower, indicating that the aggregates have high shock absorption. According to the findings of the study, the cost of manufacturing concrete can be lowered by up to 48 percent. **Akshay S. Shelke and colleagues (2014)** In this investigation, he demonstrates that crushed coconut shell is more resistant to crushing, impact, and abrasion than crushed granite aggregate when compared to the latter. The coconut shell, on the other hand, may be classified as a low- weight aggregate. The densities of coconut shell aggregate after 28 days in the open air are less than 2000 kg/m³, which is within the range of densities for structural light weight

concrete. A coconut shell concrete that meets the standards of ASTM C 330 is used in construction. According to the results of **Parag S.Kambli et al. (2014)**, oil palm shell is a waste product from the agriculture sector that is readily available in huge numbers. In this study, the compressive strength properties of concrete made using crushed, granular coconut as a substitute for typical coarse aggregate with partial replacement were investigated, with the goal of determining how well the concrete performs. The experimental program's goal was to determine the optimal mix proportion of CS used as coarse aggregate in concrete, as well as the feasibility of using CS as coarse aggregate in concrete in the first place. It was determined via experimental research that coconut shell may lower the cost of materials and is more suited for use as a lowstrength, light-weight aggregate in the concrete manufacturing process than other materials.

S. Prema and colleagues (2017) came to the conclusion that oil palm shell is a waste product from the agriculture industry that is readily available in huge numbers. In this study, the compressive strength properties of concrete made using crushed, granular coconut as a substitute for typical coarse aggregate with partial replacement were investigated, with the goal of determining how well the concrete performs. The experimental program's goal was to determine the optimal mix proportion of CS used as coarse aggregate in concrete, as well as the feasibility of using CS as coarse aggregate in concrete in the first place. It was determined via experimental research that coconut shell may lower the cost of materials and is more suited for use as a low-strength, light-weight aggregate in the concrete manufacturing process than other materials

Amarnath Yerramala and colleagues (2012) investigated the strength of concrete with coconut shell (CS) replacement and other types of coarse aggregate replacement, as well as the transport characteristics of concrete with CS as coarse aggregate replacement. They came to the conclusion that increasing the CS% lowered the density of the concrete, and that increasing the CS% improved the 7-day strength gain, which was accompanied by an increase in the equivalent 28-day curing strength.

According to J.P. RIES (2011), lightweight aggregate (LWA) plays an important role in today's move towards sustainable concrete. Lightweight aggregates contribute to sustainable development by lowering transportation requirements, optimizing structural efficiency, which results in a reduction in the amount of overall building materials used, conserving energy, reducing labor demands, and increasing productivity in the construction industry. Maninder Kaur and colleagues (2012) published a paper in which they examined a variety of issues. In this study, it was discovered that utilizing coconut shell aggregates in concrete produced adequate strength requirements for structural concrete. The coconut shell-cement composite is friendly to the environment and does not require any pre-treatment. Coconut shell concrete has a high level of impact resistance due to its high density. The

moisture-retaining and water- absorbing abilities of the coconut shell are exceptional.

MIX DESIGN FOR M20 GRADE OF CONCRETE

Mix design is a crucial process in concrete construction, involving the selection and proportioning of ingredients to achieve the desired properties and performance of concrete. It's a systematic approach that considers factors such as strength, durability, workability, and economy to create a concrete mix tailored to specific project requirements.

Step 1: Stipulation for proportioning

- | | | |
|----|--|--|
| a) | Grade designation | : M20 |
| b) | Types of cement | : PPC 53 grade |
| c) | Maximum nominal size of coarse aggregate | : 20mm |
| d) | Minimum water content | : 345kg/m ³ (As per IS: 456-2000) |
| e) | Maximum water cement ratio | : 0.5 (As per IS: 456-2000 Table 5) |

Step 2: Test data for materials

- | | | |
|----|----------------------------|----------------|
| a) | Cement used | : PPC 53 grade |
| b) | Specific gravity of cement | : 2.5 |
| c) | Specific gravity of | |
| | Coarse aggregate | : 2.87 |
| | Fine aggregate | : 2.67 |

Step 3: Determination of target strength

Standard deviation (σ) for M20 IS 4.0 taken as per IS-10262- 2019 Target Strength = $f_{ck} + 1.65 \times \sigma$

$$= 20 + 1.65 \times 4.0$$

$$= 26.6 \text{ N/mm}^2$$

Step 4: Selection of water-cement ratio

Adopt water-cement ratio = 0.5

Step 5: Water content

For 20mm nominal maximum size of aggregate, water content per cubic meter of concrete

$$= 186\text{L}$$

Step 6: Selection of cement content

Water cement ratio = 0.5 Cement

content =

$$186/0.5$$

$$= 372 \text{ Kg/m}^3$$

Step 7: Volume of Coarse aggregate and Fine aggregate

As per IS 10262-2009 Table No.3 Volume of

coarse aggregate = 0.62m^3

Volume of fine aggregate = (1-volume of C.A)
= $1-0.62$
= 0.38m^3

Step 8: Mix Calculation

Volume of concrete = 1m^3

Volume of cement = mass of cement/specific gravity $\times 1000$
= $(372/2.5) \times (1/1000)$
= 0.1488m^3

Volume of water = mass of water/specific gravity of water $\times 1000$
= $(186/1) \times (1/1000)$
= 0.186m^3

Volume of all in aggregate = $1-(0.1488+0.186)$
= 0.66m^3

Coarse aggregate = $0.66 \times 0.62 \times 2.87 \times 1000$
= 1174.404Kg/m^3

Fine aggregate = $0.66 \times 0.38 \times 2.67 \times 1000$
= 669.636Kg/m^3

Step 9: Mix proportion

For 1m^3 of concrete

Cement = 372 Kg/m^3

Fine aggregate = 669.636 Kg/m^3

Coarse aggregate = 1174.404 Kg/m^3

Volume of water = 186 L

For 1 Cubical block ($150 \times 150 \times 150\text{mm}$)

Cement = 1.360 kg

Fine aggregate = 2 kg

Coarse aggregate = 4 kg

For 9 cubical block

Cement = 12 kg

Fine aggregate = 18 kg

Coarse aggregate = 36 kg

RESULTS AND CONCLUSION

The compression test is widely regarded as the most common test conducted on hardened concrete due to its direct correlation with many desirable characteristic properties. This test is crucial because the compressive strength of concrete serves as a fundamental indicator of its overall quality and performance in structural applications.

During the compression test, specimens in the form of cubes are subjected to increasing compressive loads until failure occurs. These cube specimens typically have dimensions of 150×150×150 mm, adhering to standard testing protocols. The size and shape of the cubes allow for uniform loading and accurate measurement of compressive strength.

Compressive strength, measured in megapascals (MPa) or pounds per square inch (psi), represents the maximum load-bearing capacity of concrete under axial compression. It indicates the ability of concrete to withstand applied loads and resist deformation or failure. Various factors, including the quality of materials, mix proportions, curing conditions, and age of concrete, influence the compressive strength.

The results of compression tests provide valuable insights into the structural integrity, durability, and serviceability of concrete elements, such as beams, columns, slabs, and foundations. Engineers use these test results to assess the suitability of concrete mixes for specific design requirements, verify compliance with industry standards and specifications, and ensure the safety and reliability of constructed structures.

In short, the compression test on concrete cube specimens serves as a critical quality control measure, offering quantitative data on compressive strength and guiding engineering decisions throughout the design, construction, and maintenance phases of infrastructure projects.

The study aims to investigate the compressive strength of concrete when natural coarse aggregate is partially substituted with waste coconut shell. The concrete grade selected for this investigation is M-20. The concrete mix proportions are maintained as per standard practice, with the ratio of cement to fine aggregate to coarse aggregate.

Compression strength tests are conducted on cube samples using a compression testing machine. Each batch consists of three samples, and the average strength values are reported in the study. The

replacement levels of natural coarse aggregate with coconut shell are set at 10%, 20%, and 30% by weight of M-20 grade concrete.

Cube specimens with dimensions of 150×150×150mm are examined, and the compressive strength results are analyzed after curing periods of 7, 14, and 28 days. Curing is essential for allowing the concrete to gain strength and achieve its full potential properties over time.

The study seeks to understand how the incorporation of waste coconut shell as a partial replacement for natural coarse aggregate affects the compressive strength of the concrete at different curing durations. By evaluating the performance of the concrete mixes at various substitution levels and curing periods, valuable insights can be gained into the feasibility and potential benefits of utilizing coconut shell waste in concrete production.

Compressive strength= Maximum load/Area

Table 1: Compressive strength of concrete replaced with coconut shell at 7 days

S.NO	Specimens	Coarse aggregate (kg)	Coconut shell(g)	Date of casting	Date of testing	Weight of cube	Load (KN)	Compressive strength
1	M1	3.9	100	14/05/24	20/05/24	7252	320	14.22
2	M1	3.9	200	14/05/24	20/05/24	7310	360	16.00
3	M1	3.9	300	14/05/24	20/05/24	7289	350	15.55

Table 2: Compressive strength of concrete replaced with coconut shell at 14 days

S.NO	Specimens	Coarse aggregate (kg)	Coconut shell(g)	Date of casting	Date of testing	Weight of cube	Load (KN)	Compressive strength
1	M2	3.8	100	14/05/24	27/05/24	7440	420	18.66
2	M2	3.8	200	14/05/24	27/05/24	790	450	20.00
3	M2	3.8	300	14/05/24	27/05/24	7435	410	18.22

Table 3: Compressive strength of concrete replaced with coconut shell at 28 days

S.NO	Specimens	Coarse aggregate (kg)	Coconut shell(g)	Date of casting	Date of testing	Weight of cube	Load (KN)	Compressive strength
1	M3	3.7	100	14/05/24	10/06/24	8149	510	22.66
2	M3	3.7	200	14/05/24	10/06/24	8477	540	24.00
3	M3	3.7	300	14/05/24	10/06/24	8412	520	23.11

Table 4: Comparison of Compressive strength N/mm²

S.NO	Specimens	07 days	14 days	28 days
1	10% aggregate replace with coconut shell	15.55	18.66	22.66
2	20% aggregate replace with coconut shell	14.22	18.22	24.00
3	30% aggregate replace with coconut shell	16.00	20.00	23.11

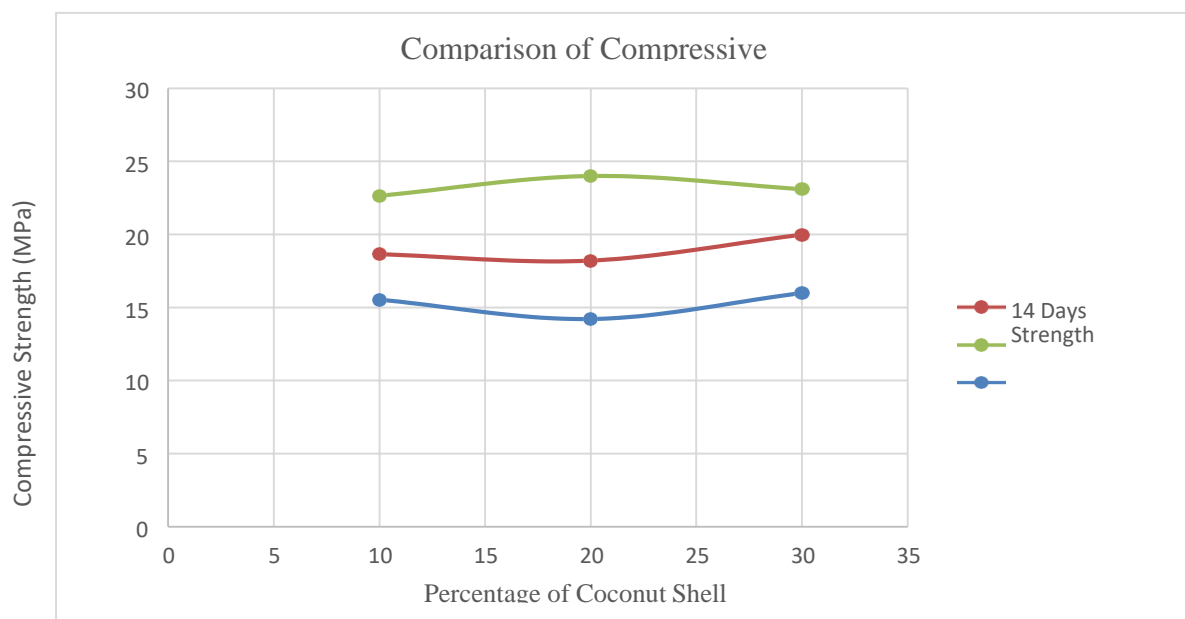


Figure 1: Comparison of Compressive Strength at different percentage of coconut shell

Concluding Remark

The utilization of waste materials in construction has gained significant attention in recent years due to its potential to enhance sustainability and reduce environmental impact. In the context of concrete production, incorporating alternative aggregates such as coconut shell has been explored as a means

to not only mitigate waste disposal issues but also to improve concrete properties. The findings of the tests conducted in this study underscore the promising benefits of replacing coarse aggregate with coconut shell in M20 grade concrete.

Firstly, the test results reveal a notable increase in various properties of the concrete when coconut shell is used as a partial replacement for coarse aggregate. This observation suggests that coconut shell aggregates possess inherent characteristics that positively influence the performance of the concrete mix. Specifically, there is a significant enhancement in workability, indicating improved ease of handling and placement during construction activities. Additionally, there is a substantial increase in compressive strength, which is a critical parameter governing the structural integrity and load-bearing capacity of concrete elements. These findings highlight the potential of coconut shell aggregates to enhance both the fresh and hardened properties of concrete compared to plain cement concrete of M20 grade.

Moreover, the study identifies an optimal range for the replacement of coarse aggregate with coconut shell in M20 concrete, ranging from 10% to 30%. Within this range, the concrete exhibits the most favorable combination of workability and compressive strength. This finding is crucial for concrete producers and construction practitioners as it provides guidance on the appropriate dosage of coconut shell aggregates to achieve desired performance levels in concrete mixes.

Furthermore, the economic implications of incorporating coconut shell aggregates into concrete are also examined. The cost comparison between plain cement concrete of M20 grade and concrete with 10% to 30% replacement of coarse aggregate by coconut shell reveals a significant reduction in cost per cubic meter of concrete. This cost savings could have profound implications for construction projects, potentially leading to overall cost reduction without compromising the quality or performance of the concrete structures.

In conclusion, the findings of this study underscore the potential of coconut shell aggregates as a sustainable alternative to traditional coarse aggregates in concrete production. The observed improvements in workability, compressive strength, and cost-effectiveness highlight the viability of incorporating coconut shell aggregates in concrete mixes, particularly in the context of M20 grade concrete. Moving forward, further research and implementation efforts in this direction could contribute to the development of more sustainable and cost-effective construction practices.

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THE BUDDHISM HUMANITIES

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The rise of Buddhism was an event of the sixth century BC. Gautam Buddha, the originator and founder of Buddhism, was born in 563 BC from the womb of Queen Mahamaya on the day of Baisakh Purnima in a forest called Lumbini near the capital of Shakyas, Kapilvastu, which is identified with Rumindei situated on the India-Nepal border. A pillar with an inscription of Maurya Emperor Ashoka was found here in 1895 AD, on which it is engraved, "Hid Budhe Jaate Sakyamuniti Hid Bhagava Jaateeti" meaning Shakyamuni Buddha was born here, God was born here. His father's name was Shuddhodhan, who was the Shakya dynasty ruler of the Kapilvastu republic on the banks of the Himalayas and was under Kosala. After the birth of Bodhisatva, Kaldeval and Kaudinya propounded the opinion that he would either become a Chakravarti emperor or renounce the world and become a famous scholar. On the fifth day, during the naming ceremony, the child was given a meaningful name, Siddhartha. On the seventh day of his birth, his Koliya mother Mahamaya died due to which he was brought up by his maternal aunt Mahaprajapati Gautami, due to which he was called Gautam. Along with various crafts, weapons and arts, the child Siddhartha was also taught bookish and Kshatriya-like skills. Strategic education was imparted. Due to the predictions of astrologers, King Shuddhodhan indulged Siddhartha in extreme pleasures. So that they do not get detached from the worldly attractions and do not experience pain and suffering. In order to bind Gautama to worldly life, at the age of sixteen a beautiful girl from the Shakya clan was born. He was married to Yashodhara. Within a few years Siddhartha became the father of a radiant son, but Gautama was not happy with the birth of a son and he blurted out that 'Rahu' (bondage) was born. Hence, the newborn baby was named 'Rahul'. According to Buddhist texts, Siddhartha's mind was neither at ease in the palace built for different seasons nor in the attraction of his wife. He always used to think about the world's pain and sorrow and wanted to get rid of worldly attachments. In the later Buddhist literature, four painful incidents are mentioned - an old man with a frail body, a suffering patient, a dead person and a detached monk. The series of these four incidents shown by the angels did what the Shakya ruler Shuddhodhan had used all his intelligence and power to avoid. Once again it was proved that the future is inevitable, it is not possible to escape it. Finally, decided to give up everything for the happiness, health and joy of everyone. It is said that

one night Gautam fell asleep while watching the dance of many beautiful courtesans. The courtesans also fell asleep. When Prince Gautam suddenly woke up, the courtesans appeared very ugly and terrifying to him in their sleep. Some had disheveled hair, some were almost naked and some of them were snoring horribly. Gautam had a strong desire to renounce the world. Finally, leaving his wife Yashodhara and child Rahul sleeping, he left home.

Abandonment of home

At the age of 29, Siddhartha left home in search of knowledge to end worldly suffering. This event is called 'Mahābhiniṣkramaṇa'. It is not true that the Bodhisattva tells the people at home Without any chanting, he sat on Kanthakka and fled. In Majjhimanikaya, Gautama himself says that 'to attain enlightenment In my previous state, the thought came to my mind that this family life is completely pure, practising a religious life. I am very intelligent. When I was a teenager with dark hair and at the beginning of my life, I went to my parents In spite of my reluctance and crying with tearful eyes, I cut off my hair and wore saffron clothes. He left home after wearing clothes and adopted a solitary life. From this it is clear that 'Bodhisattva who is a nomad ', this fact was known to Shuddhodhan and Gautami for a long time and against their wishes and in front of them He had taken up the monastic life. There is no consensus among scholars regarding the reasons for Gautam's renunciation of his home. According to the later belief, this change happened suddenly, but these four aspects must not have been the only reasons for his renunciation of home. According to Kosambi, Gautam himself renounced home to protect his family from the danger of frequent wars between the Shakyas and the neighbouring Kolis over the distribution of the water of the Rohini river. Whatever it may be, Gautam wanted to free the entire humanity from suffering by finding a way to protect the world burning with sorrow. Therefore, in search of Aryan knowledge, he renounced domestic and worldly attachments and followed the path of retirement.

The Quest for Knowledge (Aryaparyesnā)

After taking sanyaas, Siddhartha wandered in search of peace, truth and knowledge and reached the ashram of a sage named Alara Kalam in Vaishali. Here Gautam learnt many types of difficult yoga practices, but he was not satisfied. On the basis of Majjhimanikaya, Dharmanand Kosambi believes that Bodhisattva took renunciation at home in front of his parents. The ashram of Bharandu, a disciple of Alara Kalam, was in Kapilavastu and the disciples of Udraka Ramputra lived in the neighboring Kolis' country. Bodhisattva first learnt the method of meditation from these Parivrajakas and these people must have given him sanyaas initiation. Bodhisattva was given the title of Sakya or Koliya. He did not find it appropriate to spend time in any ashram in the country. He himself met Aalāra Kalam, but being unsatisfied, he left Vaishali and headed towards Rajgriha in search of true knowledge. In

Rajgriha, Bodhisatva Gautam met Magadh King Bimbisara, which is mentioned in Pabbajja Sutta of Suttanipatta and Lalitavistara. According to Lalitavistara, after this, Bodhisatva stayed in the ashram of a wise man named Rudrak Ramputra in the sub-corner of Rajgriha. Gautam achieved the status of 'Naivasangyanasangyaatan' in relatively less time and with less effort, but Gautam was not satisfied with this achievement. Impressed by Bodhisatva, five Brahmin monks of Rudrak also joined him. Now while travelling, they reached Uruvela, the military enclave of Magadh district. Siddhartha decided to do penance as per the Shramana tradition of that time by sitting under a banyan tree on the beautiful banks of the river Neranjar (Niranjana) in Senani village near Uruvilva. His difficult penance is mentioned in Majjhimanikaya and Lalitavistara. But even with the difficult penance, he did not get the desired knowledge.

Mahaparinirvana of Buddha "Mahaparinirvana of the Buddha (The Last Days of the Buddha)"

The last phase of Lord Buddha's life is associated with his Parinirvana, which is called 'Mahaparinirvana'. This event was the last turning point in his life when he abandoned his body and went beyond the world. This story conveys the message of Buddha's great wisdom, his compassion and peace. When Buddha reached the age of 80, he realized that his body had become old and his life journey was coming to an end. He started telling his disciples that he was going to leave the world now. One day, he reached near Kushinagar, which is located in present-day Uttar Pradesh. There he gathered his disciples and gave his last sermon.

Last sermon:

Buddha told his disciples, "All sanskaras are perishable. This is my last message. Work hard and meditate. Work for your own salvation. Do not depend on anyone else." This was a profound and important message to his disciples. He explained that all things in the world are temporary, and each person must follow his own path to salvation. Buddha instructed them to follow the Dhamma (religion) and recognize the truth within themselves.

Last meal:

Before Mahaparinirvana, Lord Buddha was invited to have a meal by a blacksmith named Kunda. Kunda served him Sukarmaddava (a special meat dish). Buddha ate this meal, but he left the rest. He instructed to give the food to his disciple Ananda and said that it should not be given to anyone else. After this, Buddha started suffering unbearable pain, which became the final illness of his body. However, despite this suffering, he kept his mind calm and steady.

Last rest in Kushinagar:

Buddha chose his final resting place under a sal tree in Kushinagar. He asked his disciple Ananda to place his head in the north direction. After this, Buddha lay down peacefully. His disciples and

followers gathered around him at that time, and all were mourning that now they were going to lose their beloved Guru. Ananda, who was Buddha's favorite disciple and his personal servant, was very sad. He could not imagine his life without Buddha. Buddha consoled Ananda and said, 'Ananda, do not mourn. This world is perishable. All beings have to die one day. Whoever is born, his death is certain. This is the law of the world.'

Mahaparinirvana:

Buddha meditated in his final moments and went into complete peace. When he breathed his last, it was said that he had entered Mahaparinirvana. Mahaparinirvana means reaching a state where the cycle of rebirth ends and the soul is completely liberated. After Buddha's Mahaparinirvana, his followers went into deep mourning, but they understood that while Buddha's temporary body had perished, his teachings and his Dhamma (religion) would live forever. Buddha taught that every person should strive to find peace and truth within themselves, and this was the biggest message for his followers.

Relics of Buddha:

After Buddha's Mahaparinirvana, his body was cremated. His remains were divided and placed in various stupas. These stupas were built to commemorate Buddha's Dhamma and his life. Kushinagar, where Buddha spent his last time, became a major pilgrimage site.

Importance of Mahaparinirvana:

Buddha's Mahaparinirvana was not only the end of his life, but it was also the realization of his teaching of Dhamma (religion). He showed that all things are temporary, and a person who knows the truth is liberated from the cycle of birth and death. Through Mahaparinirvana Buddha proved that physical death is only a transition, while the path to true liberation and peace lies in wisdom, compassion and truth. This story of Mahaparinirvana teaches us that by accepting the impermanence of life, we can achieve enlightenment and peace. Buddha's teachings continue to inspire people to search for truth and inner peace even today.

Source- Social-Media and History

“An Analysis of Special Education Programs for Lower Primary Children with Disabilities in Five Government Schools of Papumpare District, Arunachal Pradesh”

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Abstract: *This study analyzes the special education programs for lower primary children with disabilities in five government schools of Papumpare District, Arunachal Pradesh. Emphasizing the importance of inclusivity, the research investigates the structure and effectiveness of these programs in light of the Rights of Persons with Disabilities (RPWD) Act, 2016. Using a descriptive research design, the study involved a stratified random sample of 30 teachers, 30 parents, and 10 managing board members. Data was collected through structured questionnaires, semi-structured interviews, and opinionnaires, employing both qualitative and quantitative analysis methods. Findings reveal that while all schools have established special education programs, significant disparities exist in the quality and availability of resources. Key challenges include inadequate infrastructure, insufficient financial support, and a lack of tailored academic programs. Additionally, parental awareness is moderate, with many expressing concerns about communication and resource availability. This research highlights the urgent need for improved policies and practices to enhance the educational experiences of children with disabilities in the district.*

Keywords: *Analysis, Special Education Program, Lower Primary, Disabilities, Government Schools, Papumpare District, Arunachal Pradesh*

1. Introduction

In today's post-modern era, special education plays an increasingly vital role in ensuring that children with disabilities receive the necessary support and resources for their development and learning. This era emphasizes inclusivity and diversity, recognizing that every child, regardless of their challenges, has the right to access quality education. Special education encompasses a range of programs and

services designed to meet the unique needs of these children, enabling them to participate fully in society. In India, the significance of inclusive education has been further underscored by the enactment of the Rights of Persons with Disabilities (RPWD) Act in 2016, which promotes equality, accessibility, and opportunities for individuals with disabilities.

In Arunachal Pradesh, as in many regions across India, the implementation of special education programs faces unique challenges, especially in today's rapidly evolving educational landscape. The RPWD Act 2016 recognizes various disabilities, including physical, intellectual, and sensory impairments, mandating that educational institutions provide essential accommodations and resources. However, despite this legislative framework, the effectiveness of these programs in lower primary schools remains underexplored, particularly in remote areas like Papumpare District. This study aims to analyze the special education programs offered in five government schools within the district, examining their structure, effectiveness, and alignment with the principles outlined in the RPWD Act.

The status of disabilities in India reveals significant disparities in awareness, access, and support services, particularly in Northeast India. According to the 2011 Census, a considerable percentage of the population in Arunachal Pradesh is affected by various forms of disabilities. Yet, societal stigma and a lack of resources continue to hinder their integration into mainstream education. In today's context, where digital tools and innovative teaching methods are increasingly prevalent, understanding the current landscape of special education in this region is essential for identifying gaps and opportunities for improvement.

By focusing on the special education programs for lower primary children with disabilities in Papumpare District, this research aims to shed light on the implementation and impact of these initiatives. It will provide valuable insights into the effectiveness of current practices and inform policy recommendations that could enhance the educational experiences of children with disabilities. Ultimately, this study seeks to ensure that all children, regardless of their challenges, receive the inclusive and supportive education they deserve in a society that values diversity and promotes equal opportunities.

2. Review of the Related Literature

Sharma and Gupta (2020) conducted a qualitative case study to evaluate special education programs in North India, focusing on three government schools. They gathered data from 30 teachers and 20

parents, revealing significant gaps in teacher training, resource availability, and parental involvement. Their findings highlighted the need for enhanced training programs for educators and improved resource allocation to support inclusive education.

Kumar and Verma (2019) employed a mixed methods approach, including surveys and interviews with 100 special education teachers in Punjab. Their research identified challenges such as inadequate training, lack of support staff, and insufficient teaching materials, emphasizing the necessity for policy changes to bolster support structures for special education teachers, ultimately benefiting students.

Bhargava and Singh (2018) used qualitative interviews with 50 parents and 25 teachers to explore the perspectives on inclusive education in India. They found that collaboration between parents and teachers is crucial for the effective implementation of special education programs, with both groups stressing the importance of awareness and training regarding disabilities and inclusive practices within classrooms.

Mehta (2021) conducted a quantitative survey involving 200 lower primary school children with disabilities across five districts to assess the effectiveness of special education strategies in early childhood education. The results indicated that tailored educational strategies significantly improved both academic performance and social skills, leading to the conclusion that ongoing assessments and adaptations of teaching methods are essential for fostering effective learning environments.

Singh and Joshi (2022) performed a descriptive analysis of special education in Arunachal Pradesh, interviewing 50 educators from ten government schools. Their study highlighted specific challenges in the region, such as cultural stigma surrounding disabilities and a lack of trained personnel. However, they also identified opportunities for community involvement and the integration of local resources to enhance special education programs.

3. Rationale of the Study

The analysis of special education programs for lower primary children with disabilities in **Papumpare District, Arunachal Pradesh**, is crucial due to several identified gaps and challenges in existing frameworks. Research by **Sharma and Gupta (2020)** highlights deficiencies in teacher training, resource availability, and parental involvement, emphasizing the need for improved training programs and resource allocation for effective inclusive education. **Kumar and Verma (2019)** further

underscore the necessity for policy changes to address inadequate training and support for special education teachers.

Additionally, **Bhargava and Singh (2018)** stress the importance of collaboration between parents and teachers, indicating that enhancing stakeholder engagement can lead to better educational outcomes. **Mehta (2021)** demonstrates that tailored educational strategies significantly improve academic performance and social skills, suggesting that ongoing assessment and adaptation of teaching methods are vital for success.

Finally, **Singh and Joshi (2022)** address cultural stigma and the lack of trained personnel in Arunachal Pradesh, advocating for community involvement and local resource integration. This study aims to fill knowledge gaps regarding special education in Papumpare District, providing insights to inform policy and practice, ultimately enhancing educational experiences for children with disabilities in the region.

4. Statement of the Problem

“An Analysis of Special Education Programs for Lower Primary Children with Disabilities in Five Government Schools of Papumpare District, Arunachal Pradesh”

5. Research Questions

- i. What are the current special education programs available for lower primary children with disabilities in Papumpare District, Arunachal Pradesh?
- ii. What challenges do special education programs face in terms of infrastructure, specifically regarding the adequacy and accessibility of facilities for children with disabilities?
- iii. How sufficient is the financial support and funding for special education initiatives in Papumpare District?
- iv. What is the effectiveness of the current academic programs, including the curriculum, teaching methods, assessment practices, and co-curricular activities, in meeting the needs of children with disabilities?
- v. What vocational training opportunities are available for lower primary students with disabilities in Papumpare District, and how are these programs structured?
- vi. To what extent are parents aware of special education programs and resources available for their children with disabilities, and what are their perceptions of these programs?

6. Objectives of the Study

- i. To examine the development of special education programs for lower primary children with disabilities in Papumpare District, Arunachal Pradesh.
- ii. To investigate the challenges faced in special education, focusing on the following areas:
 - a)Infrastructure: Assessing the adequacy and accessibility of facilities for children with disabilities.
 - b)Financial Resources: Evaluating the funding and financial support available for special education initiatives.
 - c)Academic Programs: Analyzing the curriculum, teaching methods, assessment practices, and integration of co-curricular activities in special education.
- iii. To identify vocational training opportunities available for lower primary students with disabilities in the district.
- iv. To assess parental awareness and perceptions regarding special education programs and resources available for their children.

7. Methodology of the Study

- viii. **Research Design:** The present study adopted a descriptive research design to analyze special education programs for lower primary children with disabilities in five government schools of Papumpare District, Arunachal Pradesh. This approach is suitable as it allows for the exploration of existing conditions, relationships, opinions, processes, and evident effects related to special education.
- ix. **Population:** The target population for this study included:
 - Lower primary school teachers involved in special education programs.
 - Parents of children with disabilities enrolled in these schools.
 - Managing board members of the respective schools.
 - Relevant government officials and NGO representatives involved in special education.
- x. **Sample Size:** The study included a sample of **30 Teachers** Engaged in special education within the selected schools, **30 Parents** of children with disabilities attending these schools and **10 Managing Board Members** providing governance and oversight to the schools.

xi. **Sampling Techniques:** In this study the researcher used a stratified random sampling technique to ensure representation from different categories within the population (teachers, parents, and managing board members).

xii. **Tools and Techniques:**

a. **Questionnaires:**

- A structured questionnaire for school heads to gather information on the overall management and implementation of special education programs.
- A separate questionnaire for teachers to assess their experiences, challenges, and resources in teaching children with disabilities.
- A questionnaire to identify vocational training opportunities offered in the schools.

b. **Interview Schedules:**

- Semi-structured interviews with state government officials responsible for special education to understand policies and support structures.
- Interviews with management authorities of NGOs involved in special education to gather insights on their contributions and challenges.

c. **Opinionnaire:**

- A structured opinionnaire for parents to gauge their awareness, perceptions, and experiences regarding the special education programs available to their children.

xiii. **Data Analysis:** The study employed both quantitative and qualitative methods for data analysis.

a. **Qualitative Analysis:**

- Responses from interviews and open-ended questionnaire items was analyzed thematically to identify recurring themes and insights regarding special education programs.

b. Quantitative Analysis:

- The quantitative data from structured questionnaires was analyzed using appropriate statistical techniques. This included descriptive statistics (mean, median, mode) and frequency distribution.
- Data was also tabulated to establish categories for better visualization and comparison.
- Statistical software was utilized to perform further analysis, including the calculation of percentages to understand the prevalence of various issues identified in the study.

8. Findings

The findings of this study are organized according to the stated objectives, providing insights into the analysis of special education programs for lower primary children with disabilities in five government schools of Papumpare District, Arunachal Pradesh.

Objective 1: To examine the development of special education programs for lower primary children with disabilities in Papumpare District.

The analysis revealed that all five government schools have established special education programs, although the scope and quality of these programs vary significantly. While some schools have dedicated special education teachers and specific classrooms, others lack specialized resources and trained personnel.

School Name	Special Education Program Established	Dedicated Staff	Specialized Resources
School A	YES	1	Limited
School B	YES	2	Adequate
School C	NO	0	None
School D	YES	1	Limited
School E	YES	3	Adequate

Objective 2: To investigate the challenges faced in special education, focusing on infrastructure, financial resources, and academic programs.

Challenges were identified in three key areas:

- 1. **Infrastructure:** Many schools reported inadequate facilities, with a lack of accessible classrooms and resources for children with disabilities.
- 2. **Financial Resources:** Funding for special education programs is insufficient, impacting the quality and availability of teaching materials and training programs.
- 3. **Academic Programs:** The curriculum often lacks adaptation for different disabilities, and teaching methods do not cater to individual learning needs.

Challenge Area	Rating (1-5)	Description
Infrastructure	2.5	Poor accessibility and inadequate facilities
Financial Resources	2.0	Limited funding, impacting resources and training
Academic Programs	2.8	Curriculum not fully inclusive; teaching methods need improvement

Objective 3: To identify vocational training opportunities available for lower primary students with disabilities in the district.

Only two out of the five schools reported having vocational training opportunities, primarily focused on basic life skills and craftwork. The remaining schools lacked structured vocational training programs, limiting students' exposure to skill development.

School Name	Vocational Training Offered	Type of Training
School A	NO	N/A
School B	YES	Basic Life Skills
School C	NO	N/A
School D	YES	Craftwork
School E	NO	N/A

Objective 4: To assess parental awareness and perceptions regarding special education programs and resources available for their children.

A survey of parents indicated a moderate level of awareness regarding special education programs. While most parents recognized the importance of such programs, many expressed concerns about the lack of communication from schools and insufficient information about available resources.

Awareness Aspect	Percentage of Parents (%)	Comments
Aware of Programs	68%	Many know about the existence of programs
Satisfaction with Communication	45%	Poor communication from schools
Knowledge of Resources	50%	Limited awareness of additional resources

9. Discussion

The findings of this study reveal a nuanced understanding of the current state of special education programs for lower primary children with disabilities in Papumpare District, Arunachal Pradesh. The analysis aligns with previous literature and highlights several critical themes related to the objectives of the research.

Development of Special Education Programs

The study found that all five government schools have established special education programs, although there are significant disparities in their scope and quality. This aligns with Sharma and Gupta (2020), who identified gaps in teacher training and resource availability in North India. The presence of dedicated staff in some schools indicates progress, yet the lack of trained personnel and specialized resources in others suggests that comprehensive implementation remains an ongoing challenge. As observed by Kumar and Verma (2019), effective training for educators is essential, as inadequate training hampers the delivery of quality education for children with disabilities.

Challenges in Special Education

The research identified key challenges related to infrastructure, financial resources, and academic programs. Inadequate facilities and poor accessibility echo the concerns raised by Singh and Joshi (2022), who noted similar infrastructural issues and cultural stigma surrounding disabilities in

Arunachal Pradesh. The findings that financial support is limited further confirm Kumar and Verma's (2019) assertions regarding insufficient funding and its detrimental impact on resource availability and teaching materials. Additionally, the curriculum's lack of adaptation to meet diverse needs aligns with Bhargava and Singh (2018), who emphasized the importance of inclusive practices tailored to individual students.

Vocational Training Opportunities

The limited availability of vocational training opportunities for lower primary students with disabilities is particularly concerning. This finding indicates a gap in the educational framework that restricts skill development, which is critical for long-term independence. While Mehta (2021) highlighted the benefits of tailored educational strategies, the absence of structured vocational training in the majority of schools points to a missed opportunity for fostering essential life skills among these children.

Parental Awareness and Perceptions

The study's findings on parental awareness of special education programs reveal a moderate level of understanding among parents, which is similar to the perspectives highlighted by Bhargava and Singh (2018). While many parents acknowledge the importance of special education, the lack of effective communication from schools creates a barrier to fully understanding available resources. This gap in communication suggests a need for stronger engagement strategies between schools and families, which is crucial for fostering a collaborative environment that supports children's learning.

Alignment with Literature

The current study's findings closely align with the literature reviewed:

- **Sharma and Gupta (2020)** emphasized the necessity of improved training programs and resource allocation, which resonates with the identified need for better facilities and trained staff in this study.
- **Kumar and Verma (2019)** highlighted challenges such as inadequate training and lack of resources, which were similarly observed in the present study.
- **Bhargava and Singh (2018)** discussed the importance of collaboration and awareness among parents and teachers, a theme echoed in the findings regarding parental perceptions.

- **Mehta (2021)** underscored the significance of tailored educational strategies, suggesting that effective learning environments are essential, yet lacking in many schools as indicated by this research.
- **Singh and Joshi (2022)** provided insights into the challenges specific to Arunachal Pradesh, reinforcing the cultural and infrastructural issues identified in the current study.

10. Conclusion

This research provides a comprehensive analysis of special education programs for lower primary children with disabilities in Papumpare District, highlighting significant achievements alongside ongoing challenges. The establishment of these programs in all five government schools reflects progress in recognizing the needs of these children. However, inconsistencies in quality and scope reveal systemic issues that necessitate standardization to ensure equitable support across schools. Key challenges, including inadequate infrastructure, insufficient financial resources, and poorly adapted curricula, underscore the need for urgent policy reforms that prioritize inclusive education and improve funding and facilities.

Additionally, the study emphasizes the importance of parental awareness and effective communication. The moderate level of awareness among parents indicates a gap that must be addressed to enhance collaboration between families and schools. By developing communication strategies that engage parents, the educational experience for children can be significantly enriched. In conclusion, tackling these identified gaps through improved policies, targeted financial support, comprehensive educator training, and enhanced parent involvement will foster a more inclusive educational environment for lower primary children with disabilities, shaping a brighter future for special education in Papumpare District and beyond.

11. Recommendation for Teachers, Parents & Authorities

Recommendations for Teachers

- i. Engage in ongoing training programs focused on inclusive teaching strategies, differentiated instruction, and specialized support for various disabilities.
- ii. Foster teamwork among teachers, special educators, and support staff to create a more cohesive learning environment tailored to individual needs.

- iii. Regularly adapt the curriculum to accommodate different learning styles and disabilities, ensuring that teaching methods are inclusive.
- iv. Incorporate assistive technologies that can facilitate learning for children with disabilities, making lessons more accessible and engaging.
- v. Implement regular feedback sessions with students to understand their needs and adjust teaching methods accordingly.

Recommendations for Parents

- i. Stay actively involved in school activities and programs, fostering open communication with teachers and school staff.
- ii. Educate themselves about special education rights and resources available for their children, becoming advocates for their needs within the school community.
- iii. Create a supportive and inclusive home learning environment that reinforces skills learned at school, such as reading and life skills.
- iv. Attend workshops and training sessions on disability awareness and educational strategies to better support their children's learning.
- v. Support their children in developing self-advocacy and independence, empowering them to express their needs and preferences.

Recommendations for Authorities

- i. Advocate for comprehensive policies that prioritize funding and resources for special education programs, ensuring equitable access for all children.
- ii. Invest in improving school infrastructure to ensure accessibility for children with disabilities, including ramps, accessible restrooms, and specialized classrooms.
- iii. Allocate dedicated financial resources for teacher training, adaptive materials, and assistive technologies to enhance the effectiveness of special education programs.
- iv. Foster partnerships with local NGOs and community organizations to leverage resources and support for special education initiatives.
- v. Establish regular monitoring and evaluation processes for special education programs to ensure they meet the needs of children and make necessary adjustments based on feedback and outcomes.

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**EFFECT OF PHOSPHORUS AND SULPHUR LEVELS ON GROWTH
AND YIELD,
OF INDIAN MUSTARD
(*Brassica juncea* L.)**

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ABSTRACT

A field experiment was conducted during *rabi* season 2023-2024 at Crop Research Farm (CRF), Department of Agronomy, Himalayan University, Itanagar Arunachal Pradesh, India to study the Effect of phosphorus and sulphur levels on growth and yield of Indian mustard (*Brassica juncea* L.). The experiment was laid out in randomized block design with ten treatments viz., T2- 45kg/ha phosphorus + 25kg/ha sulphur, T3- 45kg/ha phosphorus + 35kg/ha sulphur, T4- 45kg/ha phosphorus + 50kg/ha sulphur, T5- 60kg/ha phosphorus + 25kg/ha sulphur, T6- 60kg/ha phosphorus + 35kg/ha sulphur, T7- 60kg/ha phosphorus + 50kg/ha sulphur, T8- 65kg/ha phosphorus + 25kg/ha sulphur, T9- 65kg/ha phosphorus + 35kg/ha sulphur, T10- 65kg/ha phosphorus + 50kg/ha sulphur were compared with T1 Control. The treatments were replicated three times. Growth attributes viz., plant height (138.40 cm at 90 DAS), number of leaves and dry weight (43.60 g at 90 DAS) were significantly higher under the treatment T10 (65kg/ha phosphorus + 50kg/ha sulphur), respectively. Crop yield viz., seed yield (1.91 t ha⁻¹) and stover yield (3.98 t ha⁻¹) significantly higher were recorded in treatment combination T10 (65kg/ha phosphorus + 50kg/ha sulphur), respectively.

Keywords: Phosphorus, Sulphur, Growth attributes and Yield.

Introduction

Oilseed crop has been the backbone for agriculture economy of India from time immemorial. Amongst the various oilseeds, rapeseed, and mustard (*Brassica spp.*) are the third most important

oilseed crop after groundnut and soybean in India occupying 6.18 M/ha acreage, 7.36 Mt production and 1109 kg hectare productivity. In India *Brassica* species are mostly grown in North India Region Consisting of Rajasthan, Uttar Pradesh, Parts of Madhya Pradesh, Gujarat, Punjab, Haryana Part of Himanchal Pradesh and are adopted to varies agro-climatic condition. Mustard is also called as raj Raya or Laha it is supposed to be native of India. Among India Sates, Rajasthan First Ranks First Both Area and production of mustard with 2.33 Mt and 2.70 Mt, respectively it is followed the state of Uttar Pradesh where mustard is grown on 12.95 lakh/ha with 8.00 lakh ton seed production and 730. kg /ha productivity (Economic survey 2008-2009). However, Gujarat states highest productivity of mustard (1510 kg/ha) in the country.

Deficiency of phosphorus restricts growth of roots and of aerial parts of rapeseed and mustard plants and in extreme cases can prevent flowering. The crop remains dwarf with small leaves and no inflorescence. Where phosphorus deficiency is slight, growth is restricted in the rosette stage but the crop tends to recover and the flowering stage may be little affected. Flowering may be delayed by a day or two by slight phosphorus deficiency as may ripen of the seed Trivedi, S,K and Kumar, R (2012) .

Mustard is responsive to sulphur in comparison to other crops. Sulphur fertilization has also been shown to increase the oil content in seeds of rapeseed-mustard. Sulphur is the key component of balanced nutrient application for higher yields and superior quality produce of mustard. Sulphur plays a vital role in the synthesis of amino acids, chlorophyll and certain vitamins (Joshi., D,C *et al.*, 1973)

Materials and methods Study

and area description

The experiment was conducted on Indian mustard during the *rabi* season of 2023 at Crop Research Farm (CRF), Department of Agronomy, Himalayan University, Arunachal Pradesh, India. The experimental site is located at 27.140 N latitude and 93.620 E longitudes and at an altitude of 320 m above mean sea level. The site comes under the Eastern Himalayan region and the Agro-climatic zone is under sub-Tropical zone of Arunachal Pradesh.

Experimental design and analysis

The experiment consisted of two factors phosphorus and sulphur, the total treatment combinations were ten and the experiment laid out in randomized block design with three replications. The treatment details are T1 Control, T2- 45kg/ha phosphorus + 25kg/ha sulphur, T3-

45kg/ha phosphorus + 35kg/ha sulphur, T4- 45kg/ha phosphorus + 50kg/ha sulphur, T5- 60kg/ha phosphorus + 25kg/ha sulphur, T6- 60kg/ha phosphorus + 35kg/ha sulphur, T7- 60kg/ha phosphorus + 50kg/ha sulphur, T8- 65kg/ha phosphorus + 25kg/ha sulphur, T9- 65kg/ha phosphorus + 35kg/ha sulphur, T10- 65kg/ha phosphorus + 50kg/ha sulphur. The experimental data were analyzed statistically using analysis of variation (ANOVA) for Randomized Block Design and by applying the technique of analysis of variance prescribed for the design to test and conclusions were drawn at 5% probability levels.

Results and Discussion

Yield

During the present experiment data (Table 1) noticed that the seed yield (1.91 t/ha) significantly higher and stover yield (3.98 t/ha), respectively were recorded in treatment T10 (65kg/ha phosphorus + 50kg/ha sulphur).

The high seed yield obtained because higher levels of phosphorus provide better environment of nutrition for active growth of plants at vegetative stages and also help in multiplication, elongation, and expansion of cell in plant body (Sahoo *et al.*, 2019).

The increase in seed yield is probably due to the fact that application of phosphorus and sulphur favourably influence the photosynthesis, biosynthesis of proteins and phospholipids and other metabolic processes of the plant. Phosphorus and sulphur also increase the formation of siliqua and formation of seed in siliqua (Patel *et al.*, 2016). The lowest seed yield was recorded under control treatment which is attributed due to the insufficient nutrient available to crop plants and increasing in weed plants.

Conclusion

This study indicated that growth attributes and productivity of Indian mustard under combination of 65kg/ha phosphorus + 50kg/ha sulphur was found to be more growth, seed yield and stover yield. Second best treatment combination is 65kg/ha phosphorus + 35kg/ha sulphur and the lowest yield was found in control treatment.

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Table 1: Effect of phosphorus and Sulphur levels on yield of Indian mustard

Treatments details	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T1 = control	0.76	2.18	25.87
T2 = 45kg/ha phosphorus + 25kg/ha sulphur	0.90	2.57	25.90
T3 = 45kg/ha phosphorus + 35kg/ha sulphur	1.42	3.00	32.10
T4 = 45kg/ha phosphorus + 50kg/ha sulphur	1.12	3.07	26.75
T5 = 60kg/ha phosphorus + 25kg/ha sulphur	1.31	3.28	28.59
T6 = 60kg/ha phosphorus + 35kg/ha sulphur	1.36	3.26	29.44
T7 = 60kg/ha phosphorus + 50kg/ha sulphur	1.18	3.10	27.63
T8 = 65kg/ha phosphorus + 25kg/ha sulphur	1.21	3.11	28.03
T9 = 65kg/ha phosphorus + 35kg/ha sulphur	1.70	3.60	32.07
T10 = 65kg/ha phosphorus + 50kg/ha sulphur	1.91	3.98	32.45
F test	S	S	S
Sem (±)	0.04	0.08	0.16
CD (P = 0.05)	0.10	0.22	0.46

EFFECTS OF DIFFERENT SOWING DATES ON THE YIELD PERFORMANCE OF HYBRID MAIZE UNDER NAMSAI CONDITION

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Abstract

The study on “effects of different sowing dates on yield performance of hybrid maize (Nem-33) under Namsai condition” was conducted in Namsai, during the period 10th February to 11th September 2023 in a randomized block design-RBD method. First Sowing dates was started from 10th February followed by 20th February, 2nd March, 12th March, 22nd March, 1st April, 11th April, 21st April, 1st May and 11th May respectively at 10 days interval. The yield parameters viz. number of cobs per plant, number of grains per cobs, 100 grain seed index and grain yield per hectare has been observed and evaluated. On evaluation it was noted that maize sown on 1st April gave maximum number of 8.00 cobs per plant, maximum number of 31.27 grains per cob, highest seed index of 41.33 and highest grain yield of 23.867 qtl/ha when compared to all other sowing dates. Thus, sowing on 1st April has paramount effect on production of hybrid Maize (Nem-33) in Namsai condition. Further study may be needed to investigate precise sowing dates of local maize in Namsai region.

Keywords: maize, morphological characters, yield, sowing dates.

INTRODUCTION

Maize (*Zea mays* L.) belongs to family Poaceae and is one of the most important cereal crops of the world as food for human beings and feed for animals. There are six major types of maize-dent corn, flint corn, pod corn, popcorn, flour corn and sweet corn. It has a very high yield potential and because of which it is called as “Queen of cereals”. Maize originated in Mexico has the diploid chromosome number $2n=20$. The word “maize” is from the Spanish connotation “maize” which is the best way of describing the plant. Various other synonyms like zea, silk maize, makka, barajavar, etc. are used to recognize the plant (Kumar & Jhariya, 2013). It was introduced to India about the beginning of the seventeenth century during the days of the East India Company. Maize is also a good feed for poultry, piggery and other animals. It provides huge quantities of green fodder for farm animals. Several industries both in urban and rural areas rely on its products and by-products such as starch milling, cornmeal, grils, flour, tortillas, snacks etc.

According to Tajamul et al. (2016) maize is a rich source of nutrition as well as phytochemical compounds. Phytochemicals play important role in preventing chronic diseases. It contains various major phytochemicals such as carotenoids, phenolic compounds and phytosterol. It is believed to have potential anti-HIV activity due to the presence of *Galanthus nivalis* agglutinin (GNA) lectin or GNA maize. Decoction of maize silk, roots. Leaves and cob are used for bladder problems, nausea, and vomiting and stomach complaints. Zein an alcohol-soluble prolamin found in maize endosperm has unique novel applications in pharmaceutical and nutraceuticals areas. Phytochemicals are bioactive chemical compounds naturally present in plants that provide human health benefits and have the potential for reducing the risk of chronic diseases (Liu, 2004). Carotenoids belong to a family of red, orange and yellow pigments. There is a large quantity of carotenoid pigments present in yellow maize grains, especially in horny and floury endosperm (Liu, 2007). According to Watson and Ramstad (1987) and Moros et al. (2002), a phytochemical compounds concentration in per 100 mg maize have Carotene 100 mg, Xanthophylls 2.07 mg, Lutein 1.50 mg and Zeaxanthin 0.57 mg.

Phenolic compounds are most widely distributed category of phytochemicals in the plant kingdom (Saxena et al., 2013). They are classified as phenolic acids, flavonoid acids, stilbenes, Coumarin and tannins (Liu, 2004). According to Zhoo et al. (2005) and Salinas et al. (1999), 100 gm of maize contains Phenolic such as Ferulic acid (FA) 174mg and Anthocyanins 141.7 mg. Phytosterol also called plant sterols are essential components of plant cell walls and membranes (Piiron et al., 2000). Most commonly consumed phytosterol from maize oil are sitosterol, stigmasterol and campesterol. Their distribution varies in different fractions of maize kernel such as endosperm, pericarp and germ (Harrabi et al.2008). According to Locatelli and Berardo (2014) per 100 gm of maize contains 9.91 mg Sitosterol, and 1.52 mg Stigmasterol. Maize contains vitamin C, Vitamin E, vitamin K, vitamin B₁ (thiamine), vitamin B₂ (nician), vitamin B₃ (riboflavin), vitamin B₅ (pyridoxine), folic acid, selenium, N-p-coumaryl tryptamine and N-ferrulyl tryptamine and potassium (Kumar and Sanjay, 2013). Maize germ contains about 45-50% oil that is used in cooking, salads and is obtained from wet milling process (Orthoefer, Eastman & List, 2003).

The maize oil contains 14% saturated fatty acids, 30% monounsaturated fatty acids and 56% polyunsaturated fatty acids. The refined maize oil contains 54-60% linoleic acid, 25-31% oleic acid, 11-13% palmitic acid, 2-3% stearic acid and 1% linoleic acid (CRA, 2006). According to Shah et al., (2016) 100 gm of edible portion of maize contains 71.88g Carbohydrate, 8.84g Protein, 4.57g Fat, 2.15g Fibre, 348mg Phosphorus, 0.10mg Riboflavin, 1.78 mg Amino acids, 1.5g Minerals, 10mg Calcium, 2.3mg Iron, 286 mg Potassium, 0.42 mg Thiamine, 0.12 mg Vitamin C, 139 mg Magnesium and 0.14 mg Copper. Maize is grown in almost all the states of India and is next to rice, wheat and

sorghum in regard to area and production. Over 85% of maize produced in the country is consumed as human food. Varieties of dishes are prepared from maize such as “Chapatis” from maize flour and grains. Green cobs are roasted and eaten by people. Maize grain contains about 10 per cent protein, 4 per cent oil, 70 per cent carbohydrate, 2.3 per cent crude oil, and 10.4 per cent albuminoides. The largest producer of the maize in the world is the United States of America contributing 35% of the total world maize production.

It is considered as the mother grain of Americans and is the driver of the US economy. In India, the major maize producing states are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Punjab, Haryana, Maharashtra, Andhra Pradesh, Himachal Pradesh, West Bengal, and Karnataka jointly accounting over 95% of the national maize production (Miliand & Isha, 2013).

In Arunachal Pradesh, Maize crop is cultivated in area of 54215 hectares with production of 85399 metric tonnes (Deptt. of Agril. Govt. of A.P, Agril. Census, 202122). However, due to lack of knowledge on actual and suitable time for maize cultivation farmers of the state and Namsai district in particular are not taking up maize cultivation on commercial scale to meet the increasing demands of maize grains and its by-products. Instead, people of the state and Namsai depend on Assam for most of its maize demand. As per previous researchers it is also said that sowing dates is effective in increasing the total annual yield of maize and therefore growers are concerned about the yield response of maize to sowing dates. The present investigation of the researcher is aimed at finding out the suitable time for sowing maize under Namsai district of Arunachal Pradesh so that the yield potential and overall production of maize can be enhanced to some extent which will provide information and guide to farmers and stakeholders in selecting appropriate time for growing maize in Namsai and other regions of Arunachal Pradesh.

With this background, the following objectives have been taken in the experiment:

- To evaluate the effects of different sowing dates on the yield performance of hybrid maize for recommending precise sowing time for hybrid maize under Namsai condition.

Materials and Methods

Experimental Site and Location

The research experiment on the title “Effects of different sowing dates on morphological characteristics and yield of hybrid maize” under Namsai condition, Arunachal Pradesh was carried out Namsai from February to September 2023. The site was situated at geo-coordinates of 27°30’ to 27°55’N and 95°45’ to 96°20’ E with elevation of 157 m above mean sea level. The field was flat land without drainage provision and subjected to water logging during rainy days. The soil was clayey loam with slightly acidic with low nutrient contents. The soil sample from the experimental site was

collected and tested at the Farmer's Training Centre, Kherem, Namsai district Arunachal Pradesh to assess the nutrient status of the soil before the start of the experiment. Fertilizers in the form of Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP) were applied based on soil test result and fertilizer recommendation. The weather parameters prevailed during the entire experimental period for Namsai was recorded for studying their influence on the growth and yield of the maize. The experiment was carried out using randomized block design (RBD) with three replications and ten treatments having plot size of 2 x 1.5 m² each. Maize hybrid Nem-33 was sown at 10 days interval started from 10th February and lasted up to 11th May 2023. The maize hybrid Nem-33 was purchase from the Namsai market for the experimental purpose. The field experiment was completed by 13th September 2023.

Experimental design and layout

Experiment was conducted using the randomized block design (RBD) with three replications and ten treatments including control. The different sowing dates and design of the present experiment are presented in Table 1. The details of technical programme and layout of the experimental design is given below.

Name of crop : Maize

Variety : Nem-33

Features of Nem 33 : plant height- 170-180 cm, plant type- semi erect, grain colour- orange yellow, grain texture- semi dent, days to maturity- 100-105 days, resistance to late blight or downy mildew, special feature- green cob.

Design : RBD

Number of replication : 3

Number of treatments : 10

Experimental area : 90 m²

Plot size : 1.5 x 2 m²

Spacing : 60 x 40 cm²

Seed rate : 20 kg/ha

Table 1 : Treatment details of different sowing dates of hybrid maize

Treatments	Sowing dates
S0D0	10 th February 2023

S1D1	20 th February 2023
S2D2	2 nd March 2023
S3D3	12 th March 2023
S4D4	22 nd March 2023
S5D5	1 st April 2023
S6D6	11 th April 2023
S7D7	21 st April 2023
S8D8	1 st May 2023
S9D9	11 th May 2023

Legend: SD = Sowing Dates

Land Preparation

The land was ploughed using hired tractor mounted with rotovator and with hired labourers. 30 sub-plots of size 1.5 m x 2 m each were well prepared and were raised 30 cm above to avoid water logging as maize being very sensitive to excessive water. 100 cm space was allowed between the sub-plots for easy movement and interculture operations like weeding, watering etc., maintaining randomized block design (RBD) chosen for the field experiment using local materials around the experimental plots to protect the crop from the possible damage by animals. All the stubbles, weeds, gravels etc were removed off and soils broken into pieces.

Seed sowing

Fertilizers (NPK) were applied @ 120:60:40 kg/ha. Full dose of Phosphorus and Potassium and half dose of Nitrogen was applied immediately before sowing seeds and remain half of nitrogen was applied in two split doses one at knee high stage and other at tasseling stage. Line sowing of 12 seeds was done in each sub-plot maintaining planting distance of 60 cm between the rows and 40 cm between the plants at every 10 days interval starting from 10th February 2023 to 11th May 2023. However, no nutrients were applied to control treatment (S0D0) which was sown on 10th February.

Weed Management

As pre-plant application one round of glyphosate 50 EC @ 5ml per water was sprayed 1 week before sowing of seeds to kill the germinated weeds as glyphosate non-selective broad spectrum herbicide. A three round of manual weeding were done one each at 30 DAS, 60 DAS and 90 DAS to keep the weeds under control which otherwise would cause 50-60 per cent of yield reduction.

Tagging

Five plants were randomly selected from each treatment of the three replications and were tagged. And data on yield variables namely number of cobs/plants, were recorded from the randomly tagged plants manually which were subjected to statistical analysis using grapes RBD software.

Water Management

Experimental site was flat land with no drainage provision to drain out excess water especially during rainy days. The drainage problem was further compounded by the clayey loam nature of soil having high water retentive capacity. However, to evade the problem of water logging the seed beds were raised 30 cm from the ground. During extreme hot dry day irrigation was provided to the crops by bringing water from the nearby dug out ponds especially at tasseling and silking stages.

Pest and Disease management

The crop was attacked by fall armyworm during the mid-whorl and late whorl stages of the maize crop. The larvae of the insect bored into the growing whorl and feed inside damaging the growing shoots. As management measures field was monitored regularly and larvae were manually killed in the initial stage. Later, Chlorpyrifos 50 EC @ 5ml per litre water was sprayed 3 times at 5 days interval. However, no disease was noticed in the crop during the experimental period.

Harvesting

Harvesting of cobs was done from each tagged plants when the plants attained fully maturity and started drying. The number of grains of the harvested cobs was counted and weighed using electronic weighing balance to determine the fresh weight of grains and then dried in the shade to bring down the moisture level. After shade drying the again weighed and counted the number of seeds per cob and averaged. Then weight of 100 grain seeds was recorded.

Yield Parameters

Plant yield parameters viz. Number of cobs/plant, number of grains/cob, 100 grain seed index and grain yield (qtl/ha) of the randomly selected and tagged plants were subjected to statistical analysis using grapes RBD software.

Number of cobs/plants

Number of cobs from each tagged plant for all the treatments of size 1.5 m x 2 m area each were

counted at maturity and harvested and averaged which were then subjected to statistical analysis.

Number of grains/cobs

Number of grains from each harvested cob of all the treatments were counted manually and recorded and then statistically analyzed.

Seed Index

100 numbers of grains from each treatment were counted manually and weighed and recorded separately which were then statistically analyzed using grapes RBD software.

Grain yield per hectare (qtl/ha)

Grain yield of each treatment of size 1.5 m x 2 m area was recorded and analyzed statistically and converted in terms of qtl/hectare for each treatment for all the three replications.

Results and Discussion

The results of the present investigation on “Effect of different sowing dates on yield of hybrid maize under Namsai condition” are illustrated in this chapter. The results obtained are supported by suitable headings, tables and figures. The results obtained are also discussed in the light of findings of earlier researchers.

Number of cobs

In the present study sowing dates significantly influenced number of cobs per plant. The maximum number of cobs per plant (8.00) was observed in 1st April sown crop, followed by 11th April sown crop (7.00) and the minimum number of cobs per plant was recorded in 10th February sown crop (0.33) and that sown on 1st May (0.66) (Table 2 and Figure 1).

Naseer et al. (2000) in study on performance of maize cultivars under late sowing conditions observed that sowing dates had significant effect on number of cobs/plants. Early sowing in July gave maximum cobs/plant (1.30) but the delayed sowing of 15th August had decreased number of cobs/plants during that year.

Yousafzai et al. (2002) studied effects of sowing dates on maize cultivars revealed that in their investigation early sowing July gave maximum cobs/plant but delayed sowing in August decreased cob numbers per plant.

Maga et al. (2015) in an experiment on Influence of Sowing Dates on the Growth and Yield of Two Maize (*Zea mays* L.) under Southern Guinea Savannah Agro-Ecological Zone at

three different sowing dates viz. 4 May, 18 May and 1st June and observed the sowing date had positive effect on ears/plant as the 4 and 18 May sowing produced the highest number of cobs/plant compared to when sowing was delayed to 1 June (1.67). Delayed sowing in June considerably reduced the number of ears/plant by -0.66/plot.

Buriro et al. (2015) studied Effect of sowing dates on growth, yield and grain quality of hybrid maize and observed that sowing dates significantly affected number of cobs per plant. Early sowing produced maximum number of cobs per plant than too early and late sowing.

The current investigation confirms the results of the investigation of Naseer et al. (2000), Yousafzai et al. (2002), Maga et al. (2015) and Buriro et al. (2015) that sowing dates have profound effects number of cobs/ears/plant. The reason for highest number of cobs per plant in 1st April and 11th April sown crops might be due to favourable rainfall and other weather parameters during that month for better seed germination, plant stand and subsequent crop growth and cob formation and development in the later phase.

Table 2 : Observation of mean number of cobs/plant in hybrid maize with different sowing dates

Treatment	Number of cobs/plants
S ₀ D ₀ - 10 th February	0.33
S ₁ D ₁ - 20 th February	2.16
S ₂ D ₂ - 2 nd March	3.16
S ₃ D ₃ - 12 th March	4.17
S ₄ D ₄ - 22 nd March	5.16
S ₅ D ₅ - 1 st April	8.00
S ₆ D ₆ - 11 th April	7.00
S ₇ D ₇ - 21 st April	6.00
S ₈ D ₈ - 1 st May	0.66
S ₉ D ₉ - 11 th May	1.00
SEm (±)	0.16
CD (P=0.05)	0.50

Legend: SD = Sowing dates

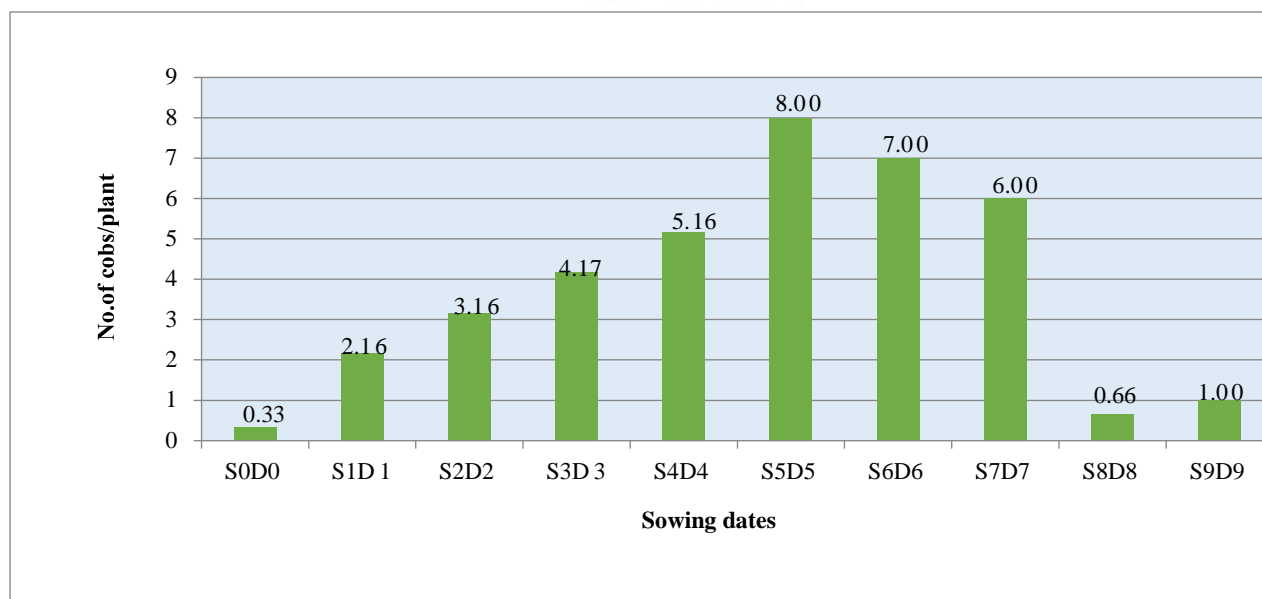


Fig. 1: Graphical representation of mean number of cobs/plants of hybrid maize with different sowing dates

Legend: S0D0 = 10th February, S1D1 = 20th February, S2D2 = 2nd March, S3D3 = 12th March, S4D4 = 22nd March, S5D5 = 1st April, S6D6 = 11th April, S7D7 = 21st April, S8D8 = 1st May, S9D9 = 11th May

Number of grains per cob

A significant difference in grains per cob of maize variety Nem-33 was observed due to difference in sowing dates. Positive effects on grains per cob was observed in 1st April sowing (31.27) and 10th April sowing (26.16). While the least number of grains per cob was recorded in that sown on 10th February (8.83) and 11th May (7.16) (Table 3 Figure 2). This might be April sown crop had optimum growing period and the temperature and other growth factors were favourable during April. While the February sown crop being too early and that sown after April had unfavourable growing conditions which resulted in low grains per cob and low grain yield. The result of the present study is to some extent agrees with the results of many earlier workers such as Ahmed et al. (2011) who revealed that sowing dates cause variation in grains per cob of maize.

Ahmed et al. (2011) In terms of sowing dates, higher number of grains ear-1 (503.86) were produced by the early sowing in June while lower number of grains ear-1 (287.39) were recorded from the late sown crop in July. It happened because may be the June was optimum growing period, while late sown crop had mostly unfavorable conditions and therefore produced less number of grains/cobs.

Jewel Alam et al. (2016) in field study on effect of different sowing dates on performance of hybrid maize by planting BARI Hybrid Butta-09 variety on nine different sowing dates viz. 3rd (S1) & 4th

(S2) week of October; 1st (S3), 2nd (S4), 3rd (S5) & 4th (S6)) week of November; 1st (S7), 2nd (S8) & 3rd (S9) week of December respectively found that 1st week of November sowing gave better yield of grain/cob (641.21) and grain weight/cob (235.16) when compared all other sowing dates.

Table 3: Observation of mean number of grains/cobs in hybrid maize with different sowing dates

Treatments	Number of grains/cobs
S ₀ D ₀ - 10 th February	6.83
S ₁ D ₁ - 20 th February	8.33
S ₂ D ₂ - 2 nd March	10.16
S ₃ D ₃ - 12 th March	13.50
S ₄ D ₄ - 22 nd March	17.90
S ₅ D ₅ - 1 st April	31.27
S ₆ D ₆ - 11 th April	26.16
S ₇ D ₇ - 21 st April	23.00
S ₈ D ₈ - 1 st May	21.50
S ₉ D ₉ - 11 th May	19.20
SEM±	0.28
CD (P=0.05)	0.84

Legend : SD = Sowing dates

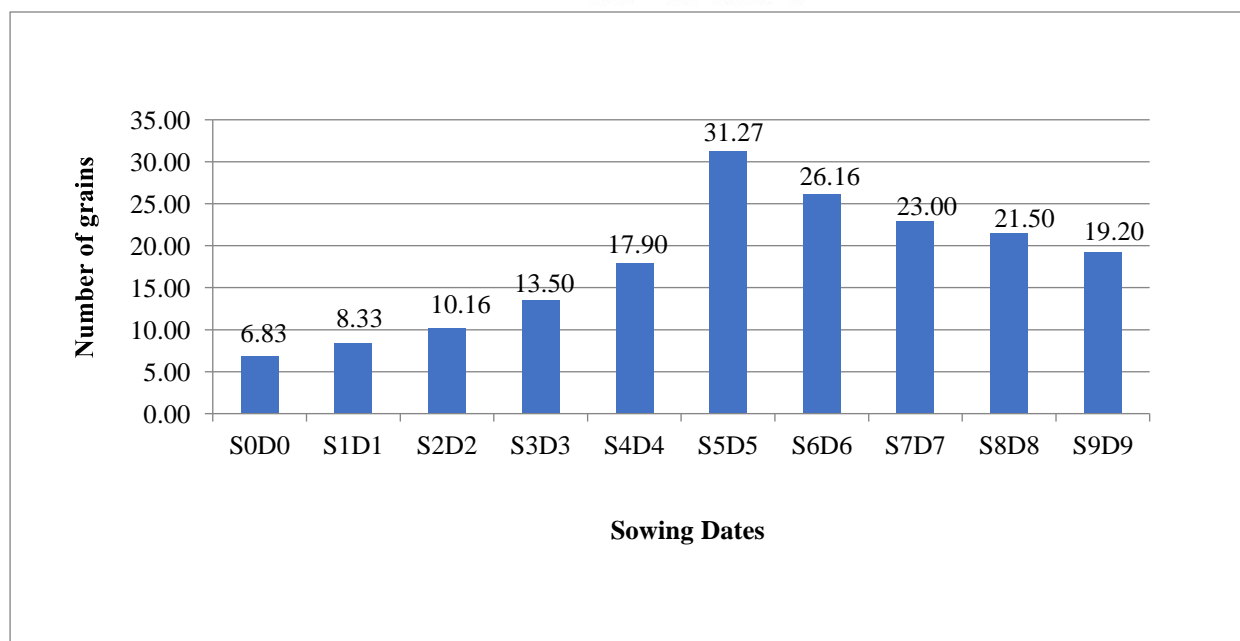


Fig. 2: Graphical representation of mean number of grains/cobs in hybrid maize with different sowing dates

Legend: S0D0 = 10th February, S1D1 = 20th February, S2D2 = 2nd March, S3D3 = 12th March, S4D4 = 22nd March, S5D5 = 1st April, S6D6 = 11th April, S7D7 = 21st April, S8D8 = 1st May, S9D9 = 11th May

Seed Index

The seed index of 100 grains of maize seed from each treatment was also determined in the present study. On statistical analysis it was observed that 1st April sown crop gave highest seed index (47.33) which was followed by 11th April sown crop (41.33). On the other hand, 11th May sown crop had lowest seed index (10.16) and 1st May crop (14.16). Which confirms the work of previous workers Ahmed et al. (2011), Babak and Mohammadreza (2012) and Kolo et al. (2012) that sowing dates significantly affect seed index/test weight.

Ahmed et al. (2011) yield and yield components of maize as affected by sowing dates and sowing methods in analysis of the data indicated that thousand grain weights was significantly affected by planting dates. Higher thousand grains weight (235 g) was attained by the early sowing in June. While lower thousand grain weight (153 g) was recorded from the late sown July crop. Early sown crop had produced bold and plump grains, it may be due to the reason that because it prolong period for growth and development and grain filling period and faster growth of late sown crop has affected the grain size and produced lighter grains.

Kolo et al. (2012) in study on influence of planting date and weed management practice on weed emergence, growth and yield of maize (*Zea mays* L.) in southern Guinea savanna of Nigeria during

2nd July, 16th July, 30th July and 13th August conducted field experiment and revealed that crop planted on 2nd July and 16th July had the 100-seed weight (g) while it declined in later sown crops.

The result of seed index of present study on effect of different sowing dates on morphological characteristics and yield of maize under Namsai condition is illustrated by the Table 4 and Figure 3. The result indicated that sowing also significantly affect the seed index/test weight. It was observed that planting in April gave the highest 100 grain seed index. While the May sown crops had the lowest 100 grain seed index that confirms delayed sowing declines seed index.

Table 4: Observation of seed index in hybrid maize with different sowing dates.

Treatments	Seed Index (100 grain seeds)
S ₀ D ₀ - 10 th February	18.28
S ₁ D ₁ - 20 th February	21.83
S ₂ D ₂ - 2 nd March	25.73
S ₃ D ₃ - 12 th March	30.06
S ₄ D ₄ - 22 nd March	34.13
S ₅ D ₅ - 1 st April	47.50
S ₆ D ₆ - 11 th April	41.33
S ₇ D ₇ - 21 st April	37.51
S ₈ D ₈ - 1 st May	14.16
S ₉ D ₉ - 11 th May	10.16
SEM (±)	0.36
CD (P=0.05)	1.08

Legend: SD = Sowing dates

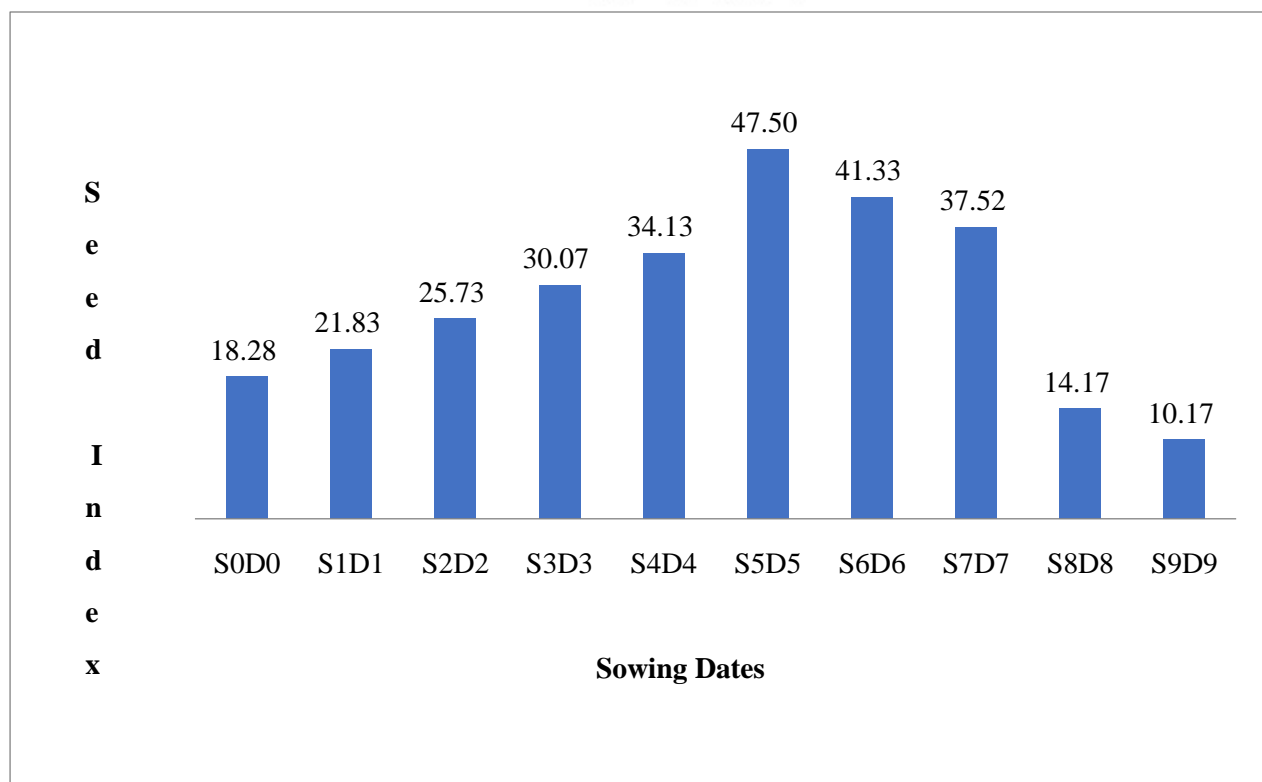


Fig. 3: Graphical representation of mean seed index of maize with different sowing dates

Legend: S0D0 = 10th February, S1D1 = 20th February, S2D2 = 2nd March, S3D3 = 12th March,

S4D4 = 22nd March, S5D5 = 1st April,

S6D6 = 11th April, S7D7 = 21st April,

S8D8 = 1st May,

S9D9 = 11th May

Grain yield per hectare

Significant variation in grain yield was observed in each treatment due to different sowing dates of hybrid maize Nem-33. Statistical analysis of data indicated highest grain yield for crop sown on 1st April (23.86 qtl/ha) and 11th April (21.19 qtl/ha). Least grain yield was recorded in 10th February planted crop (0.88 qtl/ha) followed by 20th February sown crop (10.16 qtl/ha) and 12th May sown crop (13.11 qtl/ha). Data regarding grain yield are presented in the Table 6 and Figure 6. The low grain yield during February planting may be due low soil temperature (Maximum 29 °C and minimum of 14.4 °C) because of cold laden north-east monsoon rain during February which affected seed germination and seedling emergence. While lower grain yield of maize during May planting might be water logging condition of field due to high rainfall during growth, tasseling and silking period.

Bonea (2020) studied phenology, yield and protein content of maize hybrids as affected by different sowing dates at ARDS Simic, Craiova using two maize hybrids viz.PR39D81 and

LG3350 in a randomized field experiment on three different sowing dates viz.9th April, 16th April and 23rd April revealed that the maize hybrids viz.PR39D81 and LG3350 sown on 9th April gave

maximum yields of 11.4 t/ha and 11.42 t/ha respectively when compared to 16th April and 23rd April sowings.

Imran et al. (2021) studied growth and yield of Maize hybrids as effected by different sowing Dates in Swat Pakistan recorded the delayed sowing on 30th June decreased grains/ear to 460 grain yield to 6060 kg/ha, biological yield to 15972 kg/ha and plant height to 185 cm. There was no effect of sowing dates on ear m-2 and thousand grains weight.

Yousafzai et al. (2002) studied effects of sowing dates on maize cultivars revealed that in their investigation that July sowing gave maximum emergence/m² (12.11), plant height (152 cm), cobs/plant (1.3), grains/cob (378.1), thousand grain weight (209.1 g) and grain yield (4419 kg/ha). Delayed sowing in August decreased all the above parameters.

Ahmed et al. (2011) Higher grain yield (2907 kg/ha) was obtained by the mid sowing of 26th June, while lower grain yield (1797 kg/ha) recorded from the late sown crop on 26th July. There is a random response because the grain yield increases from the first sowing date up to the 3rd and after 3rd sowing date the yield again start declining. Lesser grain yield of earliest sown crop might be attributed to the fact that earliest sown crop had minimum grains/ear and also a less population because a lot of plants were lodged due to the rainy season in month of August. The mid sown crop has higher grain yield because drop of temperature and unfavorable conditions for growth at late sowing had decreased the grain yield.

Optimum sowing date resulted in higher grain yield than early and late planting dates as revealed by Otegui et al. (1995) in their investigation “Sowing date effects on grain yield components for different maize genotypes in Argentina.

The result of the present investigation also confirms the findings of Khan et al. (2002), Aziz et al. (2007), Jaliya et al. (2008) and Namakka et al. (2008) who reported that grain yield was reduced by advance and delay in sowing dates. The significant correlation between grain yield and thousand grain weights revealed that grain yield reduction associated with delayed sowing was probably due to reduction in thousand grain weight.

Table 5: Evaluation of yield in hybrid maize with different sowing

Treatments	Yield (qtl/ha)
S0D0 -10 th Feb ^r	0.88
S1D1-20 th Feb ^r	10.16
S2D2-2 nd March	12.00
S3D3-12 th March	14.18
S4D4-22 nd March	16.18
S5D5-1 st April	23.86
S6D6-11 th April	21.19
S7D7-21 st April	19.45
S8D8-1 st May	17.41
S9D9-11 th May	13.11
SEm (±)	0.18
CD (P=0.05)	0.55

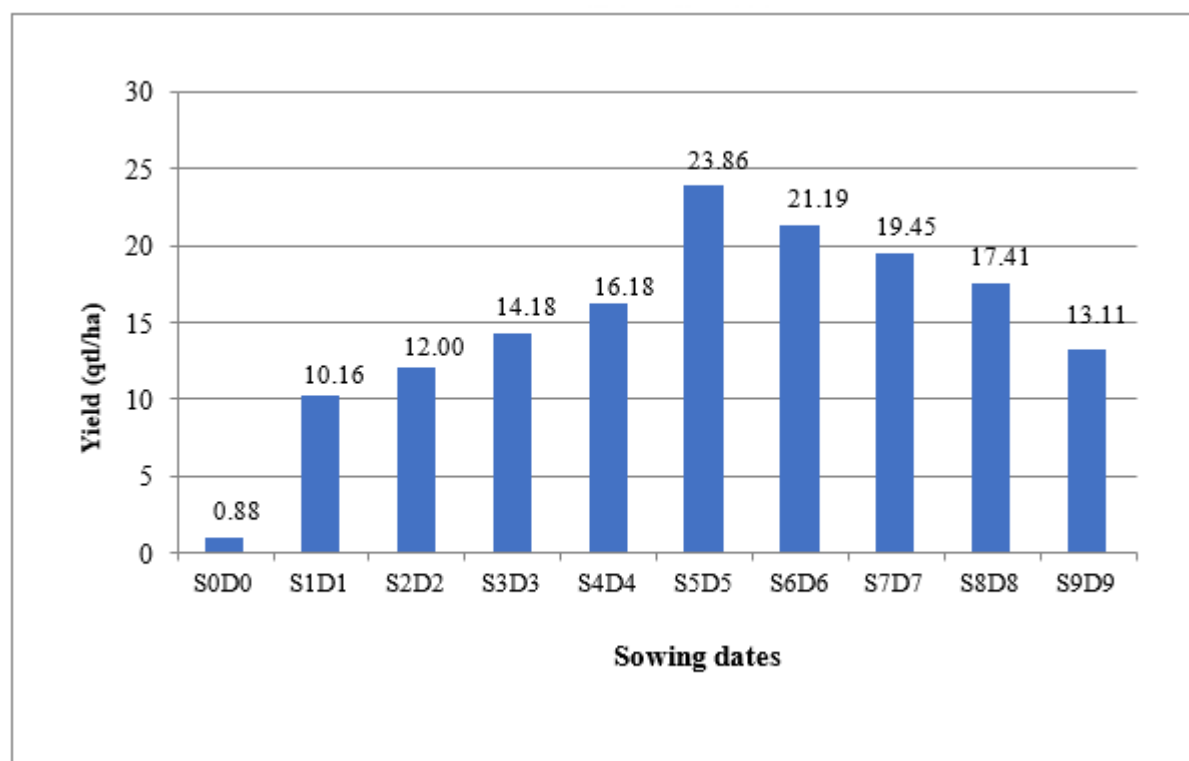


Fig.4: Graphical representation of mean maize grain yield

Legend: S0D0 = 10th February, S1D1 = 20th February, S2D2 = 2nd March, S3D3 = 12th March,
S4D4 = 22nd March S5D5 = 1st April, S6D6 = 11th April, S7D7 = 21st April,
S8D8 = 1st May, S9D9 = 11th May

Summary and conclusion

Observation on all the yield parameters viz. number of cobs per plant, number of grains per cob, 100 grain seed index and grain yield per hectare (qtl). On evaluation it was noted that maize sown on 1st April gave maximum number of cob **8.00** cobs/plant, number of 31.27 grains/cob, highest seed index of 41.33 and highest grain yield of **23.867** qtl/ha compared to all other sowing dates.

It was revealed that sowing on 1st April has paramount effect on production of hybrid Maize (Nem-33) in Namsai condition. Thus, it is concluded from the above findings that 1st April sowing gives better performance over other sowing dates in case of hybrid maize in Namsai agro-climatic condition.

Further study may be needed to investigate precise sowing dates of local maize in Namsai region.

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A CASE STUDY OF STUDENTS WITH DYSCALCULIA AND THEIR MATHEMATICAL ABILITIES OF CALCULATION AT A PRIMARY SCHOOL IN ITANAGAR

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Abstract

This case study explores the challenges faced by primary school students with dyscalculia in their ability to perform mathematical calculations at a school in Itanagar, India. Dyscalculia, a specific learning disability that affects numerical processing and calculation, often hinders academic progress and can lead to long-term difficulties in mathematical comprehension. The study focuses on a group of students diagnosed with dyscalculia, examining their mathematical abilities, learning experiences, and the instructional strategies employed by teachers to support them. Through qualitative methods, including classroom observations, interviews with teachers, and diagnostic assessments of students, the research identifies patterns in calculation errors, cognitive processing gaps, and the impact of personalized interventions on student outcomes. Additionally, the study investigates the role of the school environment, resources, and teacher training in facilitating or hindering the learning process for children with dyscalculia. The findings provide insight into the unique educational needs of students with dyscalculia and offer recommendations for creating more inclusive and supportive learning environments in primary schools, particularly in regions with limited access to specialized resources like Itanagar. This research highlights the importance of early identification, tailored teaching approaches, and ongoing support to improve mathematical learning outcomes for students with dyscalculia.

Introduction

Dyscalculia is a specific learning disability that primarily affects an individual's ability to understand and work with numbers. Characterized by difficulties in arithmetic, number sense, and mathematical reasoning, it is often compared to dyslexia but remains less recognized and addressed in educational systems. Students with dyscalculia typically struggle with fundamental mathematical concepts, such as simple mathematical operations, number comparisons, and understanding numerical sequences,

which can severely impact their academic performance and self-esteem (Butterworth, 2019). Early identification and intervention are crucial for helping these students, but in many regions, including rural and developing areas, there is limited awareness and fewer resources available to diagnose and support children with dyscalculia (Shalev & Gross-Tsur, 2020).

Learning disabilities such as dyscalculia are often under-researched and underreported, especially in less urbanized regions. This is particularly evident in the Northeastern state of Arunachal Pradesh, where access to specialized resources, including diagnostic tools and trained professionals, is often limited. Itanagar, the capital of Arunachal Pradesh, provides a unique setting for examining the educational challenges faced by students with learning disabilities, given the region's geographical isolation and resource constraints.

This case study investigates the ability of students diagnosed with dyscalculia in a primary school in Itanagar to perform mathematical calculations. The research aims to explore the specific difficulties these students encounter, the strategies employed by teachers to address these challenges, and the overall support systems in place for inclusive education. Understanding these factors is essential for developing targeted interventions and improving learning outcomes for children with dyscalculia in regions with limited access to specialized educational resources (Kumar & Patnaik, 2021).

This case study in Itanagar, the research contributes to the growing body of knowledge on dyscalculia and highlights the need for improved awareness, training, and resources in India's education system.

Specific Learning Disability

A learning disability is a neurological disorder that affects an individual's ability to acquire, process, or express information. It can impact skills such as reading, writing, mathematics, or communication, despite normal intelligence and sensory abilities. Common learning disabilities include dyslexia (difficulty with reading), dyscalculia (difficulty with math), and dysgraphia (difficulty with writing). These conditions often manifest during school years and can significantly affect academic performance and everyday life. Early identification and tailored educational interventions are essential for helping individuals with learning disabilities reach their full potential (American Psychiatric Association, 2013).

Learning disabilities are characterized by specific challenges in processing information, despite average or above-average intelligence. Individuals with learning disabilities may struggle with skills such as reading (dyslexia), writing (dysgraphia), or math (dyscalculia). These difficulties often manifest as slow reading, poor handwriting, trouble with basic calculations, or difficulty following instructions. Common characteristics include difficulty organizing thoughts, trouble remembering new information, and inconsistent performance in school. Learning disabilities are lifelong and vary in

severity, but with proper support and intervention, individuals can develop strategies to overcome these challenges and succeed academically and socially (Lerner & Johns, 2012).

Types of Specific Learning Disability

- 1. Dyslexia:** Difficulty with reading, including challenges in decoding words, reading fluency, and comprehension. It affects the ability to recognize and process written language.
- 2. Dyscalculia:** Difficulty with mathematical concepts, such as understanding numbers, performing calculations, and grasping arithmetic operations.
- 3. Dysgraphia:** Difficulty with writing, including issues with handwriting, spelling, and organizing thoughts on paper.
- 4. Auditory Processing Disorder:** Difficulty in processing sounds and distinguishing between similar sounds, despite normal hearing, which can affect language comprehension.
- 5. Visual Processing Disorder:** Difficulty in interpreting visual information, such as recognizing shapes, spatial awareness, or distinguishing visual patterns.
- 6. Nonverbal Learning Disabilities:** Challenges in understanding nonverbal cues like body language or facial expressions, often accompanied by strong verbal skills but poor motor coordination and spatial skills.

These learning disabilities affect academic performance and may require individualized support and intervention to help students succeed.

Dyscalculia: It is a specific learning disability that affects an individual's ability to understand and perform mathematical tasks. It involves persistent difficulty with basic arithmetic skills such as number sense, calculations, and understanding numerical concepts, despite adequate intelligence and education. Individuals with dyscalculia may struggle with tasks like counting, recognizing numbers, telling time, or solving simple math problems.

The condition is neurological in nature, often affecting memory, spatial reasoning, and cognitive processing related to numbers. Dyscalculia can hinder daily activities involving math, such as managing money, measuring, or following directions. Early identification and targeted interventions are crucial for supporting individuals with dyscalculia in academic and real-world settings.

Definition of Dyscalculia

Dyscalculia is defined as a specific learning disability that impairs an individual's ability to understand, learn, and perform mathematical calculations, despite normal intelligence and appropriate educational exposure (**Geary, 2013**). This condition primarily affects number sense, memory of arithmetic facts, and the ability to perform simple calculations.

Characteristics of Dyscalculia

- ❖ Struggles with basic number sense, such as recognizing the value of numbers or counting accurately.
- ❖ Difficulty performing basic calculations, such as addition, subtraction, multiplication, and division.
- ❖ Trouble recalling basic math facts, like times tables or number sequences, even after repeated practice.
- ❖ Struggles with telling time, understanding time-related concepts, or following sequences of directions.
- ❖ Difficulty understanding mathematical symbols, such as $+$, $-$, \times , \div , and their application in calculations.
- ❖ Inability to estimate quantities or distances accurately.
- ❖ Problems with understanding spatial relationships, such as difficulty recognizing patterns or understanding geometry.
- ❖ Increased anxiety or frustration when dealing with numbers or mathematical tasks, which can further hinder learning.

Statement of the Problem

A Case Study of Students with Dyscalculia and their Mathematical Ability of Calculation at a Primary School in Itanagar

Objectives of the study

1. To find out prevalence of students with dyscalculia in primary school.
2. To find out significant difference in mathematical abilities of calculation between male and female students with dyscalculia in primary school.

Hypothesis of the study

1. There is a significant proportion of students in the primary school who exhibit characteristics of dyscalculia, as determined by diagnostic assessments.
2. There is a significant difference in mathematical abilities of calculation between male and female students with dyscalculia in primary school.

Method of the study

The researcher was used survey method for the study. The researcher had used Mean, Standard Deviation, t-Test and percentage for data analysis.

Population of the study

This case study has population of primary school students of Eklavya Public School, Itanagar

Sample Size of the study

Sample size for this case study has 60 students of primary education.

Tools of Research

In this case study the researcher had adopted DTLTD developed by Dr. Smirti Swarup and Dr. D. H. Mehta.

1. Test of Eye Hand Coordination
2. Test of Number Concept
3. Test Cognitive Functioning

Data Analysis

Table 1.1: Status of Mathematical Ability of students of Primary School

Themes	High	Medium	Low
Test of Eye Hand Coordination (EHC)	35%	40%	25%
Test of Number Concept (NC)	71%	-	29%
Test of Cognitive Functioning (CF)	56%	12%	32%

Table 1.2: Significant Difference in the Status of Mathematical Abilities of Calculation between Male and Female Students of Primary School the Area of Eye Hand Coordination.

Students	Strength	Mean	SD	T-Test
Female	24	8.41	1.52	0.43
Male	36	8.52	1.23	

The analysis explores the difference in mathematical calculation abilities between male and female primary school students in the area of EHC. The mean score for female students ($M = 8.41$, $SD = 1.52$) is slightly lower than the mean score for male students ($M = 8.52$, $SD = 1.23$). But on the other hand, the t-test value ($t = 0.43$) indicates that this difference is not statistically significant. This means that there is no significant difference between male and female students in their mathematical abilities related to eye hand coordination.

Table 1.3: Significant Difference in the Status of Mathematical Abilities of Calculation between Male and Female Students of Primary School the Area of Number Concept.

Students	Strength	Mean	SD	T-Test
Female	24	7.76	2.21	0.41
Male	36	7.69	2.20	

The analysis explores the difference in mathematical calculation abilities between male and female primary school students in the area of EHC. The mean score for female students ($M = 7.76$, $SD = 2.21$) is slightly higher than the mean score for male students ($M = 7.69$, $SD = 2.20$). But on the other hand, the t-test value ($t = 0.41$) indicates that this difference is not statistically significant. This means that there is no significant difference between male and female students in their mathematical abilities related to number concept.

Table 1.4: Significant Difference in the Status of Mathematical Abilities of Calculation between Male and Female Students of Primary School the Area of Cognitive Functioning.

Students	Strength	Mean	SD	T-Test
Female	24	8.21	1.48	0.40
Male	36	8.10	1.02	

The analysis explores the difference in mathematical calculation abilities between male and female primary school students in the area of EHC. The mean score for female students ($M = 8.21$, $SD = 1.48$) is slightly higher than the mean score for male students ($M = 8.10$, $SD = 1.02$). But on the other hand, the t-test value ($t = 0.40$) indicates that this difference is not statistically significant. This means that there is no significant difference between male and female students in their mathematical abilities related to cognitive functioning.

Discussion

Across the three areas EHC, NC, and CF gender comparisons reveal slight differences in mean scores between male and female students. However, none of these differences are statistically significant, as indicated by the t-test values in Tables 1.2, 1.3, and 1.4.

In the area of Eye Hand Coordination, the female students have a slightly lower mean score ($M = 8.41$, $SD = 1.52$) compared to male students ($M = 8.52$, $SD = 1.23$), but the t-test value ($t = 0.43$) confirms no significant difference between genders in this ability.

In the area of Number Concept, the female students show a slightly higher mean score ($M = 7.76$, $SD = 2.21$) than male students ($M = 7.69$, $SD = 2.20$). The t-test value ($t = 0.41$) indicates no statistically significant difference, meaning both genders perform similarly in number concept understanding.

In the area of Cognitive Functioning, the female students have a mean score of ($M = 8.21$, $SD = 1.48$) while male students have a slightly lower mean of ($M = 8.10$, $SD = 1.02$). Again, the t-test value ($t = 0.40$) shows no significant difference in cognitive functioning between genders.

Conclusion

The data analysis highlights that primary school students show a varied distribution of mathematical abilities, with a notable strength in number concepts and eye-hand coordination. But on the other hand, there is no significant difference in mathematical abilities between male and female students across all three tested areas (EHC, NC, CF). This suggests that both boys and girls in this primary school perform similarly in their mathematical skills, with gender not playing a significant role in their abilities. The results emphasize the need for further interventions to support students who fall in the low performance categories across these tests.

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A Comparative Analysis of Fish Fauna in Arunachal Pradesh and Jammu & Kashmir: Ecological Traits and Conservation Challenges

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Abstract

The fish fauna, ecological traits, and environmental circumstances of two different Indian regions—Arunachal Pradesh and Jammu and Kashmir—are thoroughly compared in this research paper. Both regions, which are found in the Eastern and Northwestern Himalayas, respectively, are notable hotspots for biodiversity with distinctive aquatic environments. They vary, nevertheless, in terms of the variety of species, altitude, climate, river systems, and environmental stresses. The present study examines the fish diversity, ecological adaptations of various fish species, the environmental factors that impact aquatic ecosystems, and the conservation challenges that arise from human activities and climate change in these regions. The results show that the fish fauna of Arunachal Pradesh is more varied and tropical, whereas the aquatic systems of Jammu & Kashmir are typified by cold-water species with a reduced range of diversity. In order to protect the aquatic biodiversity and uphold the ecological integrity of both regions, the study emphasizes the significance of region-specific conservation strategies including the strategies for sustainable management and the role of local communities in conservation efforts.

Keywords: Fish fauna, Endemism, Arunachal Pradesh, Jammu & Kashmir, Biodiversity, Conservation.

1. Introduction

The fish fauna of India is rich and diverse, with notable differences between various geographical regions due to the unique environmental factors affecting aquatic ecosystems (Sarkar et al., 2020). Fishes are important indicators of aquatic ecosystem health and biodiversity (Pinna et al., 2023). The regions of Arunachal Pradesh and Jammu & Kashmir, both situated in the Himalayan range, represent distinct ecological zones with unique hydrological and climatic conditions that influence their aquatic ecosystems. Arunachal Pradesh, located in the Eastern Himalayas, is characterized by its subtropical to tropical climate and vast river systems flowing through dense forests that provide habitats of diverse environmental conditions fish species (Gurumayum et al., 2016). On the other hand, Jammu & Kashmir, in the Northwestern Himalayas, features cold-water streams and rivers, fed primarily by

glacial melt and snowmelt. It shares a similar ecological setting to that of Arunachal Pradesh but with notable differences in the species composition of its aquatic systems (Scott et al., 2019).

Despite the geographic proximity of these two regions within the greater Himalayas, their fish faunas differ considerably due to variations in altitude, climate, and environmental conditions. This comparative analysis aims to examine these differences, explore the environmental pressures impacting fish diversity, and evaluate conservation challenges.

The paper begins with a geographical and climatic overview of both regions, followed by an analysis of the fish fauna diversity and species composition. Subsequently, the ecological adaptations of fish in response to environmental conditions are discussed, leading into an examination of environmental threats and conservation challenges.

2. Geographical and Climatic Overview

2.1 Arunachal Pradesh

Arunachal Pradesh is located in the northeastern corner of India, sharing borders with China, Bhutan, and Myanmar. It spans altitudes ranging from the lowland floodplains at 100 meters above sea level to the high peaks of the Eastern Himalayas exceeding 7,000 meters (Sharma & Shukla, 1992). This elevational gradient results in a variety of habitats, from tropical rainforests in the foothills to alpine ecosystems at higher altitudes (Nath & Dey, 2000).

Arunachal Pradesh is part of the Indo-Burma hotspot, recognised as one of the most significant biodiversity hotspots among the twenty-five global mega biodiversity hotspots (Myers et al., 2000). The state's major river systems—such as the Brahmaputra River and its tributaries, the Siang, Subansiri, and Lohit rivers—originate in the Eastern Himalayas (Rawat & Laskar, 2010). Fish species can find a wide variety of aquatic habitats in these swift-moving rivers as they meander through dense forests. The Southwest Indian monsoon, which brings intense rains from June to September, is the main factor influencing the climate in Arunachal Pradesh (Dikshit & Dikshit, 2014). This rainfall helps create large seasonal variations in river discharge and high-water flow, both of which have an impact on fish migration and breeding patterns.

2.2 Jammu & Kashmir

Situated in the Northwestern Himalayas, Jammu and Kashmir is a cold-water region distinguished by glacial meltwaters, alpine lakes, and swift-moving rivers like the Jhelum, Chenab, and Indus. The climate of the area is temperate to alpine, with mild summers and frigid winters (Sehgal, 1999). The main sectors in the state that directly depend on these water resources are agriculture, irrigation, horticulture, hydroelectricity, and tourism (Shukla & Ali, 2018). While snowmelt is the primary cause of seasonal flow variations, especially in the spring and early summer, glaciers are essential in

preserving river water levels during the summer (Raina & Petr, 1999).

There are many different types of ecosystems found in Jammu and Kashmir's water bodies, including wetlands, lakes, and rivers. Two of the most well-known lakes are Wular and Dal. These aquatic habitats in Jammu & Kashmir are distinguished by low water temperatures which restrict the diversity of fish species in contrast to the subtropical conditions in Arunachal Pradesh.

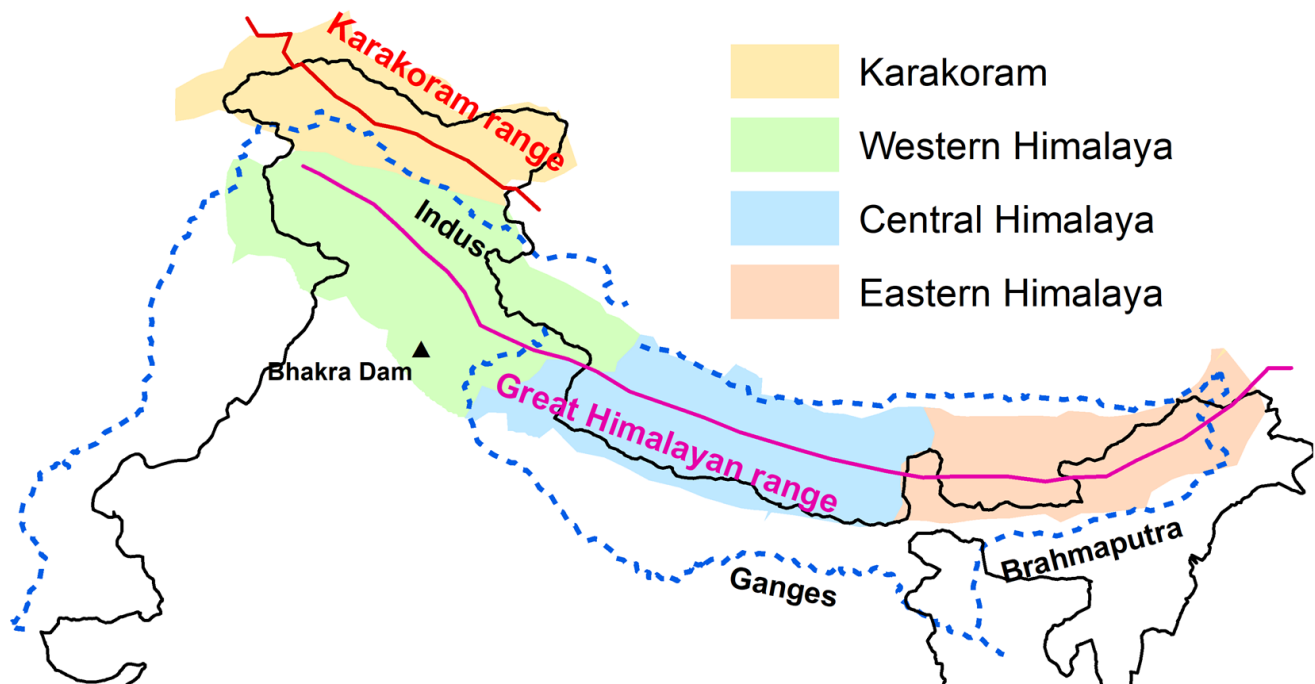


Fig. 1: Showing Divisions of Himalayas (Kulkarni et al., 2018)

3. Fish Fauna Diversity and Composition

3.1 Fish Fauna of Arunachal Pradesh

Arunachal Pradesh boasts one of the richest fresh water fish faunas in all of India, with 259 species of fish identified from its diverse river systems (Gurumayum et al., 2016). The region's diverse topography, a broad range of habitats, and subtropical to tropical climate, which support a variety of ecological niches, are primarily responsible for the diversity of fish found in Arunachal Pradesh.

Among the most common fish families are:

- **Cyprinidae:** This is the largest family of freshwater fish in Arunachal Pradesh, with genera such as *Tor*, *Neolissochilus*, *Garra*, and *Barilius* being well-represented (Bagra et al., 2009). Species such as *Tor putitora* (golden mahseer) and *Neolissochilus hexagonolepis* are iconic migratory species.
- **Sisoridae:** This family of catfishes is common in the fast-flowing hill streams of Arunachal Pradesh. *Bagarius bagarius*, a large sisorid catfish, is an apex predator in many rivers.

- **Balitoridae:** Hill stream loaches such as *Balitora* spp. and *Schistura* spp. are adapted to the fast currents and rocky substrates of the hill streams.

The abundant system of wetlands and floodplains in Arunachal Pradesh contributes significantly to the region's high fish biodiversity by offering young fish and other aquatic species vital habitats. (Goswami et al., 2012). The geographical location and altitudes ranging from lower to higher elevations creates suitable conditions for cold water fish species in Arunachal Pradesh. The abundance of rivers, streams, and lakes at different altitudes provides various aquatic environments suited to cold water fishing, with 108 species classified as prospective cold-water fish species (Gurumayum & Tamang, 2017).



Fig. 2: Siang River near Pasighat

3.2 Fish Fauna of Jammu & Kashmir

With only 120 species reported, the fish fauna of Jammu and Kashmir is relatively less diverse (Bhat et al., 2020). This is mostly because of the cold-water conditions that restrict the number of species that can thrive in these environments (Sehgal, 1999). The Cyprinidae family holds the greatest dominance, especially with regard to species belonging to the genus *Schizothorax*, which is widely recognized as snow trout.

- ***Schizothorax* spp.:** Native species such as *Schizothorax curvifrons* (Satter gad), *Schizothorax niger* (Ael gaad), *Schizothorax plagiostomus* (Khont), *Schizothorax esocinus* (Chirru), and *Schizothorax labiatus* (chhush) are well adapted to the cold, oxygen-rich waters of the region's

rivers and lakes. These species have specialized feeding mechanisms and body structures that enable them to graze algae from rocks in fast-moving waters (Bharti et al., 2023).

- *Oncorhynchus mykiss* (rainbow trout) and *Salmo trutta* (brown trout): Introduced during the colonial period, these non-native trout species have become established in the region and are now an important part of the fishery industry (Ganie et al., 2024). However, their introduction has also raised concerns about competition with native species.

Compared to the rich fish diversity in Arunachal Pradesh, the cold-water ecosystems in Jammu & Kashmir support fewer species but are ecologically significant due to the unique adaptations of the native fish.

4. Endemism

4.1 Endemic species of Arunachal Pradesh

The state is home to 32 endemic fish species, including *Amblyceps arunachalensis*, *Bhavana arunachalensis*, *Glyptothorax dikrongensis*, *Devario horai*, *Creteuchiloglanis kamengensis* etc (Gurumayum et al., 2016). Among the 63 fish species found in the type locality, which belong to 04 orders, 13 families, and 26 genera, 56 are found to be endemic to this region (Gurumayum et al., 2020). This indicates that the state's fish fauna is highly endemic.

4.2 Endemic species of Jammu & Kashmir

Although Jammu and Kashmir is well-known for having endemic fish species, especially in the Cyprinidae family, it has less fish diversity than Arunachal Pradesh, which results in fewer endemic fish species. *Schizothorax niger*, *Schizothorax esocinus*, and *Schizothorax curvifrons* are among the species that find a special home in the region's cold-water rivers (Sehgal, 1999). These species have adapted well to the region's chilly rivers. Because endemic species in this area are particularly sensitive to changes in the environment and habitat degradation, conservation efforts are essential to the survival of these species.

5. Ecological Adaptations and Environmental Conditions

5.1 Arunachal Pradesh

Arunachal Pradesh's fish species have evolved to survive in a variety of habitats, including lowland rivers and swift-moving hill streams. During the monsoon season, migratory species like the golden mahseer (*Tor putitora*) travel great distances in order to breed in the upper reaches of rivers (Bhatt & Pandit, 2016). Changes in the temperature and flow of the water, as well as the presence of appropriate spawning grounds, cause these migrations.

The rivers in Arunachal Pradesh have different flow patterns and steep gradients, which have caused

fish in the area to adapt as well. For instance, species like *Garra* spp. and *Schistura* species, possess streamlined bodies and unique mouthparts that enable them to cling to rocky substrates and consume algae and detritus, making them suited to life in swift currents (Husain, 2015).

5.2 Jammu & Kashmir

Jammu and Kashmir's fish fauna has adapted to live in cold-water environments with high oxygen content, chilly temperatures, and swift-moving streams. Native species like *Schizothorax* spp. are well adapted to the nutrient-poor conditions of glacial meltwater rivers. These species demonstrate key adaptations like allometric growth patterns, which suggest they can thrive even in environments with limited nutrient availability (Qadri et al., 2016).

The natural dynamics of Jammu and Kashmir's aquatic ecosystems have also changed as a result of the introduction of non-native trout species. Predatory species like *Salmo trutta* (brown trout) and *Oncorhynchus mykiss* (rainbow trout) have created new trophic interactions in the area and may have an impact on native species by competing with them for food and habitat (Zutshi and Gopal, 2000; Farooq, 2024).



Fig.3: Trout fish farming project, Kokernag (Ganie, et al., 2024)

6. Environmental Threats and Conservation Challenges

6.1 Arunachal Pradesh

Arunachal Pradesh's rich fish fauna is increasingly threatened by a range of human activities, including:

- **Hydropower Development:** One of the biggest threats to aquatic biodiversity in Arunachal Pradesh is the building of dams for the purpose of producing hydroelectric

power. Dams damage fish migration paths, split river systems, and change the natural flow patterns that are necessary for feeding and spawning. Species that migrate, like the golden mahseer, are especially susceptible to these modifications (Patir et al., 2023).

- **Deforestation and Habitat Degradation:** The region's fast deforestation and shifting land uses have caused soil erosion and sedimentation in rivers, lowering water quality and harming fish habitats (Tewari, 2004). Because it stabilizes riverbanks, adds to nutrient cycling, and provides shade, riparian vegetation is critical to the health of river ecosystems.
- **Overfishing and Illegal Fishing Practices:** There have been decreases in fish populations in various rivers in Arunachal Pradesh due to unsustainable fishing methods like using poison and dynamite fishing. Both non-target species and young fish are especially harmed by these practices. (Darshan et al., 2019).

6.2 Jammu & Kashmir

The cold-water ecosystems of Jammu & Kashmir face different challenges, including:

- **Climate Change and Glacial Retreat:** The region's aquatic ecosystems are seriously threatened by climate change. Since fish populations depend on cold, oxygen-rich water, the retreat of glaciers due to global warming has reduced the amount of water available in rivers and lakes (Qureshi et al. 2015). Variations in the amount and timing of snowmelt also cause disturbances to the seasonal flow patterns that are essential for fish migration and reproduction.
- **Introduction of Non-native Species:** The aquatic biodiversity of the area has been impacted by the introduction of trout in different ways. Although sport fishing and aquaculture have benefited the local economy from trout farming, native fish populations have been negatively impacted by the presence of predatory trout species, especially the slow-growing *Schizothorax* species (Naik et al., 2015).
- **Habitat Degradation and Pollution:** Many water bodies are experiencing increased pollution and habitat degradation as a result of urbanization, agriculture, and tourism. Fish populations in the lakes of the Kashmir Valley, such as Dal Lake and Wular Lake, have been impacted by eutrophication, invasive species, and deteriorating water quality (Zargar et al., 2012).



Fig.4: Dead fish floating on the surface of Dal Lake, Kashmir, on 25 May 2023, (Javeed, 2023) (Image: Umer Asif)

7. Conservation Strategies and Recommendations

7.1 Arunachal Pradesh

Given the significant threats to the aquatic ecosystems of Arunachal Pradesh, conservation efforts should focus on:

- **Sustainable Hydropower Development:** Planning and management of hydropower projects are necessary to reduce their effects on fish migration and river ecology. Building fish passages, preserving minimum flow levels, and prior to approving new projects, environmental impact assessments (EIA) should be carried out.
- **Community-based Conservation:** Overfishing and illicit fishing can be decreased by involving the local community in conservation initiatives. Fish biodiversity in the area can be sustained over the long term with the help of community-led programs to monitor fish populations, control fishing methods, and restore riparian habitats.
- **Protected Areas and Habitat Restoration:** Protecting important fish habitats from habitat destruction can be achieved by establishing protected areas that include spawning grounds and

migratory corridors. Restoring riparian vegetation, reducing erosion, and enhancing water quality in impaired river systems should be the main goals of habitat restoration initiatives.

7.2 Jammu & Kashmir

In Jammu & Kashmir, conservation strategies should focus on:

- **Glacier and Water Resource Management:** Understanding how climate change affects cold-water fish species requires tracking its effects on glaciers and water resources. The ecological integrity of glacial meltwater rivers should be preserved, and sustainable water management techniques that take into consideration potential future climate changes should be the main goals of conservation efforts.
- **Regulating Trout Introductions:** Maintaining the biodiversity of native fish requires controlling the introduction of non-native trout species. Researching the ecological relationships between native and introduced species, encouraging native fish farming, and limiting the spawning of trout in sensitive areas are a few possible ways to achieve this.
- **Pollution Control and Habitat Restoration:** In the lakes and rivers of the Kashmir Valley, efforts to reduce pollution and rebuild damaged habitats are essential to maintaining fish populations. This include limiting the amount of nutrients that urban and agricultural areas add to the water, managing invasive species, and enhancing waste management techniques to improve the quality of the water.

8. Conclusion

The distinct geographical, ecological, and environmental conditions of Arunachal Pradesh and Jammu and Kashmir have shaped their respective fish faunas. In contrast to the high diversity of fish species found in Arunachal Pradesh's tropical to subtropical rivers, which include numerous endemic and migratory species, Jammu & Kashmir's cold-water ecosystems are home to a smaller number of species, primarily cold-adapted fish like *Schizothorax* spp. and introduced trout.

Numerous environmental challenges, such as habitat fragmentation, climate change, and pollution caused by humans, are present in both areas. Every region has unique ecological needs and threats, so conservation strategies must be customized to meet those needs. Safeguarding riverine environments, controlling the building of dams, and encouraging environmentally friendly fishing methods are Arunachal Pradesh's top priorities. Lessening the effects of climate change, controlling the introduction of trout, and cleaning up degraded and contaminated water bodies should be the main priorities in Jammu and Kashmir.

The adoption of successful conservation strategies that strike a balance between ecological preservation and sustainable development will determine the future of aquatic biodiversity in both regions.

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EXPLORING OLLO GOVERNANCE: LOWANG AND LOSAVANG

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ABSTRACT

This article provides an in-depth examination of the traditional governance system of the Ollo community, with focus on the integral roles of Lowang and Losavang. Lowang the chief leader, the Losavang, the chief council form the foundation of Ollo's decision-making. This article explores the selection process, roles, and responsibilities of Losavang members, highlighting their significance in maintaining social harmony and collective progress. This research is based on an analysis of Ollo customs, traditions, and community practices. There is intricate balance between Lowang's authority and the Losavang's advisory role, ensuring effective governance and community cohesion. The study also examines the cultural significance of the Lowang system and the Losavang council, shedding the light on their historical and symbolic importance. By exploring the Ollo governance system, this study contributes to a deeper understanding of traditional leadership models and their relevance in contemporary society. Furthermore, this study reveals the intricate dynamics between the Lowang and the Losavang, highlighting their collaborative approach to conflict resolution, and community development. Despite modernization, the Ollo community remains deeply rooted in tradition, with the Lowang and Losavang commanding utmost respect and authority. The institution of Lowang continue to thrive, with the chief serving as a unifying figure and guardian of cultural heritage.

KEYWORDS: Ollo Community, Lowang, and Losavang.

INTRODUCTION

Arunachal Pradesh can roughly be divided into several semi distinct cultural areas on the basis of identity, language, religion and material culture—the Tibetanic area bordering Bhutan in the west, Tani area at the centre of the state, the Mishmi area to the east of that, the Tai/Singpho/ Tangsa area to the far west and the ‘Naga’—like area to the immediate south. In between there are few transitions zones, such as the Aka/Hrusso/Sherdukpen area which provides a ‘buffer’ of sorts between the Tibetan Buddhist tribes and animist, hill tribal Tani. Within each of these cultural spheres one finds

populations of related tribes speaking related languages and sharing similar traditions(Rajput,2011,p.14). The Nagas are one of the Mongolian racial groups found in Assam, Meghalaya, Tripura, Mizoram, Manipur, Arunachal Pradesh, Burma, Bangladesh, Bhutan, Sikkim, Nepal, Tibet, the fringes of the U.P, Himachal Pradesh and Kashmir of the Himalayan tracts. They have their distinctive tribal names with a number of sub-Names, about fifty, of which better known are Angami (Tengmai), Chakhsang (Chokroma), Ao, Sema, Rengma, Lotha, Kuki, Chang, Konyak, Khienmungam, Sangtam, Yimchunger, Phom, Damsa, Zemai, Liangmai, Rongmai (three combined Zelagrong), Mao(Shipoumai), Maram (Maharamai), Thangatankul, Maring, Kom, Chiru, Anal, Moyong, Mongsang, Lamgang (Pakan),

Nocte, Tangsa, Wancho, Singpho, Khampti, Haimi Htangram, Rangpan, Para, Kalyo kengyu. The population of Naga is over one million, the areawise break-up being; 5,15,561in Nagaland, 2,50,000 in Manipur, 70,000 in Tirap district of Arunachal Pradesh, and some lakhs in the North Cachar-Mikir hills, other contagious place of Assam and Burma(Asoso,p.6,7).

The Noctes, about 35000 live in 63 villages occupying half of the Tirap district, beyond the river Tissa is the home of Wanchos. There are many Nocte villages across the Myanmar border also. In the absence of any recorded history or authentic reference, it is difficult to ascertain the exact ethnic origin about the Noctes(Lowang,p.3).Deep within the verdant hills of Arunachal Pradesh, a state nestled in the northeastern corner of India, lies the Laju circle under the Tirap District. It is here ,amidst the picturesque landscape, the the Ollo community has made their home(Kholia,15-05-24).

This article is focus on the Ollo community's traditional governance system, led by the Lowang and the Losavang, has endured for generations. This article examines the roles, responsibilities, and cultural significance of these revered institutions, shedding light on their importance, roles and structure.

OBJECTIVES

Despite the existence of traditional governance and unique social norms, there is no notable comprehensive research of the Ollo community. The objectives of the study aims to bridge this knowledge gap by exploring the traditional governance systems, specifically focusing on the roles and responsibilities of Lowang and Losavang. The objectives of the study iare :

1. To identify the traditional governance structures of the Ollo community
2. To examines the roles and responsibilities of Lowang and Losavang.

METHODOLOGY

This study employed a mixed-methods approach, combining qualitative date from firld interviews with Lowang, Gaon bura and students and elders of the Ollo community and quantitative data from existing

literature, including books, article etc., to examine the traditional governance system of Ollo community with main focus on the Lowang and the Losavang.

THE OLLO COMMUNITY: AN OVERVIEW

Spread across 13 villages, this distinct subgroup of the Naga tribes has cultivated a unique cultural identity, shaped by their history, traditions, and the rugged terrain they inhabit. For generations, the Ollo people have lived in harmony with their surroundings, developing a profound connection with the land and its rhythms. The Ollo or the Ollo Laju people, as they themselves, shares a rich cultural heritage with the broader Naga and Nocte tribes, yet their unique experience, customs, and practices have woven a distinct narrative. Their language, social organization, and livelihoods have evolved in harmony with their surroundings, reflecting the intricate web of traditions that defined them. The Ollo or Ollo Laju community's story is one of resilience , adaption, and cultural richness, waiting to be shared and celebrated (Kholia,15-07-24).Ollo people are not just found in the Laju circle and the Deomali in Tirap district of Arunachal Pradesh, but there are many Ollo villages are found in the Myanmar (Burma) and they share a history together as a Ollo tribe(sapong,kongkang,kongkang,namet,12-06-24). According to the data collected from the research field, there 12 villages of Ollo community under the Laju circle and 1 village under Deomali town.

Table No. 1; 13 Ollo villages under Tirap District.

1	LAJU (LAJU)
2	LOWER CHINHAN (LAJU)
3	UPPER CHINHAN (LAJU)
4	NOGLO (LAJU)
5	LONYEN (LAJU)
6	SENNYU (LAJU)
7	RAHO (LAJU)
8	LIANGCHEN (LAJU)
9	LONGLIANG (LAJU)
10	PONGKONG (LAJU)
11	SENLIAM (LAJU)
12	LONGBO (LAJU)
13	LONGKHONG (DEOMALI)

Sources; Extracted from interview with Gaon Bura Sina Mophuk (interpreter, Nali Mangyut) ,Laju

village,03-08-2023.

In the heart of Arunachal Pradesh, where the majestic Himalayas meet the lush valley, the Olo community thrives, carrying the torch of their ancestor's legacy. There is a story of resilience, courage, and the unbreakable bond with their heritage. The Voorang folksong, a cherished oral tradition, whisper tales of their forbears; journey from the mystical land of Tanghneu. Tanghneu a place of origin, where the Olo people's ancestors acquired the essence of their identity, ornament, culture and tradition.

TRADITIONAL GOVERNANCE SYSTEM OF OLO COMMUNITY

The term 'political institution' may also refer to the recognized structure of rules and principles with in which the above organizations operates, including such concepts Arunachal Pradesh have highly ordered and organized system of functioning in their villages. Each tribe or clan or villages has its own head styled as Gam or Gaon Bura. All matters relating to the community as a whole are decided at the village level(Osik,1996,p.10). These councils are composed of village elders, and they traditionally enjoy a good deal of autonomy in judicial, administrative and developmental matters(Choudhury,p.162). The Olo community's traditional Governance system is a unique and intricate framework that has guided the community's decision making and disputes resolution process for centuries. In the picturesque Tirap district of Arunachal Pradesh, nestled in the eastern Himalayas, the Olo community as thrived for centuries. This indigenous tribe, with their cultural heritage and traditions, has maintained a unique identity shaped by their history, geography, and social practices. At the heart of the Olo society lies the chieftain system, a time-honored institution that has guided the community through the ages. The Olo chief or Lowang, is revered figure, embodying the wisdom, courage, and leadership that has defined the community since time immemorial. The chieftain system is a remarkable example of indigenous self-determination, a testament to the resilience and adaptability of the Olo people. Despite external influence and modernization, the Lowang continues to wield significant influence, their authority rooted in the love and respect of their people. As we explore the world of the Olo community, we find ourselves immersed in a realm ancient customs, intricate social hierarchies, and deep-seated traditions. The chieftain system is intricately woven into Olo society, influencing every aspect of community life, from disputes resolution to cultural practices. At the heart of the system lies the chief or Lowang, who plays a vital role in maintaining social harmony, resolving disputes, and preserving cultural heritage. But where did this chief system originate? Unlike other tribes of Arunachal Pradesh, the Olo chief system has a unique history. The Olo people's traditional village where each village managed its own affairs, shaped their leadership structure. The autonomy allowed them to develop a distinct system, separate from external influences. In Olo society, clans

and families play a significant role in governance and leadership. Leaders emerge from prominent families, and their authority is rooted in their ability to navigate complex social relationship. This is in contrast to other communities, where leadership may be based on military prowess or spiritual influence. The chief system also differs in its emphasis on consensus building and collective decision-making. While other communities may have more autocratic leadership style, the Ollo Lowang or the King works to build consensus among community members. This approach has helped maintain social harmony and resolve disputes effectively (Nali Lowang,04-08-2024).

CHIEF COUNCIL (LOSAVANG)

In the Ollo community, the Losavang is the traditional governance institution that has been the cornerstone of village life for centuries. Every Ollo village has its own Losavang, comprising respected chief and the elders of the Ollo villages, who make decision for the collective well-being of the community. The Losavang is not just a council, but a symbol of Ollo unity and solidarity. The Losavang operates on the principles consensus-building and collective responsibility, ensuring that every decision benefits the community as a whole (Kholia,15-06-24). The Losavang is more than just an institution, it is a collective of respected individuals who embody the wisdom, experience, and values of the Ollo community. The Losavang leadership is traditionally inherited by the son from his father, following a patriarchal system that has been practiced for generations, originating from the old Ollo traditions. At the helm of the Losavang stands the Lowang, a revered title bestowed upon the chief of the Ollo community. The Lowang is considered the kingpin of the community, shouldering immense responsibility as the leader and representative of the Ollo people. This esteemed the position is not merely a title but a hereditary right, passed through generations. Every Ollo villages has their own Lowang. The Lowang system is built on a hereditary framework, where the eldest son of the incumbent Lowang inherits the title upon his demise. This ensures continuity and stability in leadership, as the successor is groomed from a young age to assume the responsibilities of the revered position. The Lowang's role is not only a privilege but also a sacred duty, requiring unwavering dedication to the community's well-being. Being the Lowang is a formidable task, demanding exceptional leadership qualities, wisdom and vision. The Lowang must navigate complex community dynamics, mediate disputes, and make informed decisions for the collective good. The position requires a deep understanding of Ollo customs, traditions, and values, as well as the ability to adapt to changing circumstances. While the Lowang holds the highest position, the Losavang membership operates as a cohesive unit, providing support and counsel to the chief. The members work collaboratively to address community concerns, share knowledge, and contribute to decision making processes. The hierarchical structure ensures a clear chain of command while fostering a sense of unity

and shared responsibility. The Lowang's role extends beyond leadership ; it symbolize the continuity of Ollo traditions and the community's rich cultural heritage. The chief's position serves as unifying force, bridging generational gaps and reinforcing social cohesion. As the embodiment of Ollo values and wisdom, the Lowang inspire respect, loyalty, and devotion from the community members. The Ollo community organized around a clan-based social structure and each member position's is determined by their clan affiliation and family lineage (Rumsu, Rukhet, Rangsong, Rangsong,13-06-24). Next to the Lowang stands Ngongpa, a position of immense importance and respect, equivalent to governor or the chief's right hand man. The Ngongpa assumes significant responsibilities, particularly in the absence of the Lowang, when he takes charge of decision making processes. As the second-in-command, the Ngongpa weilds considerable power, rivaled only by the Lowang. A notable aspect of the community's structure is the presence of two dormitories is called 'pang' in Ollo dialect, in every cvillage, one reserved exclusively for the Lowang and the other for Ngongpa. This distinction underscore the Ngongpa's elevated status in the community, solidifying his position as a trusted advisor and leader. The Ngongpa demands exceptional leadership skillsm strategic thinking, and a deep understanding of Ollo customs and traditions(Rumsu, Rukhet, Rangsong, Rangsong,13-06-2024). Following Ngongpa, the second-in-command, are additional esteemed elders and members who contribute their wisdom an expertise to the community's governance. Among these respected individuals in Ngongba, who provides valuable advice and guidance to Losavang. The Losavang also encompasses various sub-heads, each addressing specific aspects of community governance. These sub-heads includes ; Nokpa, Rumsu, Kongkang, Menyak, Hoodiong etc. There are one head in each sub-clan of the Ollo community. This sub-heads work in harmony, addressing various aspect of community governance and ensuring a comprehensive approach to leadership. Through this collaborative structure, the Ollo community benefits from a rich tapestry of wisdom, experience, and skills, empowering its members to build a brighter future together (Kholia,15-06-2024).

LAW AND A RITUAL JUSTICE

The customary laws are the property of the people so interpretation by expert was natural and instinctive. They are not required to be enforced. Punishment was considered as natural consequences of violation of the custmary law which are natural. The Ollo community does not have any written codified law, but they follow a set of unwritten rules that have been accepted and practiced by general consensus for generations. The Ollo community has perpetuated their customary law traditions for centuries, fostering a profound familiarity with the uncoded norms that govern their social interactions. Through oral tradition and cultural transmission, the rules and limitations of these unwritten laws have become an integral part of the community's collective knowledge, ensuring a

shared understanding and compliance with established norms(Wangdong, Wangdong, Chatkhet,14-06-2024). In the Ollo community, Benshong day is sacred occasion when the Losavang convenes to settle disputes and offences. Through a ritualistic process, the Losavang fixes the fines for each case, taking into account the nature and severity of the offense. This ritual serves as a means of purging wrongdoing and restoring balance, reinforcing community values and norms, and demonstrating the Losavang's authority and wisdom. On Benshong day, the community comes together to witness the ritual, ensuring transparency and accountability. The fixed fine is then paid as a form of restitution, closing the case and reaffirming harmony within the community. The ritualistic process underscores the significance of Benshong as a day to reckoning, where justice is served and community cohesion is maintained. (Rumsu, Rukhet, Rangsong, Rangsong,13-06-2024).

CHANGES

The Ollo, an indigenous community have witnessed significant changes in their traditional political institutions. External influences and internal dynamics have altered the fabric of their governance, leading to a blend of traditional and modern practices. Colonialism introduced foreign governance while dividing the power of chief with introduction of Gaon bura. Christianity brought a new values, leading to a decline in traditional practices day by day. Modernization and urbanization have drawn younger generations away from customary ways. Social and economic changes have transformed power structure, but it didn't create any tensions between traditional and modern governance. Despite these changes the Ollo people have continue to navigate their governance with resilience and adaptability. Amidst the change, the Ollo have maintained significant continuity to their traditional political institutions. Their customs, language, and cultural heritage remain vital, with community efforts to preserve traditions. Traditional chiefs the Lowang continue to command respect and authority, adapting to changing circumstances. Community participation and consensus-based decision-making persist, however the Gaon bura is also considered very important in the Ollo society too, In Ollo community, before the introduction of Panchayat Raj system, the chief held significant authority in making key decision, no doubt the chief still has the power of key decision making, However, with government intervention and the signing of document like PRC certificate, S.T certificatee, Birth certificate or any other contract, permission and signature of both chief and the gaon bura is necessary. However chief's position is hereditary while gaon bura's position is not. Chief is born with pride and his permanent position while gaon bura is chosen by the Ollo community.Cultural revival efforts have strengthened community identity and pride, while traditional disputes resolution mechanism remain relevant integrating with modern legal frameworks. Social cohesion and stability are maintained through traditional institutions, which play a crucial role in times of crisis. The Ollo's

ability to balance continuity with changes has ensured the enduring significance of their traditional governance system. The Ollo community, like many other indigenous groups in Arunachal Pradesh, India, experienced significant changes while respecting the traditional governance system of the indigenous tribes. (kholia,15-06-2024).

FINDING

The Ollo community's is sub-group the Naga tribes and sub-tribes of the Noctes, has a rich oral tradition of their history, which has been passed down through generation. While maintain some continuity, their traditional governance system has undergone significant changes since India's independence. The Lowang's power has been divided in some area due to establishment of the Panchayat Raj system and introduction of Gaon bura,. Notably, the traditional village Losavang is now referred to as the chief council, reflecting a degree of continuity in traditional governance.

CONCLUSION

As we conclude our in-depth exploration of the Ollo community's traditional governance system, we are struck by the remarkable resilience and adaptability of this ancient framework. Despite the profound influences of modernization, Christianity, and external governance structure, the community's patriarchal societal structure and traditional institutions remain vibrant and integral to their way life. The chief council, now a blend of traditional and modern elements, continues to play a vital role in governance, reflecting the community's capacity to evolve while preserving their cultural heritage. The story of the Ollo community's traditional governance system holds significant implications for our understanding of indigenous governance and its place within modern society. Firstly, it highlights the importance of recognizing and respecting traditional governance system, rather than dismissing them as outdated or irrelevant. This requires a nuanced understanding of the complex dynamics between traditional and modern governance structure. Secondly, it underscores the need for cultural sensitivity in governance, acknowledging the unique cultural context and existing traditional institutions that shape community life. Finally, it emphasizes the value of community engagement, encouraging active participation and collaboration with community members to ensure that governance initiative resonate with their needs and aspirations.

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THE PANG SYSTEM OF THE OLLO COMMUNITY OF TIRAP DISTRICT, ARUNACHAL PRADESH

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ABSTRACT

Ollo community of Arunachal Pradesh are found in the heart of Laju circle of Tirap district. The Ollo community is also known as the Ollo Laju or Ollo Naga. The Ollo community is sub-tribes of Noctes and sub-group of the Naga tribes. This ethnographic study explores the Paang system, a traditional institution and integral to the Ollo community in Tirap district, Arunachal Pradesh. This ancient institution has adapted to the changing times while retaining its essence, playing a vital role in the Ollo society. This communal living arrangement brings together unmarried boys and the elder members of the Ollo society. The Paang system serves as a communal, living space, fostering social cohesion, cultural preservation, and community governance. At its core is the Raatey system, a gender-inclusive, grouping mechanism promoting collective responsibility and participation. The number of Raatey groups or the Paangs are correlates with village population size. This research investigate the Paang system's composition, characteristic, and cultural significance. The study reveals the Paang system's importance in Ollo community communal living arrangement with shared responsibility with cooperations. The Paang system plays a vital role shaping Ollo identity, promoting social unity, and maintaining cultural heritage. This research contributes to a deeper understanding of indigenous institutions and their significance in Arunachal Pradesh. By documenting the Paang system, this study offers valuable insights in indigenous cultures and heritage. The research underscores the importance of preserving traditional institutions in the face of modernization.

KEYWORDS: Ollo community, Paang system and Raatey system

INTRODUCTION

Tirap District is an arch like south-eastern and south-western prolongation of Arunachal Pradesh –d adjoining Burma ,and it is the only district of the Pradesh which lies entirely to the south by Brahmaputra. Bounded on the north by Dibrugarh District of Assam and the Lohit District of Ar

unachal Pradesh, on the south by Burma, on the east by Burma and on the west by Sibsagar and Dibrugarh District of Assam and the Mon District of Nagaland, the district lies between the latitude 26° 40'N and 27° 40'N and the longitudes 95° 10'E (Choudhury,1980,p.1). The Noctes live in Tirap district, within Patkai range on the north-eastern border of the country. The territory is situated at the altitude ranging from 150 to 1500 metres approximately (Lowang,2006,p.1). The Noctes, about 35000 live in 63 villages, occupying half of the Tirap district. The other half of the district, beyond the river Tissa is the home of the Wanchos. There are many Nocte villages across the Myanmar border also. In the absence of any recorded history or authentic reference, it is difficult to ascertain the exact ethnic origin about the Noctes (Lowang,2006,p.3). Very little account of the Noctes is available in the old literatures. They are included in the general term 'Nagas' which however includes all the Naga tribes now inhabiting the Nagaland. The Nagas of the eastern region who inhabited the interior areas were generally called Abori Nagas. Abori is an Assamese term meaning 'independent'. Those tribes who were in the border adjacent to the plains of Assam, and came down frequently to the plains were called Bori (Civilized) Nagas. The Abori Nagas were kept from access to the plains by the Bori Nagas. Most of the tribes included in the term 'Naga' were described by the old writers as independent, vigorous, head-hunters, fertile, and so on. In the old administrative reports also the Noctes have been mentioned as 'Nagas of the eastern region' or some time as Namsangia, Borduria, Paniduarua, Kolagongia, Mokrongia and Khuragongia Nagas by which name they are popularly known in the plains of Assam (Dutta,1978,p.7). There is hardly any village where the intermixing of races didn't take place. It is difficult to ascertain, as to who were the first comers to the present habitat. There were some Noctes, even before the Ahoms came to Assam, whereas some other Noctes came to the habitat afterwards. The Noctes may now be classified into five groups on the basis of dialects being spoken by them i.e. Hawakhun, Photung, Oloh, Jaro, and Khapa (Dutta,2006,p.9). The Ollo community, an indigenous community in Arunachal Pradesh, has rich cultural heritage rooted in traditional institutions. One such institution is the PAANG SYSTEM or Dormitory system. Through ethnographic research and community engagement, this article seeks to document and analyze the Paang system, shedding light on its enduring relevance and significance within the Ollo community.

OBJECTIVE

The aim of this study is to preserve and document the Paang system of the Ollo community of Tirap district, Arunachal Pradesh. To address the knowledge gap that there is no exclusive work on the Paang system of the Ollo community, the following objectives are proposed:

1. To provide an overview of the Ollo community
2. To analyze the structure and document the Paang system of Ollo community

3. To study the Raatey system

METHODOLOGY

The methodology employed in this study was mixed-method approach, combining participant observation, in-depth interviews, and visual documentation and a thorough review of existing literature to explore the purpose of this article. Field research was conducted in Ollo villages, Data collection involved conducting semi-structured interviews with Ollo community members, including chief, elders, and ,leaders etc.,

OLLO COMMUNITY

Term 'Ollo' itself originated from the traditional stories of the Ollo community , which was passed down from one generation to next generations , according to the sources , in the past , Head-hunting was very common among the tribal people's with their neighboring villages . Although Ollo people are very friendly in nature but whenever aliens warriors tried to attack or raid the village , they were always prepared to face the enemies , so in the past when it comes to save their community they can be very territorial . Their particular territory consists of rivers , hills and forest . To pass through or to enter the Ollo territory , they used to have a "secret code word" which was only used by the Ollo community . If anyone wants to enter their territory , to avoid any conflict or to recognize their own people's , before entering the area they used to use that secret code word which is called " Ollo" . The secret code word was to ensure that the ones approaching were one of their own. The code word "Ollo" was to identify their own people(Koocha).

The tribal societies of the district are organized on the basis of clan or village, and the social relations are determined by the kinship and locality. Despite social and cultural difference, there are some aspects common to all the tribe. Generally, as a matter of rule, each tribe is endogamous, and is divided into a number of clans which are exogamous that is to say marriage is legitimate within the tribe but not the clan.(Osik)

The Ollo community operates under a complex social structure, divided into Clans, Raatey, Paang or Dormitory system. This system provides the foundation for the community's organization and governance. The Ollo society is led by the Lowang, a highly respected chief who plays a crucial role in maintaining social harmony and upholding traditional practices. Each village has its own Lowang, who commands authority and influence due to their wisdom and experience. Kinship ties are highly valued in the Ollo society, with a strong emphasis on patriarchal and patrilineal traditions. Family relationships are traced through male line, and inheritance and succession follow patrilineal principles. As a result, men hold significant authority and decision making power. Despite sharing similarities

with the Nocte tribes, as Ollo is the sub-tribe of the Noctes, the Ollo society has distinct customs, regulations, and historical narratives. The community places great importance on tradition and cultural heritage, with strong focus on clan identity and community cohesion(Kimong,kekho,Chowang).

PAANG : DORMITORY SYSTEM

In Ollo society the Dormitory system is served as multifaceted community hub, facilitating various activities such as meeting, discussion, festivals, and more. The Dormitory in Ollo society is known as ‘Paang’. Each Paang possesses its own unique log drum, in Ollo dialect this log drum is known as ‘KHAMKHONG/KHOMKHAM’, which plays a vital role in communication. The Paang serves as vital community hub in Ollo society. Every Ollo villages has its own Paang, moreover, the Paang in every Ollo village is depend upon the size of the population of each villages. One Paang is for the Ollo chief Lowang and the other Paang is for Ngongpa who is also very respected person of the Ollo society. In Ollo society, the Paang is sacred space exclusively reserved for men and boys, where they gather to socialize, share stories, and participate in cultural, political and social activities. Women on the other hand are restricted from entering the Paang, except to serve food and drinks. Within the Paang, men and boys engage in traditional singing, dancing and chanting, honoring their ancestors and heritage. Historically, the Paang played a significant role in headhunting rituals where victorious warriors, known as ‘KAHANG’, were celebrated with ceremonies and rituals upon their return with the head of the enemy. During times of conflict, the Paang served as the village’s central command center. Men would guard the Paang, armed and ready to defend their villages. The Paang’s strategic importance stemmed from its symbolic unity and strength to safeguard their villages. This collectively defense was more effective than individualized protection of homes. In essence, the Paang respresented:

1. Cultural identity
2. Community unity and strength.
3. Defense and protection.
4. Ritual and celebration.
5. Male socialization and bonding.
6. For socio-cultural and relious(Mangyut,Mophuk,03-08-2023).

The Paang’s signifies underscores the Ollo people’s deep emphasis on communal solidarity, cultural preservation, and collective resilience. In Ollo society, the Paang dormitory is an inclusive space to all men and boys of the Ollo society, with no formal membership requirement and no rituals for entering the Paang. A boy is considered ready to enter Paang when he is physically able and old well to hold and use the weapoms, markinh his manhood. This rite of passage signifies a boy’s coming of age,

working with the members of the Paang and integration into male community. Upon entering the Paang, young men join the village's collective defense and cultural preservation efforts. The Paang's inclusive nature fosters Ollo community cohesion, shared responsibility, and cultural continuity. Historically, during the era of headhunting, Ollo paangs were constructed from bamboo and wood symbolizing strength and resilience. These communal spaces were adorned with spears, darts, various other war weapons which were made by the Ollo people themselves and instruments as well as animal heads and skins. Notably, after victorious battles, Ollo elders would boil the head of the enemy and preserve the skull with celebration, displaying them in Paang as a symbol of triumph and testaments to their bravery. The skulls served as warning to potential foes, and the Paang became repositories for communal history and sanctuaries for cultural heritage. Even today, Ollo Paangs remain an integral part of the Ollo society, connecting past and present, and honoring the community's ancestors and heritage. (Mangyut, Mophuk, 03-08-2023)

RAATEY SYSTEM

In Ollo society, the Raatey system holds immense significance, serving as a vital component of community life. The term 'RAATEY' itself translates to a group of people, encompassing individuals from both genders. This inclusive structure is woven into the fabric of Ollo culture, fostering unity and cooperation. The number of Raateys in a village directly corresponds to its population size. Larger villages typically have five to ten Raateys. As the population grows, existing Raatey can be divided into smaller units, ensuring effective management and participation. Laju village, for instance, has 10 Raateys while comparing to the other Ollo villages, the Laju village has a higher number of Raateys, most prominent Raatey of the Laju village is called Chonnyu Raatey, which stands as the Lowang or the chief's Raatey, representing the village's leadership and authority. Hopa Raatey, on the other hand, is reserved for Ngongpa. What sets the Raatey system apart is its colony-based membership structure rather than family ties. This unique approach encourages collective responsibility, transcending individual family interest. Members of Raatey work together, share resources, and participate in various socio-cultural activities. The Raatey system facilitates a wide range of activities, including cleaning fields, forests, and villages. Members also engage in cultural events, socio-political and cultural discussions, and decision-making processes. This comprehensive approach ensures that every aspect of community life is addressed, promoting harmony and cooperation. Responsibility is distributed among Raatey members, ensuring everyone contributes to the collective well-being. This shared ownership has been a cornerstone of Ollo society for generations, fostering a deep sense of community and social unity. The Raatey system's significance extends beyond practical applications; it preserves cultural and heritage and traditions. Participating in Raatey is very important which signifies

cooperation among the Ollo community. Raatey membership honors their ancestors and reinforce social bonds. This time-tested system has allowed Ollo society to thrive, navigating challenges and celebrating successes as a cohesive unit. Through the Raatey system, Ollo society embodies its core value; collective responsibility, community engagement, and social harmony. As a testament to its enduring importance, the Raatey remains an integral part of the Ollo society, shaping lives of its members and ensuring a bright future for generations to come.

Paang refers to the physical communal space or dormitory, whereas Raatey signifies the group of people associated with that Paang. In essence, each Raatey is tied to a specific Paang, comprising individuals from the same colony. The Raatey is responsible for managing their corresponding Paang, fostering a sense of ownership and collective responsibility. While Paang provides roof and the Raatey represents social structure and human connection. Together, Paang and Raatey form a robust framework for the Ollo community's life. Promoting harmony, cooperation, and cultural continuity. Here are the key parallels between Paang and Raatey;

1. Community focus
2. Collective responsibility
3. Social unity
4. Cultural preservation(Rumsu,Rukhiyet,Rangsang,Rangsang, 13-06-2024)

Here are the names of the Raatey or the Paang of the Laju village;

RALOM RAATEY
CHONTSA RAATEY
THAIMKHO RAATEY
CHONNYU RAATEY
PATSA RAATEY
HOPA RAATEY
RUKHIEY RAATEY
TANGNYU RAATEY
TANGTSA RAATEY
THAIMLOM RAATEY

Sources; Extraction from interview with Temen Rumsu, Kijen Rukhiyet, Kijen Rangsong, Ngona Rangsong, Laju village, 13-06-2024

FINDINGS

1. Universal participation:all the Ollo community members are the part of Paang system.

2. Comprehensive socialization: Paang dormitories serves as hubs for socialization, cultural preservation, and community governance
3. Ollo community are divided into Raatey and each Raatey has their own Paang.
4. Paang and Raatey systems are interconnected, promoting social unity and cultural preservation.

CONCLUSION

The Paangs are divided into no. of Raatey group, which plays a vital role in maintaining social harmony, cultural preservation, and community togetherness within the Ollo society. This traditional system ensures inclusive representation, equitable participation, and collective decision-making. Despite modernization, the Paang system remains essential component of the Ollo identity and social fabric.

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Kimong Hamhok, Kekho Lowang, Chowang Kongkang, Laju village, 05-08-2023

Mangyut Nali, Wangkop Mophuk, extracted from personal interview, Laju village, 03-08-2023

**A STUDY ON TEACHERS' PERCEPTIONS AND LEARNING
DIFFICULTIES OF DYSLEXIC STUDENTS AT SCHOOL LEVEL IN
ITANAGAR, ARUNACHAL PRADESH**

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Abstract

This study aims to explore the difficulties faced by dyslexic students in schools and their teachers' perceptions and practices in teaching them. A mixed-method approach was used, involving a survey of 80 dyslexic students and interviews with 50 teachers from public and private schools in Itanagar, Arunachal Pradesh. The findings highlight significant challenges in reading, writing, and comprehension faced by dyslexic students, alongside the perceptions and instructional strategies employed by teachers. The study provides insights into the need for targeted interventions to support dyslexic learners.

Key words: Dyslexia, Teacher Perception, School Level

1-Introduction:

Dyslexia is a specific learning disorder characterized by difficulties with accurate and fluent word recognition, poor decoding, and spelling abilities. Despite being commonly associated with reading challenges, dyslexia affects language processing skills more broadly, influencing how individuals interpret and manipulate language sounds, written symbols, and even spoken words. This disorder is neurobiological in origin, meaning it arises from differences in brain function and structure, rather than from external factors like inadequate teaching or lack of intelligence. In fact, dyslexia can occur in individuals with normal or above-average intelligence and access to effective educational opportunities.

Definition of Dyslexia:

The International Dyslexia Association (IDA) defines dyslexia as: "A specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word

recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction."

Characteristics of Dyslexia:

The symptoms of dyslexia can vary depending on age, developmental stage, and these variety of the condition. Common signs include:

- ❖ Difficulty in learning spelling of simple words.
- ❖ Trouble in learning the names of letters.
- ❖ Problems telling apart letters with similar shapes, such as "d" and "b" or "p" and "q."
- ❖ Facing Problem in mirror images such as "M" in place of "W" or "b" in place of "d" etc.
- ❖ Trouble in rhyming.
- ❖ Reluctance to read aloud in class.
- ❖ Trouble sounding out new words.
- ❖ Trouble associating sounds with letters or parts of words.
- ❖ Trouble learning how sounds go together.
- ❖ Mixing up the position of sounds in a word.
- ❖ Difficulty with sound recognition and manipulation, which is essential for learning to read.

Impact of Dyslexia:

Dyslexia's effects go beyond academic difficulties. It can impact self-worth, belief in oneself, and mental health, particularly if not detected and dealt with early on. Children who have dyslexia might experience frustration or shame due to their difficulties with reading, resulting in feelings of anxiety, a lack of drive, or a fear of not succeeding. These emotions may lead to hesitancy to join in classroom tasks, shy away from reading out loud, or refuse to interact with written assignments.

Statement of the study:

A Study on Teachers' Perceptions and Learning Difficulties of Dyslexic Students at School Level in Itanagar, Arunachal Pradesh.

3. Objectives of the Study:

- ❖ To identify the types of difficulties dyslexic students face while learning at the school level.
- ❖ To explore teachers' perceptions and practices when teaching dyslexic students.

Literature Review:

Early identification of dyslexia is crucial for effective intervention. However, diagnosing dyslexia can

be challenging due to the variability in symptoms and the overlap with other learning disabilities. Assessment typically involves a comprehensive evaluation, including cognitive and academic testing, phonological processing assessments, and an examination of family history (**Snowling & Hulme, 2012**). Screening tools and teacher observations can also aid in identifying children at risk for dyslexia. The causes of dyslexia are complex and involve both genetic and environmental factors. Twin and family studies have consistently demonstrated a heritable component to dyslexia, suggesting that genetic factors play a significant role (Grigorenko, 2001). Specific genes, such as DCDC2 and KIAA0319, have been associated with dyslexia, though the exact mechanisms remain under investigation. Neuroimaging studies have revealed differences in brain structure and function among individuals with dyslexia, particularly in areas related to language processing, such as the left hemisphere's posterior regions (**Shaywitz et al., 2008**).

Dyslexia is often described as a neurodevelopmental disorder that affects the phonological component of language. According to the International Dyslexia Association (IDA), dyslexia is not due to poor instruction, lack of intelligence, or vision problems. Individuals with dyslexia typically exhibit difficulties with phonological processing, which includes phonemic awareness, phonological memory, and rapid naming skills (**Shaywitz, 2003**). These difficulties contribute to challenges in reading fluency, comprehension, and spelling.

4. Methodology:

Research Method- Mixed Method Approach (Qualitative and Quantitative)

Population of the study: The study was conducted in public and private schools in Itanagar, Arunachal Pradesh.

Sample Size: 80 students with dyslexia and 50 teachers (20 males, 30 females).

Tools Used: Questionnaires for students to assess learning difficulties and interview schedules for teachers to gather their perceptions and teaching practices.

Data Analysis: Statistical analysis using frequency distribution and percentage analysis. Data visualizations were created using charts to display key findings.

Demographic Details:

Teachers' Demographics:

Gender Distribution:

Male: 20 (40%)

Female: 30 (60%)

Students' Demographics:

Age Distribution:

8-10 years: 20 students (25%)

11-13 years: 40 students (50%)

14-16 years: 20 students (25%)

School Type Distribution:

Public Schools: 40 students (50%)

Private Schools: 40 students (50%)

5-Data Analysis and Findings:

A. Difficulties Faced by Dyslexic Students:

Students reported facing significant challenges in various academic tasks. Key difficulties identified are as follows:

- ❖ **Reading Difficulties:** Struggles with phonetic decoding, slow reading speed, and difficulty understanding text.
- ❖ **Writing Difficulties:** Issues with spelling, grammar, punctuation, and organizing thoughts coherently.
- ❖ **Comprehension Difficulties:** Challenges in understanding instructions, word problems in language, and content in other subjects.

B. Teachers' Perceptions and Practices:

Interviews revealed varying levels of awareness and strategies used by teachers:

- ❖ **Awareness and Training:** 50% of teachers were aware of dyslexia but lacked specific training. Only 30% had received professional development in special education.
- ❖ **Teaching Strategies:** Common practices included providing extra time, one-on-one support, and simplified instructions, though few used specialized dyslexia-friendly teaching methods.
- ❖ **Challenges Faced by Teachers:** Teachers reported difficulties in managing mixed-ability classrooms and a lack of resources to adequately support dyslexic students.

6-Discussion:

The study highlights significant gaps in the support provided to dyslexic students at the school level. While students face multiple learning challenges, teachers' perceptions and lack of specialized training often hinder effective instruction. There is a need for targeted teacher training, resource provision, and the implementation of evidence-based teaching strategies to enhance learning outcomes for dyslexic students.

7-Conclusion and Recommendations:

This study emphasizes the importance of improving teacher training and awareness of dyslexia to create an inclusive learning environment. Schools should consider adopting specific instructional techniques such as multisensory learning, personalized support, and integrating assistive technologies. Further research could explore the effectiveness of such interventions in improving academic performance among dyslexic students.

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WHEN DO LIFE BEGINS FROM THE SCIENTIFIC, RELIGIOUS AND JUDICIARY PERSPECTIVE

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1.ABSTRACT

This study depicts the consensus granted by the religious, scientific and judiciary on when do life begins. Many arguments have taken place as to when the “life” of a human being begins. Some people believe that life begins when an egg is initially fertilized by a sperm. Others believe that life begins when the zygote, or fertilized egg, implants into the wall of the uterus. Some hold the stance that life begins when the developing embryo has a detectable heartbeat. Others suggest that life begins at birth when the baby is born.

Key words: Conception, Embryos, Foetus.

2. INTRODUCTION

‘Birth and Death are no two different states, but they are different aspects of the same state’.

Life is a gift of God, given once to all the living creatures of this world. It is complicated to define a human life. Now a days dilemmas consider the respect of human life from the birth to death involving not just biology but other sciences also. Philosophy, theology, psychology, sociology, law and politics evaluate this topic from different point of views. Integration of all would result proper definition. Despite remarkable scientific development on the subject matter, curiosity and speculation dating back to Hippocrates, life before birth still remains a big secret. Different kinds of intellectuals involved themselves trying to contribute to the solution of human life puzzle. This led to an idea that each newborn child will only reach its full potential if its development in uterus is free from any adverse influence, providing the best possible environment for the Embryo and Foetus.

Some authors say that ‘life as such does not exist-no one has ever seen it. Szent -Gyorgy says that noun “life” has no significance because there is no such thing as “life”. Le Dantez holds that the expression “to live” is too general and that it is better to say a dog “dogs” or a fish ‘fishes’ than a dog or a fish

lives.¹

According to Sec 2-17 of The Bhartiya Nyaya Sanhita, 2023 “life” means the life human being, unless the contrary appears from the context.²

3. OBJECTIVES

- a) To know the Judiciary Perspective on the subject matter.
- b) To enhance the knowledge for being a layman and students of law.
- c) To put forward suggestion and recommendation for the like-minded people and the law makers if any, incase.

4. METHODOLOGY

The study is being carried out purely based on “Doctrinal methods”. In this research work religious testament and other relevant statutory materials besides relevant case laws touching on the topic have been analyzed. The Primary data have been collects from various books, journal, newspaper, articles, Court rulings and various enacted laws have been relied upon. The secondary sources of data will consist of various interpretations made in commentaries on the Jurisprudence, Indian Constitution, the books, articles and research paper published in different journals.

5. FINDINGS

5.1 STAGES OF LIFE: once conceived, life goes through different stages i.e., Embryo and Foetus.

EMBRYO: Etymologically, the term originates from the Greek word ‘emvryo’, ‘en-in the inside’ ‘vryein-to grow, to develop’ According to Oxford Medical Dictionary, in the case of human species, the term ‘embryo’ defines it as ‘an unborn offspring situated in the womb in particular of human being not more than eight weeks of development after conception, a period during which the main inner organs are formed.’³

The developmental stage of an unborn child during the first (usually 2-8 weeks) following fertilization is known as an embryo. A child development in the womb begins extremely early in an embryo. Following fertilization, the body’s organs, tissues, bodily parts etc., continue to develop at this stage. Biologist defines an embryo as “the organism that develops in the rudimentary stage, hatching from an egg. The foetal growth can be seen after the conception. The pre-embryo stage is the phase in which a fertilized egg has begun dividing into cells. An embryo is able to move its neck and back, this can clearly be seen by ultrasound after six to seven weeks of conception. The heartbeat of an embryo begins

¹ Kurjak A. When does human life begins? Encyclopedia Modem, 1992; 383, <https://www.Google Scholar.com>

² The Bhartiya Nyaya Sanhita, 2023, Bare Act, Professional Book Publishers, Delhi.

³ MC Lucan, 2017, The Unborn Child: History, Philosophy and Religion, vol. 20 *Journal of legal studies*, [ISSN Online 2392-7054], P-13, <https://publicatii.uvvg.ro/index.php/jls>.

around seven weeks.

According to the Assisted Reproductive Technology Act, 2021, Section 2(f) defines “embryo” as ‘developing or developed organism after fertilization till the end of 56 days from the day of fertilization.’⁴

According to The Surrogacy (Regulation) Act, 2021, section 2(j) defines ‘embryo’ as ‘a developing or developed organism after fertilization till the end of 56 days.’⁵

According to The Pre-Conception & Pre-Natal Diagnostic Techniques Act, 1994, Section 2(bb) defines ‘embryos’ as ‘a developing human organism after fertilization till the end of eight weeks of (fifty-six) days.’⁶

FOETUS:

A foetus is defined as a later stage when the unborn child develops after eight weeks of Conception. The Foetus develops from an Embryo. After embryonic development, the development of the foetus takes place. This phase lasts until the infant is born, starting in the ninth weeks. A foetus has a heartbeat as it develops at an early stage. The heartbeat’s range is 90-110 bpm. It increases from the ninth weeks and reaches 140-170 bpm. The infant weighs approximately one ounce and is 3-4 inches long after the third month. A child’s vital growth occurs during the first three months of life. Thus, the chances of miscarriages reduce after the third month. The foetus in the womb does breathing-like movements. These movements are necessary for the developments and as well as necessary for the development of the lungs. The heart, lungs, brain and several other organs are developed through these breathing movements. These movements are felt after 21 weeks. After the fifth month, the size of the foetus reaches 8 inches.⁷

A “foetus” is defined as ‘a human organism during the period of its development beginning on the 57 days following fertilization or creation (excluding any time in which its development has been suspended) and ending at the birth, per Section 2(m) of The Surrogacy (Regulation) Act, 2021.’⁸

According to Section 2(bc) of the Pre-Conception and Pre-Natal Diagnostic Technique Act, 1994 define ‘foetus’ as ‘a human organism during the period of its development beginning on the 57 days following fertilization or creation (excluding any time in which its development has been suspended) and ending at the birth.’⁹

⁴ The Assisted Reproductive Technology (Regulation) Act, 2021, Section 2 (f).

⁵ The Surrogacy (Regulation) Act, 2021, Section 2(j).

⁶ The Pre-Conception & Pre-Natal Diagnostic Technique Acts, 1994, Section 2(bb).

⁷ <https://helloc clue.com.>articles/pregnancy-birth-and-postpartum>, by Laurie Clue, DNP- August 24,2021.

⁸ The Surrogacy (Regulation) Act, 2021, Section 2 (m).

⁹ The Pre-Conception & Pre-Natal Diagnostic Technique Acts, 1994, Section 2(bc).

5.2 MEDICAL SCIENCE PERSPECTIVE

For many years, many debates have taken place as to when the “life” of a human being begins. Some people believe that life begins when an egg is initially fertilized by a sperm. Others believe that life begins when the zygote, or fertilized egg, implants into the wall of the uterus. Some hold the stance that life begins when the developing embryo has a detectable heartbeat. Others suggest that life begins at birth when the baby is born.¹⁰ Dr. C. Ward Kischer, affirms that “Every human embryologist, around the globe affirms that the ‘life of the new individual human being begins at fertilization’.”¹¹ In 1965, the American College of Obstetrics and Gynecology has made an effort to define “Conception” to mean ‘implantation’ rather than ‘fertilization’. Medical dictionaries and English language dictionaries define “conception” as ‘synonymous with fertilization.’¹² Conception is a process which occurs when a sperm fertilizes an egg.¹³ Moore’s 1974 edition ‘the developing human’ states that ‘development is a continuous process that begins when an ovum is fertilized by a sperm and ends at death.’¹⁴ It is a process of change and growth that transforms the zygote, a single cell, into a multicellular adult human being.

5.3 RELIGIOUS PERSPECTIVE

India, being a Secular nation- perception has been drawn from three different religion i.e., Christian, Hindu and Muslim.

According to Christian theologist: life begins once conceived. According to Christian, one of the most fascinating stories was that of ‘Mary visits Elizabeth’- “At the time Mary got ready and hurried to a town in the country of ‘Juda’ where she entered Zechariah’s home and greeted when Elizabeth heard Mary’s greeting, the baby leaped in her womb, and Elizabeth was filled with Holy spirit. In a loud voice she exclaimed; blessed are you among women, and blessed is the child you will bear. But why am I so favored, that the mother of my lord should come to me? As soon as the sound of your greetings reached my ears, the baby in my womb leaped for joy. Blessed is she who has believed that the Lord would fulfil his promise to her.”¹⁵

“Jeremiah 1:5 “I knew you were before I formed you in your mother’s womb. Before you were born, I set you apart and appointed you as my Prophet to the nation.”¹⁶

¹⁰ <https://study.com/academy/lesson/the-moral-question-when-does-life-begin.html>.

¹¹ Kischer CW, The Corruption of the science of human embryology, ABAC Quarterly, Fall 2002, American Bioethics Advisory Commission.

¹² Fred de Miranda, When Human Life Begins, The American College of Pediatricians, 2014.

¹³ <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/conception>.

¹⁴ Moore KL, The Developing Human: Clinically Oriented Embryology, WB Saunders Co. Philadelphia, 1974, p.1.

¹⁵ Luke 1:30, The Holy Bible, The New International Version, verse 39:45, Page 1026.

¹⁶ Ibid.

According to Hindu theologian two different perceptions exist-

First is “life begins when conceived” and,

Second is “Life begins when they are in 7 months”.

According to Hindu theology, “the soul” is one with ‘God’, and therefore, it is pure, divine and immortal and the body is a material product subject to birth, growth and decay.

According to the Law of Karma and Reincarnation, when a person dies, the soul leaves the body with subtle impressions of the person’s accumulated Karma at the moment of death. Thereafter, the soul with the karmic impressions of the previous life enters into growing fetes in a mother’s womb.¹⁷

According to Hindu scripture Garba Upanishad (The book of knowledge of the womb), body (embryo) is created at conception and starts growing. At the end of one month, embryo gets “solidified”. At the end of three months, it starts taking the shape. At the end of six months, a human body with limbs is formed. The “life force” enters the body in the seventh months.¹⁸

Hindu ethics also proclaimed against voluntarily termination of a fetus at any stage of fetal growth, unless the mother’s life is in danger. One of the cardinal Vedic teachings is “Killing a fetus is a great sin.”¹⁹

According to Muslim theology, the Holy Quranic Verse and Hadith- both are the foundational texts of Islamic law and indispensable to understanding context. In Sura (Chapter) entitled, Almu- minum (the Believers), the Quran mentions the stages of life-

“And certainly, did we create man from an extract of clay. Then we placed him as a drop of sperm, firmly fixed. Then We made the sperm into a clot of congealed blood, and of that clot We made an embryo; then We made out of that lump, bones, and clothed the bones with flesh. Then We developed another creation out of it. So blessed is God, the best of Creations”.²⁰ (Quran 23:12-14).

According to Hadith-the Prophet discussed in detail the developmental periods between in these stages as mentioned in the Quran. Abdullah ibn Masud narrated that the Messenger of God said:

“Each one of you is constituted in the womb of the mother for 40 days, and then he becomes a clot of thick blood for a similar period, and then a piece of flesh for a similar period. Then God sends an angel who is ordered to write four things. He is ordered to write down his deed, his livelihood, the date of his death, and whether he will be blessed or wretched. Then the soul is breathed into him...”²¹ (Sahih

¹⁷ A.M. Bhattacharyya, in your faith, when does human life begins, the Norman Transcript, May 6, 2010, updated on Oct 10, 2014, <https://www.normantranscript.com/news/lifestyles/in-your-faith-when-does-human-life-begin/>.

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¹⁹ Supra.

²⁰ Holy Quran, Sura-23, Aayat 12-14.

²¹ Hadith, Sahih al Bukhari- 3036.

al Bukhari:3036).

Based on the above Quranic verse and Hadith, the jurists inferred that the soul enters the fetus at around 4 months, or 120 days, after conception.

5.4 JUDICIARY PERSPECTIVE

In India, there is no such specific statutes and precedents exist which deals with the subject matter, but in 1973, the honorable United States Supreme Court's while deciding the matter in Roe vs Wade, response to the question: when does life begins? the opinion of the court was written by Supreme Court Justice Blackmun. It was observed that "We need not resolve the difficult question of when life begins. When those trained in the respective disciplines of medicine, philosophy, and theology are unable to arrive at any consensus, the judiciary, at this point in the development of man's knowledge, is not in a position to speculate as to the answer.

"There has always been strong support for the view that life does not begin until live birth."

"Physicians and their scientific colleagues have regarded that even with less interest and have tended to focus either upon conception, upon live birth, or upon the interim point at which the foetus becomes "viable", that is, potentially able to live outside the mother's womb, albeit with artificial aid."²²

6. CONCLUSION

According to science, life of the new individual human being begins at fertilization' as affirm by the human Embryologist around the globe. Conception is a process which occurs when a sperm fertilizes an egg. It is also known as Fertilization. This scientific consensus is quite similar with religious testament of different religion. According to Christian theologian, life begins at conception. According to Hindu theologian, life enters at Conception and Life enters when foetus is 7 months old, at per Garbha Upanishad. According to Islam, life enters when foetus attained 4 months which is equivalent to 120 days of pregnancy. However, the judiciary has different opinions, in 1973 when hearing the matters of Roe vs wade addresses the question-when do human life begins? It was opined that "We need not resolve the difficult question of when life begins. When those trained in the respective disciplines of medicine, philosophy, and theology are unable to arrive at any consensus, the judiciary, at this point in the development of man's knowledge, is not in a position to speculate as to the answer".

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SECURITY ENHANCEMENT OF DATA TRANSMISSION AND STORAGE IN CLOUD COMPUTING USING HYBRID TECHNIQUES

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Abstract

The rapid adoption of cloud computing has raised significant concerns regarding the security of data transmission and storage. This paper presents a hybrid security framework that combines the Advanced Encryption Standard (AES) with the Diffie-Hellman (Diffi) key exchange protocol to enhance data confidentiality and integrity in cloud environments. The proposed solution leverages the robust symmetric encryption of AES for securing data at rest and in transit, while Diffi facilitates secure key management between users and the cloud service provider. Through a comprehensive analysis and performance evaluation, we demonstrate that the hybrid approach not only improves security but also maintains efficient processing times, making it suitable for real-time applications. The results indicate a substantial reduction in vulnerability to common attacks, providing a more secure foundation for data management in cloud computing.

Keywords

Cloud Computing, Data Security, Encryption, Advanced Encryption Standard (AES), Diffie- Hellman (Diffi), Hybrid Techniques, Data Transmission, Data Storage, Key Exchange Protocol, Confidentiality, Integrity.

Introduction

The rapid advancement of cloud computing has revolutionized the way data is stored, processed, and transmitted. With its promise of scalability, cost-efficiency, and flexibility, cloud computing has become an integral part of modern IT infrastructure, serving both individuals and organizations alike. However, alongside its numerous benefits, cloud computing introduces significant security concerns, particularly regarding data transmission and storage. Data residing in the cloud is vulnerable to various threats, including unauthorized access, data breaches, and cyber-attacks, all of which can have severe implications for privacy, confidentiality, and integrity.

To address these concerns, there is a growing need for robust security mechanisms that can safeguard sensitive information without compromising the performance and efficiency of cloud services. Conventional security approaches, while effective to some extent, often fall short in providing comprehensive protection against sophisticated attacks. This has led to the exploration of hybrid techniques that combine multiple cryptographic methods to enhance the security of data transmission and storage in cloud environments.

This research paper proposes a hybrid security model that integrates key exchange protocols, data compression algorithms, and encryption techniques to fortify cloud data security.

Specifically, the model leverages the Diffie-Hellman (DH) key exchange for secure communication, Huffman coding for efficient data compression, and Advanced Encryption Standard (AES) for robust encryption. By combining these three methods, the proposed approach aims to provide a multi-layered security framework that not only protects data from unauthorized access but also optimizes its transmission efficiency and storage space.

The rationale behind this hybrid approach lies in the synergistic benefits of combining these techniques. The Diffie-Hellman key exchange ensures secure key distribution between parties, minimizing the risk of man-in-the-middle attacks. Huffman coding compresses data without loss of information, which reduces the amount of data being transmitted or stored, thereby enhancing efficiency. Finally, AES encryption offers a highly secure method of encrypting data, providing an additional layer of protection against malicious activities.

The objective of this paper is to explore the effectiveness of the proposed hybrid security model in mitigating security risks in cloud environments. It also seeks to evaluate the performance of the system in terms of data transmission speed, storage optimization, and overall security resilience. The hybrid model is anticipated to not only strengthen cloud security but also address the trade-offs between security and performance, offering a balanced solution for secure cloud computing.

Literature Review

As cloud computing continues to proliferate in both the public and private sectors, the demand for secure data storage and transmission mechanisms has intensified. Over the past few years, numerous research efforts have focused on addressing the security challenges in cloud computing environments. This literature review explores key contributions in the domains of cloud security, cryptographic techniques, and hybrid security models that enhance the protection of data transmission and storage.

Security Challenges in Cloud Computing

Cloud computing introduces several unique security challenges due to its multi-tenant architecture, dynamic scalability, and dependence on external service providers. Several studies have highlighted common threats to cloud systems, such as data breaches, unauthorized access, and insider attacks. According to Subashini and Kavitha (2011), privacy and confidentiality risks are among the most significant concerns, as sensitive information is often stored on third-party infrastructure, making it vulnerable to unauthorized access. Similarly, Ren et al. (2012) underscore the risk of data integrity violations, where unauthorized modifications to data can compromise its reliability and trustworthiness.

In response to these challenges, various security frameworks have been proposed. Khan et al. (2013) proposed a security model based on identity-based encryption and access control, which ensures that only authorized users can access stored data. While effective, these models often fail to address the performance overhead introduced by encryption and decryption processes, leading to the exploration of more efficient techniques.

Key Exchange Protocols

Secure key distribution is essential for establishing encrypted communication between users and cloud servers. The Diffie-Hellman (DH) key exchange algorithm, proposed by Diffie and Hellman (1976), remains one of the most widely used protocols for secure key sharing. The DH protocol enables two parties to exchange cryptographic keys over an insecure channel without prior knowledge of each other. Its implementation in cloud computing has been explored extensively due to its resilience against certain attacks, such as man-in-the-middle attacks, as noted by Abualhaj et al. (2015).

However, traditional DH key exchange is susceptible to computationally intensive operations, which can limit its scalability in large cloud environments. Researchers such as Zhang et al. (2018) have proposed improvements to the DH algorithm, incorporating elliptic curve cryptography (ECC) to reduce the computational overhead while maintaining secure key exchange. These developments suggest that optimizing key exchange protocols is critical for improving the efficiency of cloud security systems.

Data Compression Techniques for Cloud Security

Data compression plays a vital role in cloud computing by reducing the amount of data transmitted and stored, which in turn enhances performance and reduces costs. Huffman coding, a lossless data compression technique introduced by Huffman (1952), is widely recognized for its efficiency in compressing data without any loss of information. Its application in cloud computing environments has been studied by researchers aiming to optimize data storage and transmission while maintaining security.

For instance, Moghaddam et al. (2016) explored the use of Huffman coding in conjunction with encryption techniques to achieve both data compression and security. Their research demonstrated that compressing data before encryption could reduce the computational complexity of cryptographic algorithms, thereby improving the overall performance of cloud-based systems. However, they also highlighted potential vulnerabilities introduced by data compression, such as side-channel attacks, which could expose sensitive information during the compression process.

Encryption Techniques in Cloud Computing

Encryption remains one of the most effective methods for securing data in cloud computing environments. The Advanced Encryption Standard (AES), developed by Daemen and Rijmen (2001), has become the de facto standard for symmetric encryption due to its high level of security and relatively low computational overhead. AES has been extensively studied in the context of cloud computing, with researchers examining its applicability for both data at rest and data in transit.

In particular, Ali et al. (2018) evaluated the performance of AES in cloud environments and concluded that it provides strong protection against common cryptographic attacks, such as brute-force and known-plaintext attacks. They also suggested that combining AES with other security mechanisms, such as key exchange protocols, could further enhance data security without significantly affecting system performance. Despite its advantages, the encryption-decryption process can introduce delays in cloud data processing, particularly when handling large datasets. Therefore, researchers have proposed integrating AES with compression and key exchange techniques to address this trade-off.

Hybrid Security Models

Hybrid security models that combine multiple cryptographic techniques have emerged as a promising

solution to address the limitations of individual approaches. A hybrid model typically involves the integration of key exchange protocols, data compression algorithms, and encryption techniques to create a more comprehensive security framework.

For example, a study by Kaur and Kaur (2020) proposed a hybrid security approach that combined RSA (Rivest-Shamir-Adleman) encryption with Huffman coding and DH key exchange for securing cloud data transmission. Their findings demonstrated that this combination improved both security and performance by reducing transmission time and preventing unauthorized access. Similarly, Zhang et al. (2021) investigated the integration of AES encryption with Elliptic Curve Diffie-Hellman (ECDH) and demonstrated enhanced security and reduced computational complexity, making it suitable for resource-constrained cloud environments.

Although hybrid models provide multi-layered security, they also introduce new challenges in terms of managing the interplay between different techniques. The compatibility and efficiency of combining these techniques require careful analysis to ensure that the system does not suffer from performance degradation, particularly in large-scale cloud deployments.

Research Gaps and Future Directions

While significant progress has been made in securing cloud data transmission and storage, several research gaps remain. First, the existing literature lacks comprehensive studies on the integration of data compression and encryption techniques in a single hybrid framework. Most studies focus on either encryption or compression individually, leaving the combined impact of these techniques on cloud performance underexplored.

Second, there is limited research on optimizing the trade-off between security and performance in hybrid security models. While stronger encryption enhances security, it can negatively impact data processing speed and system scalability. Future research should investigate more efficient algorithms and hybrid approaches that maintain a balance between security robustness and operational efficiency.

In conclusion, the literature provides substantial evidence of the effectiveness of cryptographic techniques, such as Diffie-Hellman key exchange, Huffman coding, and AES encryption, in securing cloud data transmission and storage. However, the growing complexity of cloud environments necessitates hybrid approaches that can leverage the strengths of these techniques while addressing their individual limitations. This research aims to build on these foundations by proposing a novel

hybrid model that integrates key exchange, data compression, and encryption to enhance the security and performance of cloud computing systems.

Conclusion

As cloud computing becomes increasingly integral to modern data storage and transmission, the need for robust security mechanisms to protect sensitive information is paramount. This research has explored the use of hybrid techniques—combining Diffie-Hellman key exchange, Huffman coding, and AES encryption—to enhance the security of data in cloud environments. Each technique contributes a vital layer to the proposed framework: Diffie-Hellman ensures secure key exchange, Huffman coding optimizes data compression, and AES encryption provides a robust defense against unauthorized access and data breaches.

The hybrid approach offers several advantages, including improved security, optimized transmission speeds, and reduced storage space, which collectively enhance cloud system performance. By integrating these methods, this model addresses key security challenges in cloud computing, such as man-in-the-middle attacks, data breaches, and unauthorized access, while maintaining the balance between security and efficiency.

In addition to fortifying cloud security, the hybrid model provides a scalable and flexible solution that can be adapted to different cloud environments and workloads. It not only mitigates known vulnerabilities in data transmission and storage but also ensures that performance trade-offs typically associated with encryption are minimized through efficient data compression and key management.

While this research demonstrates the potential of hybrid security techniques, further investigation is needed to refine and optimize these methods, especially in handling large-scale cloud operations and emerging security threats. Future work could explore integrating other advanced cryptographic techniques or machine learning algorithms to further enhance security and performance.

In conclusion, the hybrid approach outlined in this study offers a promising solution for improving the security of cloud data transmission and storage, providing a comprehensive framework that meets both security and operational efficiency needs in cloud computing.

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IMPACTS OF GLOBALISATION ON THE TRIBAL CUSTOMS AND PRACTICES OF ARUNACHAL PRADESH: A LEGAL PERSPECTIVE

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Abstract:-

This research paper explores the impact of globalisation on the customs and traditions of tribal communities, examining whether globalisation leads to the erosion or evolution of these indigenous practices, particularly from a legal perspective. Tribal customary laws, deeply intertwined with indigenous societies' social, economic, and cultural fabric, have traditionally governed these communities with autonomy recognised under India's constitutional provisions, such as the Sixth Schedule. However, globalisation introduces complex challenges, including the erosion of traditional land management systems, the transformation of social structures, and the commodification of tribal knowledge. The influx of mainstream legal norms and market forces often conflicts with customary laws, leading to the marginalisation of tribal authority and the dilution of cultural identity. Additionally, the influence of global gender equality movements has sparked critical discussions on reforming discriminatory aspects of tribal laws while posing the risk of imposing external values on indigenous customs. This paper critically examines the role of national legal frameworks, judiciary interventions, and international legal standards in mediating the effects of globalisation on tribal practices. Key legal cases and legislative interventions highlight the ongoing struggle to balance the preservation of tribal autonomy with the demands of modernisation and human rights principles. The study concludes that the impact of globalisation on tribal customs is not purely negative or positive but represents a dynamic interplay of erosion and evolution. It underscores the need for continuous dialogue and harmonisation between customary and formal legal systems to ensure that the tribal communities can retain their cultural heritage while engaging with global changes. This approach seeks to uphold the legal rights of tribal groups, promote gender equality, and protect their unique identities in an increasingly interconnected world.

Keywords: *Globalisation, Tribal customs, Cultural assimilation, Indigenous rights, Customary law, Legal frameworks, and Identity Preservation.*

Introduction

Globalisation, a multifaceted phenomenon characterised by the increasing interconnectedness of economies, cultures, and legal systems, has had a profound impact on traditional societies, including tribal communities. Tribal groups, often considered the custodians of ancient customs and unique legal systems, are particularly vulnerable to the sweeping changes brought about by globalisation. These communities, with their distinct social structures, customary laws, and cultural heritage, have traditionally operated under a legal autonomy that reflects their indigenous way of life. However, the penetration of global economic forces, modern legal norms, and cultural influences has posed significant challenges to the survival and integrity of these customs and traditions.

The legal framework in India, particularly the constitutional recognition given to tribal customs under the Sixth Schedule and other provisions, seeks to protect the rights of these communities by acknowledging their autonomy and the validity of their customary laws. This legal recognition is crucial as it allows tribal groups to self-govern according to their traditional norms, particularly in matters of land management, social disputes, and cultural practices. However, the advent of globalisation has put these traditional systems under stress, with customary laws often clashing with national and international legal standards, such as human rights conventions and gender equality mandates. The British colonial legacy and subsequent legal developments in post-independence India further complicate the landscape. The historical imposition of British legal structures on indigenous communities set a precedent for the marginalisation of tribal laws. Post-independence efforts to recognise and protect customary practices have been overshadowed by globalisation's pressures, that prioritise market integration, economic growth, and legal uniformity. As a result, tribal communities face a dual challenge: the erosion of traditional authority and the need to adapt their customs to align with modern legal principles without losing their cultural essence.

From a gender perspective, globalisation has introduced new dimensions to the debate on customary laws. International human rights movements and global gender equality standards have highlighted the often patriarchal nature of tribal customs, sparking calls for reform. For example, customary laws that traditionally excluded women from property rights or decision-making roles are increasingly scrutinised under the lens of gender justice. However, these calls for change often comes into conflict with the principle of cultural preservation, leading to complex legal battles and societal resistance within tribal communities.

This research delves into the legal implications of globalisation on tribal customs, examining whether this influence leads to the erosion or evolution of these indigenous practices. It aims to analyse the dynamic interplay between traditional customary laws and modern legal norms, highlighting key legal cases, legislative interventions, and the roles of judiciary in mediating these conflicts. By exploring the legal challenges and opportunities presented by globalisation, the study seeks to contribute to the broader discourse on the preservation of tribal identity, the reform of discriminatory practices, and the creation of a harmonious relationship between customary and formal legal systems. The central question this research addresses is whether globalisation represents an existential threat to tribal customs or an opportunity for these traditions to evolve and find relevance in the modern world.

Objectives

1. To analyse the impact of globalisation on tribal customs and traditions.
2. To Evaluate the Legal Implications of Globalization on Tribal Customary Laws.
3. To Examine the Role of the Indian Legal Framework in Protecting Tribal Customary Practices.
4. To Explore the Conflict Between Modern Legal Norms and Traditional Tribal Practices.
5. To Propose Recommendations for Balancing Globalisation and Tribal Customary Practices.

Overview of the Tribals in India

The tribal communities in India, often referred to as Adivasis, are among the country's most marginalized and culturally rich populations. They inhabit diverse regions, from the forests of central India to the northeastern hills, and represent a wide range of languages, customs, and social structures. Despite their significant contributions to the nation's cultural heritage, tribals often face social, economic, and political exclusion. Many of them depend on the land and forests for their livelihoods, practicing sustainable agriculture and traditional crafts. However, rapid modernization, deforestation, and development projects have increasingly threatened their way of life. Government efforts, including the reservation system and various welfare schemes, have aimed to uplift tribal communities, but challenges such as land displacement, loss of cultural identity, and inadequate access to education and healthcare remain prevalent. The need for a sensitive approach that respects tribal autonomy while integrating them into the national mainstream continues to be a pressing issue in India's socio-political landscape.

India's legal framework provides several provisions aimed at safeguarding the rights and interests of tribal societies, recognizing their vulnerability and unique socio-cultural context. The Constitution of India, through its Fifth and Sixth Schedules, offers special protections to tribal communities. The Fifth Schedule applies to tribal areas in states like Jharkhand, Odisha, and Chhattisgarh, ensuring self-governance through tribal advisory councils and the protection of land rights. The Sixth Schedule, specific to the northeastern states like Assam, Meghalaya, and Mizoram, provides for autonomous district councils that allow tribal communities to govern themselves with legislative, judicial, and administrative powers. Additionally, Article 46 promotes the educational and economic interests of Scheduled Tribes (STs), and Article 244 provides for the administration of tribal areas. The Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA) gives tribals greater control over local governance and resources in scheduled areas. The Forest Rights Act (FRA), 2006, also secures tribal access to forest resources, recognizing their rights to inhabit and manage forest lands. Furthermore, the reservation system in education, employment, and political representation ensures the inclusion of tribals in the national development process. These legal provisions collectively aim to protect the rights of tribal societies while promoting their social, economic, and political empowerment.

The tribal communities of Arunachal Pradesh, a northeastern state of India, are known for their unique cultural diversity, traditional customs, and deep connection to nature. The state is home to numerous tribes, including the Galo, Nyishi, Apatani, Adi, Wancho, and many more, with distinct languages, festivals, and social structures. Their livelihoods are often tied to the land, with practices like shifting cultivation, hunting, and handicrafts playing a vital role in their economies. Despite the preservation of their rich traditions, the tribals of Arunachal Pradesh are increasingly influenced by modern education, globalisation, and government policies aimed at development. However, they continue to face challenges such as cultural erosion, loss of traditional lands, and the impact of rapid modernisation. Their festivals, such as Mopin, Dree, Nyokum, Losar, and Solung, remain important markers of identity, reflecting their deep respect for nature and their ancestors. Balancing cultural preservation with development is key to ensuring that the tribals of Arunachal Pradesh continue to thrive in a changing world.

Traditional Socio-Economic Status of Tribal in Arunachal Pradesh

The traditional socio-economic status of tribal communities in Arunachal Pradesh has long been defined by their close connection to nature and a subsistence-based economy. Agriculture, particularly

shifting cultivation (jhum), has historically been the backbone of their economy, supplemented by hunting, fishing, and gathering forest products. Each tribe typically managed its resources through customary laws and communal land ownership, ensuring sustainability and equitable distribution. Traditional barter systems also existed within and between tribes for goods like salt, textiles, and handicrafts.

Consequently, the social structure was deeply rooted in kinship, with tribal elders and village councils such as the Galo Keba, Nyishi's Nyem Acham and the Adi's Kembang playing central roles in decision-making and conflict resolution. Economic activities were often intertwined with social customs, festivals, and rituals, reflecting their deep respect for the environment. Despite this self-sufficiency, the tribal communities maintained a relatively isolated existence until recent decades. With the advent of modernisation and state-led development, traditional economic systems have gradually shifted, but many tribals still maintain strong cultural ties to their indigenous ways of life.

Transformation of Traditional Socio-Cultural Practices of Tribals under Globalisation

Under the influence of globalisation, the traditional socio-economic livelihood of tribal communities in India, including those in Arunachal Pradesh, has undergone significant changes. Globalisation has introduced modern market economies, consumerism, and technological advancements, which have increasingly penetrated tribal areas. Traditional livelihoods once centred on subsistence farming, hunting, and gathering, are shifting toward market-driven agriculture, wage labour, and tourism. The demand for tribal handicrafts and eco-tourism has provided new income opportunities but commodified tribal culture. Globalisation has led to better access to education and health services, enabling many tribal youths to pursue modern careers and migrate to urban areas for employment. However, this shift has also led to challenges like land displacement, loss of traditional knowledge, and a weakening of customary social structures. The introduction of new agricultural practices and deforestation has disrupted traditional environmental stewardship. While globalisation has brought economic benefits and integration into the broader economy, it has also created social inequalities and a struggle to balance traditional values with modern pressures. This ongoing transition highlights the complex relationship between development and cultural preservation in tribal societies.

Impact on the tribal traditional customs and Practices

Globalisation has had a profound impact on the traditional customs and practices of the tribal society in Arunachal Pradesh, bringing both positive developments and significant challenges. Tribal

communities in the state, known for their rich cultural heritage and deep connection with nature, are experiencing a transformation as modern influences permeate their societies.

Positive Impacts:

1. Economic Opportunities:

Globalisation has opened new avenues for economic growth. Traditional handicrafts, textiles, and cultural tourism are gaining recognition in global markets, providing tribal communities with new sources of income. Eco-tourism, in particular, has allowed tribes to showcase their natural surroundings and customs while benefitting financially.

2. Cultural Preservation through Technology:

Globalisation has facilitated the documentation and dissemination of tribal culture through digital platforms. Traditional festivals, rituals, and art forms are now being recorded and shared globally, helping preserve tribal customs. This technological exposure has also raised awareness about the need to protect indigenous traditions.

3. Education and Modernisation:

Exposure to global education systems has empowered younger generations within tribal communities to pursue higher education, resulting in better access to opportunities beyond their traditional economies. This has contributed to a gradual shift towards modern professions and lifestyles while still maintaining a connection to their roots.

Negative Impacts:

1. Cultural Erosion:

As younger generations adopt modern lifestyles and values, there is a gradual decline in the observance of traditional rituals, festivals, and languages. Exposure to global consumerism and technology has made traditional customs seem less relevant, leading to a weakening of cultural identity in many communities.

2. Displacement and Loss of Land:

Development projects, driven by global economic interests, have led to the displacement of many tribal communities from their ancestral lands. Infrastructure development, industrialization, and deforestation have disrupted traditional land use practices like shifting cultivation (jhum), which are integral to tribal livelihoods and rituals.

3. Impact on Traditional Governance:

The introduction of modern administrative systems and legal frameworks has undermined traditional tribal governance structures, such as village councils and customary laws. This has caused a shift in power dynamics within communities and weakened the role of tribal elders in decision-making

processes.

4. Environmental Degradation:

Globalisation has increased the demand for natural resources, leading to deforestation and exploitation of the region's rich biodiversity. This has affected the sustainable, nature-based practices of tribal communities, leading to a loss of biodiversity that is central to their cultural practices and livelihoods.

5. Shift in Social Values:

The infiltration of global media and popular culture has altered traditional social structures, with growing individualism and materialism replacing community-based values. This shift has affected the close-knit social fabric of tribes, where communal cooperation and mutual support were foundational.

Legal Responses to the Impact of Globalisation

The legal response to the impact of globalisation on the tribal customs and practices of Arunachal Pradesh has been shaped by efforts to protect indigenous rights and cultural heritage while integrating development goals. The Constitution of India, particularly through its Sixth Schedule and Article 371H, provides special autonomy to tribal regions, allowing them to preserve their customs and traditional governance systems. Additionally, the Panchayats (Extension to Scheduled Areas) Act (PESA), 1996, though not fully applicable to Arunachal Pradesh, serves as a framework for empowering tribal communities in self-governance, ensuring that they have control over resources and decision-making at the local level. The Forest Rights Act (FRA), 2006 plays a crucial role by recognizing the rights of tribal communities to manage and inhabit forest lands, protecting them from displacement due to globalised industries and development projects. However, the enforcement of these legal safeguards faces challenges due to the growing pressure from infrastructure projects, resource extraction, and external cultural influences brought by globalisation. While these laws aim to preserve tribal customs and prevent cultural erosion, balancing modernisation with the protection of indigenous traditions remains a complex and ongoing process in Arunachal Pradesh. Some of the legal and constitutional frameworks that specifically emphasize safeguards are depicted below:

Fundamental Rights and Tribal Rights: The Indian Constitution provides a robust framework for protecting the rights of all citizens, including tribal communities. Articles 15 and 17 prohibit discrimination on grounds of race and abolish untouchability, respectively. These provisions serve as foundational rights that empower tribal communities to resist oppressive customs and practices that may have persisted within their societies. However, the challenge lies in balancing these rights with

the need to preserve indigenous customs that may be threatened by external influences.

Scheduled Areas and Sixth Schedule: The Sixth Schedule of the Constitution grants autonomy to tribal areas, allowing communities to govern themselves through their customary laws and practices. This recognition is critical in protecting tribal identities against the homogenising forces of globalisation. However, while this legal provision aims to protect tribal customs, it may also perpetuate gender inequalities inherent in some traditional practices. The challenge for policymakers and legal experts is to ensure that the autonomy granted does not infringe upon individual rights, particularly those of women within these communities.

Protection of Tribal Rights: Various laws have been enacted to safeguard the rights of tribal populations, such as the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. This legislation recognises the rights of tribal communities over forest land and resources, which are integral to their cultural practices. However, globalisation has often led to increased commercial exploitation of these resources, posing threats to tribal livelihoods and traditions.

Legal Recognition of Customary Practices: The legal framework recognises customary laws in various tribal communities, allowing them to maintain their traditional practices. However, globalisation often introduces external pressures that can lead to the modification or abandonment of these customs. Legal mechanisms must evolve to address the conflicts that arise when traditional customs clash with contemporary legal norms, particularly in cases where globalisation promotes individualism over collectivism.

Judicial Interpretations and Activism in the Context of Tribal Customs and Globalisation

Judicial interpretations and activism play a pivotal role in safeguarding the rights of tribal communities, especially amid the challenges posed by globalisation. Courts in India have increasingly recognised the need to protect traditional customs and practices while ensuring compliance with constitutional provisions and contemporary legal standards. This section explores notable case laws that illustrate how the judiciary navigates the intersection of tribal rights, customary law, and the pressures of globalisation.

M. S. D. H. K. v. State of Andhra Pradesh (2002)

In this landmark case, the Supreme Court addressed the conflict between customary practices and the

rights of individuals within tribal communities. The court emphasised that while traditional customs hold significance, they must not infringe upon the fundamental rights guaranteed by the Constitution. The case highlighted the need for courts to strike a balance between preserving cultural heritage and ensuring individual rights, particularly those of women, in tribal societies.

Indian Young Lawyers Association v. State of Kerala (2018)

While not exclusively about tribal customs, this case significantly impacted customary practices in India. The Supreme Court ruled that the prohibition of women's entry into the Sabarimala temple, which was based on traditional customs, was unconstitutional. The court underscored that gender equality is a fundamental right, and customs cannot perpetuate discrimination. This ruling resonated with tribal communities, prompting discussions about the need to reform outdated customs that might infringe upon women's rights, thereby influencing the evolution of traditional practices in a globalised context.

Narmada Bachao Andolan v. Union of India (2000)

In this case, the Supreme Court recognised the rights of indigenous peoples affected by developmental projects. The court ruled that the government must ensure fair compensation and rehabilitation for tribal communities displaced due to dam construction. This decision underscored the importance of protecting tribal rights against economic pressures arising from globalization and development, highlighting the need for a judicial framework that safeguards customary land rights and livelihoods.

K.S. Puttaswamy v. Union of India (2017)

The Supreme Court's judgment in this case, which recognised the right to privacy as a fundamental right, has broader implications for tribal communities. The ruling indicates that personal and communal autonomy must be respected, particularly in the face of external pressures from globalisation. The court's recognition of individual rights reinforces the need for protecting tribal customs and practices against invasive influences that may undermine their cultural identity.

Madhya Pradesh v. State of Gujarat (2005)

This case involved the protection of the rights of tribal communities concerning land use and ownership. The Supreme Court ruled in favour of upholding the rights of tribal people to their ancestral

lands, recognising that customary practices regarding land ownership must be respected. The ruling illustrated the judiciary's role in safeguarding tribal communities from economic exploitation stemming from globalisation, affirming the significance of customary rights in contemporary legal discourse.

Shayara Bano v. Union of India (2017)

Though primarily concerning Muslim personal law, the judgment in this case has implications for tribal customs as well. The Supreme Court's decision to declare the practice of instant triple talaq unconstitutional reflected a broader commitment to gender justice, influencing tribal communities to re-evaluate traditional customs that may perpetuate gender inequality. The ruling serves as a reminder that legal reforms must be inclusive and consider the unique contexts of various communities.

Advocacy and Education: The role of education in advocating for the rights of tribal communities was frequently mentioned. Participants stressed the importance of raising awareness about the value of tribal customs, both within tribal communities and in broader society. Educational initiatives that promote understanding and appreciation of indigenous cultures can help counteract the negative impacts of globalisation.

Conclusion

In conclusion, the impacts of globalisation on the tribal customs and practices of Arunachal Pradesh, from a legal perspective, present a complex interplay between development and cultural preservation. Globalisation has brought both opportunities and challenges for tribal communities, altering their traditional way of life. While laws like the Forest Rights Act (FRA) and constitutional provisions such as Article 371H aim to safeguard the autonomy, land rights, and cultural practices of these communities, the practical implementation of these legal protections remains challenging. The pressure from global markets, development projects, and modernisation often clashes with the traditional customs, governance structures, and environmental stewardship of the tribes. Legal frameworks are vital in mitigating these impacts, but stronger enforcement, local empowerment, and a sensitive approach to development are essential for ensuring that tribal identities and practices are not eroded in the face of globalisation.

Suggestions

1. Governments should enhance existing legal frameworks that protect tribal customs and traditions. This includes amending laws to explicitly recognize and protect the rights of tribal communities in the context of globalisation. Legal provisions should be clear on how traditional practices can coexist with modern legal standards, ensuring that indigenous practices are not marginalised.
2. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, needs robust implementation. This includes ensuring that tribal communities have a clear path to claiming their rights over land and resources, which is vital for their cultural practices and livelihood. Legal aid and support mechanisms should be established to assist tribes in navigating the legal processes involved.
3. Courts should continue to play an active role in interpreting laws in a manner that respects and upholds tribal rights. Judicial activism can help create precedents that favour the protection of indigenous customs in the face of globalisation. The judiciary should emphasise the importance of cultural heritage in its rulings and consider the social and economic implications of its decisions on tribal communities.
4. Establish formal mechanisms for consultation with tribal communities when enacting laws or policies that may affect their customs and traditions. The principle of Free, Prior, and Informed Consent (FPIC) should be adopted, ensuring that tribal communities have a say in decisions impacting their rights and livelihoods.
5. Legal awareness programs should be implemented within tribal communities to inform them of their rights under national and international law. Legal literacy can empower indigenous populations to assert their rights effectively and navigate legal frameworks that impact their customs and traditions.
6. Nations should engage in international dialogues to harmonise their laws with global standards protecting indigenous rights, such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). This cooperation can enhance legal protections and ensure that the voices of tribal communities are amplified on international platforms.
7. Encourage comprehensive research on tribal customs and their legal significance. Documenting these customs will not only preserve their cultural heritage but also provide a robust basis for legal advocacy. This can serve as an essential resource for policymakers, legal practitioners, and scholars alike.

8. Recognize and promote customary laws that govern tribal communities, ensuring that they are respected within the broader legal framework. This includes acknowledging the legitimacy of traditional dispute resolution mechanisms that have been historically utilised by indigenous groups.
9. Establish a framework for the ongoing monitoring and evaluation of laws affecting tribal communities to assess their effectiveness in safeguarding customs and traditions in a globalised context. Feedback from tribal populations should be integral to this process.
10. Legal frameworks should support the economic empowerment of tribal communities through access to markets and fair trade practices that respect their customs. This can help tribes adapt to globalisation while retaining their cultural identity, providing a legal basis for sustainable development.

References

Bourdieu, Pierre. (1990) explores the concept of habitus and how cultural practices evolve, influenced by external factors such as globalisation. He argues that cultural practices are not static and can adapt, leading to an evolution of traditions rather than their complete erosion. This perspective provides a theoretical foundation for understanding how tribal customs might adapt in the face of globalisation.

Baviskar, Amita. (1995) discusses the impact of development and globalisation on tribal communities, particularly in the context of displacement and environmental degradation. The book highlights how globalisation can undermine traditional customs and practices, forcing communities to negotiate their identity and rights amid external pressures.

Shah, Ghanshyam. (2007) examines the intersection of tribal identity and globalisation, arguing that tribal communities are not passive victims of globalisation but active agents negotiating their cultural identity. This study provides insights into how tribal customs may evolve through political engagement and adaptation to global influences.

Mishra, A.K. (2011) This article discusses the various ways globalisation has impacted tribal cultures, particularly in terms of cultural commodification and loss of traditional practices. Mishra emphasises the need for policies that protect tribal customs from globalisation's adverse effects.

Hirsch, Eric, and Charles Stewart. (2005) the authors argue that globalisation affects local customs by introducing new cultural forms, leading to hybridisation. This perspective suggests that tribal customs might not be wholly eroded but instead could evolve into new, hybrid forms that incorporate elements of global culture.

Giddens, Anthony. (1990) discusses how globalisation reshapes social practices, emphasising that traditional customs may be reinterpreted or transformed in modern contexts. His analysis supports the notion that while globalisation poses threats to tribal customs, it can also lead to new forms of cultural expression.

Gupta, Akhil. (1998) examines how globalisation has influenced agricultural practices among tribal communities. His work highlights the tension between traditional agricultural practices and the pressures of global markets, leading to significant changes in tribal customs and social structures.

Sundar, Nandini. (2009) discusses the implications of globalisation for environmental governance in tribal communities, emphasising how tribal customs related to nature and land use are being challenged by global environmental norms. This study illustrates the complex interactions between global policies and local customs.

Rao, N. (2014) research focuses on the Santhal community and examines how globalisation affects their cultural identity and customs. He finds that while some traditions are under threat, others have been revitalised through new forms of cultural expression that engage with global influences.

Zavitz, Josh. (2018) compares the effects of globalisation on tribal practices in two distinct cultural contexts, highlighting similarities and differences in how indigenous communities respond to global pressures. This comparative study sheds light on the various paths of adaptation or resistance faced by tribal customs in different global contexts.

EXISTING CONTEXT OF MEDIA TRIAL IN INDIA

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Abstract

The aim of this paper to study the present-day scenario of media courts in India by assessing the correlation between the media, judiciary and society. A media trial can be said to happen when different media or even one particular media tries to cover the matter of the case and discuss it even when the court is adjudicating over that particular case. This problem is especially relevant for the developing country like India, where many of the popular cases are in the spotlight of the media. The paper attempts to examine and systematically review the impact that media trials have in particular on the presumption of innocence of the defendants and the fairness of the trial. It examines historical dynamics and establishes the most important legal norms that govern today's relations, such as significant cases and transforming media. The paper focuses on the influence of the media on the establishment of the story of the legal case and how this affects the person being tried and the court as a system. Following the tactics of the media tend to advocate for media trial, slanting of targeted media coverage and balancing of the media coverage among others. Moreover, the paper examines the existing responses and laws that have been established to tackle these problems, including new changes and the impact they have had on the identified problems.

Keywords: Media Trials, Judicial Impartiality, Context of Media Trial, Public Perception, Fair Trial, Sensationalism, Indian Constitution.

Introduction

Media trials are the situations whereby the media give extensive coverage of legal matters even before the court decides on the matter at hand. Media trials are those whereby the media overrides the judicial process and carries out a trial based on public discussion on a legal issue. This is particularly true of India where the scope of this kind of media coverage has increased dramatically and raised questions

on the implications of such coverage on the judicial process and people's conduct in court. This article will analyze the reasons of increase of media trials in India, the consequences of this phenomenon and the aspects of conflict of interests that are associated with them. And it's also finally understanding where it stands vis-a-vis the legal system in explaining the effects of media trials on justice, particularly the impact of public perception, possible biases and constraints of ease into the legal system.

Overview of media trial

In most cases, media trials do start with the detonation of the calamity through the hype of crime reporting. The press disseminates data that influences people's attitudes way before a decision is made. Such reporting would involve describing the features of the crime in detail, talking to any relevant witnesses, and discussing with legal practitioners, etc. The media helps educate people on various issues, but the stress it places on the administration of justice is unhealthy.

Impact on the Indian Judicial System

➤ Presumption of Innocence

Imprisonment without trial is one of the notable aspects of justice; One is to be presumed innocent until proven guilty, this is a legal rule that operates throughout the world. Such principles can be subverted in the context of "media trials." If the people in general have read reports of some manner or other regarding the head of a public institution or agency where he or she is being charged with committing wrong, then it is unlikely that the jurors will be completely neutral regarding that spokesperson.

➤ Influence on Public Opinion

Media trials often end up creating an altered public opinion about a case. The manner in which the news media reports incidents can also impact the way people perceive the accused and in turn, affect their life, reputation and mental being. People start forming opinions even before the entire information is made available to them and this may lead to a lot of other serious problems later on too.

Current Scenario of Media Trials

Over the recent past, the outlines of media trials in India have surfaced with some high-profile cases. Crime reporting, particularly one centered around a 'star factor' or sensationalism, has raised issues regarding media ethics, fairness to the accused as well as fairness of justice.

High-Profile Cases: Nirbhaya crying in her friend's lap died after it was pushed inside the president's mansion and Sushant Singh Rajput in scene are cases which have attracted a firestorm of attention from the media. It is largely during these times that the media, in terms of the stories becoming the Laura in the trial of law, escalates the atmosphere as if the suspects had already supremed sack in

dismissal.

Public Influence: Images of these court cases suggest that a person's case may suffer from 'trial by public' or 'trial by media impression' where there are negative portrayals of a party expected to be legal representatives long before any litigation has commenced. Conclusively this in their way deep underscores the right that the Indian Constitution guarantees, "the right to a fair trial," in other words, undermines the public respect for justice.

Their actions restrained them to only arms monitoring and to some extent monitoring the activities of the foreign state authorities.

Ethical Consequences

- Sensationalism (Sensation seeking journalism)

So, when inflamed with passion, it often works to the hindrance of true work, that is, original research, which is actually value-centric in nature rather than driven by client's wishes. To wit, certain media outlets couldn't find the circumstances of the trials to adorn facts provided to them.

- Accountability in Reporting

Journalists are also obliged to serve ethical concerns by reporting in a proper way. One important prong of this definition is that journalists do not get involved in non-crucial controversies among the various parties. The scope of investigations and coverage is acceptable, given that ratings and engagement factors are paramount.

Consequences of Media Trials

The evolution of the digital age has only made the situation worse. Information is disseminated instantly, and opinions are quickly formed, meaning that some facts may be missed out on. And this can bring about:

- The Spread of Misinformation: Because of the 24/7 media, false reports about ongoing cases has become common as the attention is not on the correct facts but on drama.
- Social Media's Role: Twitter and Facebook are tools for propagating distortions of the truth creating situations where the 'angry mob' takes matters into their hands.

Applications and Use Cases

Nothing said in the previous section is limited to the courtroom. It affects:

- Public Trust in Justice: Negative media influence only on the few which are very few cases may encourage public scepticism regarding the judicial system.
- Legal Reforms: Ever since the public demand for fair trials in the courts has increased, media houses have been asked to self-regulate and reforms have been proposed to ensure that the accused gets his or

her rights respected.

The relevance of media trials can be seen in different aspects. Cases against high social status individuals catch mass public attention. This highlights the need of regularization. Also, these can be used as an application in legal education to make law students understand the impact of media on justice.

Applications and Use Cases An understanding of the impact of media trials can have multiple applications. For legal practitioners, it underscores the need for ensuring fair media representation and educating people about legal proceedings. Policymakers may have to consider legislation to regulate media reportage of cases under trial. Media organizations could adopt self-imposed guidelines to minimize sensationalism and concentrate on sober reportage.

Campaigns geared at raising the awareness of the public could be of help in informing the citizen of how the judicial process works thereby preventing the spreading of misinformation and promoting a more informed view of high-profile cases. Apart from creating awareness, there campaigns could also push for the protection of individuals' right against the media.

Comparison with Other Countries

As practiced in the United States and in the United Kingdom, as well, in some cases such media trials also take place. Their legal frameworks are, nevertheless, stricter. For instance, the UK's 'sub judice' rule helps to safeguard the interests of the parties to the case by restricting any reporting on the matters currently before the court. Such Measures may be implemented in India in order to reduce the effects of media trials on the public.

Challenges and Limitations

News today moves at breakneck speed, which means that stories have to be reported fast. In that haste, mistakes can happen and often the coverage is not complete. This can end up doing a disservice to the people who are on trial or considering legal action. Additionally, there are no real regulations or directives about how ongoing trials should be covered by the media and therefore they can be exploited for entertainment value.

Media trials bring a number of challenges. Firstly, there is the risk of misinformation and emotional prejudice. It can be very difficult for defendants to receive a fair trial in the face of overwhelming adverse media coverage as it becomes almost impossible for judges and lawyers to shield jurors from media-generated public perceptions. Social media only amplifies this danger with its capacity to spread misleading information quickly.

Secondly, there is a heightened risk that certain individuals will be disproportionately targeted by the media due to their race, class or gender. This can compound societal divisions and skew public

perceptions still further.

A review of current media experiments in India

With increased access to news channels and social media monitoring is therefore important in the Indian scenario. This phenomenon includes intense coverage of court cases, legal arguments and details of the investigation. This is often a public judgment before an official judgment is made. High-profile cases such as the Nirbhaya gang rape case, the Sheena Bora murder case and the recent Sushant Singh Rajput case show how media stories can shape public perception and influence legal outcomes. When the media presents information, it can create an environment that influences public opinion and puts pressure on the judicial system. Broad dissemination of opinion and analysis often oversimplifies complex legal issues, and may lead to bias. Journalists and various channels Always analyze evidence Express your opinion about guilt or innocence. Analysis of personal life Raise ethical concerns about fairness and justice.

Many argue that media scrutiny undermines the basic legal principles of "Innocent until proven guilty". The media's emotional narrative can distort facts and create a narrative that is inaccurate. This process harms the reputation of the accused and the possibility of a fair trial.

Challenges and Biases

So, the media trial has a set of its own challenges. First, journalist bias can play in what stories get covered and how they're reported on. Second, media companies face very little accountability meaning they can push narratives with no real consequences only serving to cement pre-existing biases/stigma against groups of people which affects justice overall all the more.

Final Thoughts and Recommendations

The current scenario of media trials in India raises serious questions for justice as well as public opinion. With the ever-changing media, a balance needs to be struck between reporting and responsible journalism. It would be interesting for future researchers to develop ethical norms related to media functioning while reporting in judicial matters, and the impact of this kind of portrayal on Justice outcomes. It is necessary that public is made aware about their part during judicial matters to ensure fairness and justice prevails for all.

Conclusion

The media trials in India are increasing at an alarming rate, creating hardships for fair administration of justice and the principle of 'innocent until proven guilty'. In order to overcome this situation, it becomes important to support responsible journalism and contemplate some regulatory effects in order to ensure procedural fairness in the context of judicial dealings. Further, it calls for undertaking research study directed towards exploring the workability of media regulations that have been adopted

by other countries and their suitability in Indian perspective. Hence, developing a symbiotic association between media trial and legal system becomes necessary as public confidence on one hand is dependent upon fairness while on other is also based on perceptions.

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“NUTRIENT UPTAKE MECHANISMS IN BLACK SOYBEAN (GLYCINE MAX): FACTORS FOR AGRICULTURE AND NUTRITION”

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Himalayan University, Jollang, Itanagar, Arunachal Pradesh, India Black Soybean Variety – VL Bhat

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Abstract

Field experiment was laid out at agriculture field of Himalayan university, Jollang during Kharif season 2023-2024 to study the response of black soybean. This study aimed to investigate the impact of long-term application of compost and biofertilizer on pattern of nutrient uptake of black soybean in the soil. The field experiments was conducted with eight treatments i.e. T2 = 100% NPK + Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T3 = 100% NPK + Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T4 = 100% NPK + Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T5 = 100% NPK + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T6 = 100% NPK + Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T7 = 100% NPK + Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T8 = 100% NPK + Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha and T1 = control. The highest uptake pattern of nutrient in soybean were associated with integrated application of fertilizer along with (100% NPK + Vermicompost + Phosphate solubilizing bacteria). While, the lowest value was found in control supplementation of fertilizer P with NK (100% NPK) enhanced the content uptake in soybean. However, in general higher uptake of nutrients were found in grain as compared to straw. Keywords: Farmyard manure, nutrient content, nutrient uptake, soybean.

Keywords: Nutrient uptake, NPK, Field experiments and Black soybean

Introduction

Soybean (*Glycine max* (L.) Merrill) is considered to be an important grain legume and oil crop. It is called as vegetarian meat and wonder crop because it is a rich and cheap source of protein 40-42% and oil 18-20% (Ferrier 1975). The studies of Osaki (1991) and Tanaka et al., (1993) investigated nutrient uptake by soybeans in Brazil and were used as references for several fertilization and liming recommendation guidelines in Brazil. However, soybean cultivars have improved since their publications and now soybean cultivars have increased yields, shortened crop cycles and growth habits to allow cropping systems with corn as second harvest. These changes have led to changes in nutrient demands. Bender et al. (2015) observed that modern soybean cultivars exhibited doubled daily biomass production and nutrient uptake compared to cultivars planted in the country. The maximum N content

in grain and straw was observed with the application of super optimal dose and the lowest content in grain and straw was recorded in control treatment Raghuwanshi et al. (2016) . The balanced fertilization has required for crop production, but combined application of manure may reduce the need for chemical fertilizer. An application of chemical fertilizers in combination with biofertilizers and compost may increase the yield and yield contributing characters such as grain yield, straw yield and biological yield, nutrient content and nutrient uptake, hence ultimately resulting in increased productivity of soybean (Shirpurkar, et al., 2006) . Use of organic manure alone or in combination with organic and inorganic fertilizers will help to improve physicochemical properties of the soils (Maheshbabu et al., 2008). Therefore, adequate and balanced application of organic and inorganic fertilizers is necessary to increase productivity and soil fertility.

Materials and Methods

Present study was conducted during 2023-2024 in Kharif season at experimental site of Himalayan University ,Jollang, Arunachal Pradesh, India (23°10'N, 79°57'E), with soybean (*Glycine max* (L.) Merrill) as rainy season crop .The region has a semi-arid and sub-tropical climate, with a mean annual temperature of 25.7°C and precipitation of 1350 mm. Soil was medium black soil classified as Vertisol. The experiment consisted of 8 treatments replicated three times in a randomized block design consist of gross plot size 17x10.8 m with 1 m spacing between plots and 2 m spacing between the replications With soybean variety VL Bhat 201; included; T2=100% NPK + Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T3 =100% NPK + Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T4= 100% NPK + Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha, T5= 100% NPK + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha, T6= 100% NPK + Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha , T7= 100% NPK + Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha , T8 = 100% NPK + Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha and T1 = control . Inorganic fertilizers include urea (0.3036 g/l N kg-1 of Urea), super phosphate (1.28 g/l P kg-1 of Super phosphate), and potassium (2.4 g/l g K kg-1 of MOP) as the sources of N, P, and K respectively. All soybean plants were harvested at crop maturity and grain yield was obtained. Next to this, grain nutrients NPK were analyzed (Bhargava et al., 1984 and Bradstre et al., 1965) and the uptake of individual nutrients by the grain and stover was calculated by multiplying the nutrient content of grain and stover by their dry weight and expressed in g NPK uptake = Nutrient content (%) x dry weight of sample (g)/100.

Result and Discussion

The Nutrient uptake recorded at harvest, is presented in Table no.1. The data shows that there was a significant effect of different treatments on the nutrient uptake and graphically depicted in figure no.

1.

The significant and highest nitrogen uptake was recorded in treatment T4 (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 156.22 kg ha⁻¹ ,T5 (Vermicompost at 5 kg/ha+ Rhizobium at 2.5 kg/ha) i.e., 150.13 kg ha⁻¹ , T6 (Biochar at 2.5 kg/ha+ Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha) i.e., 147.77 kg ha⁻¹ ,T7 (Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha)i.e., 146.01 kg ha⁻¹, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha+ Biochar at 2.5 kg/ha) i.e.,143.98 kg ha⁻¹, T3 (Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha)i.e., 141.59 kg ha⁻¹ and T2 (Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 130.84 kg ha⁻¹. Lowest nitrogen uptake was observed in treatment T1 (control) i.e., 125.14 kg ha⁻¹.

The significant and highest phosphorus uptake was recorded in treatment T4 (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 20.79 kg ha⁻¹ ,T5 (Vermicompost at 5 kg/ha+ Rhizobium at 2.5 kg/ha) i.e., 19.05 kg ha⁻¹ , T6 (Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha) i.e., 16.70 kg ha⁻¹ ,T7 (Biochar at 5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 15.70 kg ha⁻¹, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha) i.e., 14.35 kg ha⁻¹ , T3 (Coir compost at 5 kg/ha + Rhizobium at 2.5 kg/ha)i.e., 12.81 kg ha⁻¹ and T2 (Coir compost at 2.5 kg/ha+ Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 11.96 kg ha⁻¹. Lowest phosphorus uptake was observed in treatment T1 (control) i.e., 10.62 kg ha⁻¹.

The significant and highest potassium uptake was recorded in treatment T4 –(Vermicompost at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 71.40 kg ha⁻¹ ,T5 (Vermicompost at 5 kg/ha + Rhizobium 2.5 kg/ha) i.e., 66.36 kg ha⁻¹ , T6 (Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + Rhizobium at 2.5 kg/ha) i.e., 64.02 kg ha⁻¹ ,T7 (Biochar at 5kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha)i.e., 62.01 kg ha⁻¹, T8 (Coir compost at 2.5 kg/ha + Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha) i.e., 58.65 kg ha⁻¹ , T3 (Coir compost at 5kg/ha + Rhizobium at 2.5 kg/ha)i.e., 46.63 kg ha⁻¹ and T2 (Coir compost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) i.e., 44.60 kg ha⁻¹. Lowest potassium uptake was observed in treatment T1 (control) i.e., 41.58 kg ha⁻¹.

The probable reason for higher nitrogen, phosphorus, and potassium uptake in the treatment T4– (Vermicompost at 2.5 kg/ha + Phosphate solubilizing bacteria at 2.5 kg/ha) of black soybean is due to the synergistic effects of vermicompost providing essential nutrients and PSB (Phosphate-Solubilizing Bacteria) enhancing nutrient availability and uptake by plants. Vermicompost enriches the soil with organic matter, making nutrients more accessible to plants, while phosphate solubilizing bacteria solubilizes phosphorus, making it easier for plants to absorb. This combination promotes plant growth and nutrient uptake, leading to higher levels of nitrogen, phosphorus, and potassium in the plants, Yaduwanshi et al. (2018).

Table 1. Effect of compost and biofertilizer on nutrient uptake of black soybean

Treatment	Nitrogen (kg ha⁻¹)	Phosphorus(kg ha⁻¹)	Potassium (kg ha⁻¹)
T ₁ - Control	125.14	10.62	41.58
T ₂ - Coir compost at 2.5 kg/ha + <i>Phosphate solubilizing bacteria</i> at 2.5 kg/ha	130.84	11.96	44.60
T ₃ - Coir compost at 5 kg/ha + <i>Rhizobium</i> at 2.5 kg/ha	141.59	12.81	46.63
T ₄ - Vermicompost at 2.5kg/ha + <i>Phosphate solubilizing bacteria</i> at 2.5kg/ha	156.22	20.79	71.40
T ₅ - Vermicompost at 5 kg/ha + <i>Rhizobium</i> at 2.5 kg/ha	150.13	19.05	66.36
T ₆ - Biochar at 2.5 kg/ha + Vermicompost at 5 kg/ha + <i>Rhizobium</i> at 2.5 kg/ha	147.77	16.70	64.02
T ₇ - Biochar at 5 kg/ha + <i>Phosphate solubilizing bacteria</i> at 2.5 kg/ha	146.01	15.70	62.01
T ₈ - Coir compost at 2.5 kg/ha +Vermicompost at 2.5 kg/ha + Biochar at 2.5 kg/ha	143.98	14.35	58.65
F Test	S	S	S
SEd (±)	0.48	0.41	0.59
CD (P=0.05)	7.96	2.78	8.73

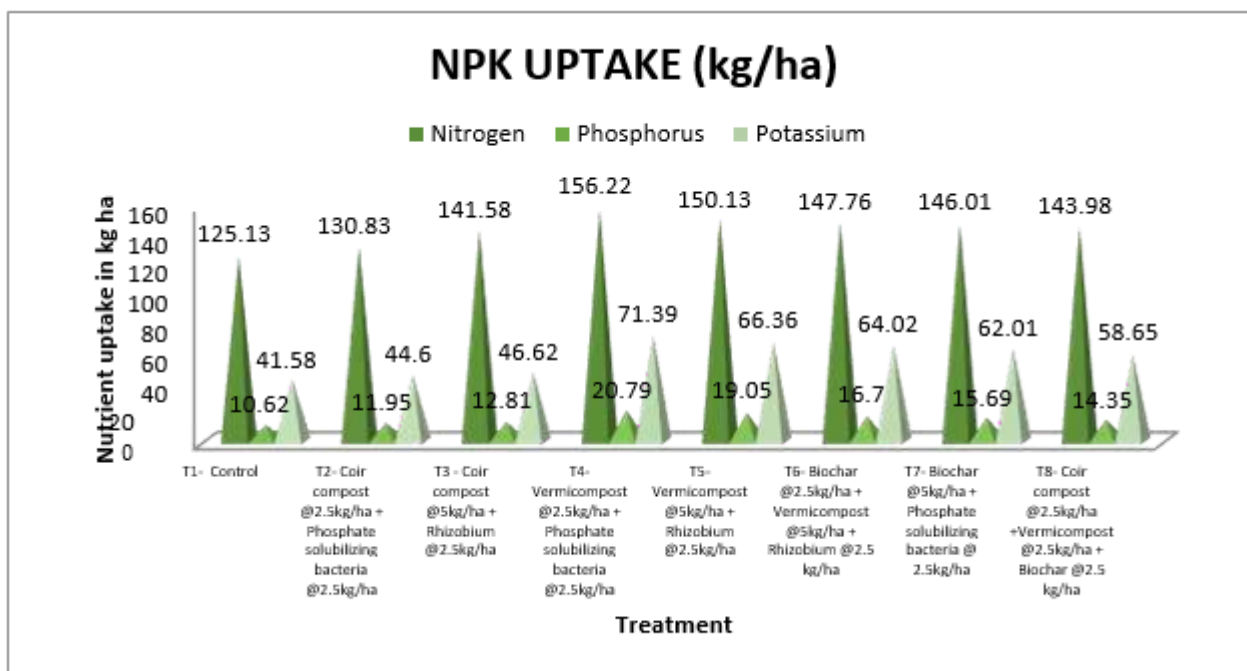


Figure 1: Effect of compost and biofertilizer on nutrient uptake of black soybean

Conclusion

Finally, it could be concluded that the integration of biofertilizers, compost, nitrogen phosphorus and potassium enhanced the yield attributes such as pod length, pod weight, weight of 100 seeds, seed index and seed yield of black soybean. The highest grain yield was recorded in the treatment (T4- Vermicompost at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5kg/ha) 1.88 t ha⁻¹ through phosphorus, nitrogen and potassium and biofertilizer. Similarly, the highest nutrient content was also obtained from the integration 100% RDF + Vermicompost at 2.5kg/ha + Phosphate solubilizing bacteria at 2.5kg/ha through inorganic fertilizers coupled with organic fertilizers. Thus the objective of maximizing yields as well as maintaining soil health and productivity can be furnished by a balanced use of inorganic fertilizers conjunctively with fertilization and organic biofertilizers.

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WITHANIA SOMNIFERA L.: AN OVERVIEW

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Abstract

Withaniasomnifera L. is a member of solanaceae, also known for thousands of years by Ayurvedic practitioners. *Withaniasomnifera* root contains flavonoids, alkaloids, steroid and many active functional ingredients (Kumar *et al.*, 2015). *Withaniasomnifera* having small white flowers mainly in rainy and winter seasons that can be develop into fruit during the winter seasons. Plants products can be obtained from the roots, leaves, and branches, by using many different biological techniques. Withania which is also known as Ashwagandha having effectiveproperty can also used in blends and supplements which are designed to show many multiple effects. It is described as an herbal tonic and health food in Vedas and considered as ‘Indian Ginseng’ in traditional Indian system of medicine (Singh *et al.*, 2001).

Introduction

The meaning and origin of the word *Withania* is doubtful, whereas *somnifera* refers to the narcotic property of the leaves of plant. *Withaniasomnifera* is an erect, evergreen (green in whole year), branching, and tomentose shrub of 30 to 150 cm in height. Leaflets are simple, petiolate with the leaf blade varying in shape from elliptic-ovate to broadly ovate, entire along margins, acute to obtuse at apex, oblique at base, clothed with a persistent grayish tomentum on sides, 4-10cm long and 2-7cm broad (Mirjalili *et al.*, 2009).

Leaves on vegetative shoots are alternate and large and those on floral branches are opposite, arranged somewhat laterally in pairs of one small leaf and one large leaf, bearing in their axil a cymose cluster of 4-25 inconspicuous pale green monoecious flowers. It produces flowers indeterminately round the year with a peak of flowering between March and July (Mirjalili *et al.*, 2009). In Sanskrit it is called ashvagandha (asva_ ‘horse’, gandha_ ‘smell’) which means ‘smell of the horse’, because the root of the infected plant has the smell of the horse urine, but in general the meaning of the name is: ‘what gives the energy and the sexual vitality of a horse’.

Other synonymous are: Varada (vara_ ‘choosing’, ‘desiring’, ‘offering’, ‘producing’) that means ‘granting wishes’, ‘conferring a ‘a; Vajigandha (vaji_ ‘strength’, ‘vigour’, ‘gandha_ ‘smell’) i.e. ‘smell of the strength’; Vajikari (kari_ ‘causing’, ‘accomplishing’) that means strengthening, ‘producing virility’; Vajiini (_ ‘a mare’) i.e. ‘what promotes pregnancy’; Palashparni (palasa_ ‘cruel’, ‘toxic’;

parna_‘leaf’) with reference to the poisoning leaves. In Ayurveda *Withania* is used as tonic, aphrodisiac, sedative, as *Medharasayana* (Nadkarni 1993; Monier-Williams 1997). Vernacular names Sanskrit, *Ashvagandha*, *Ashvakandika*, *Balada*, *Balaja*, *Gandhapatri*, *Vajigandha*, *Vajikari*, *Vajiini*, *Palashaparni*; Hindi, *Asgandh*; English, *Winter cherry*; Italian, *FalsoAlchechengi*; Japanese, *Ashwagandha*; AasogandaNepalese; Singalese, *Amukkara*; Arabic, *Bahman*; Tibetan, *Ba-dzigandha* (Kirtikaret *al.*, 1993).

Distribution:-The genus *Withania* is restricted and related to the old World; rather it closely belongs to the genus *Physalis*, the gooseberries. *Withania* possesses a natural occurrence, most probably in the drier and humid areas, spread from the Mediterranean region to throughout tropical region of Africa to South Africa and also from the Cape Verde Islands and Canary region to the Arabia and Middle East region like India, southern China and Sri Lanka.

Ashwagandha is propagated and cultivated in gardens in the warmer and drier regions of Europe and became a natural herb in New South Wales and South Australia. Generally, it is cultivated in India and in many other places as a medicinal crop (Govindarajuet *al.*, 2003), most probably for its fleshy roots. *Ashwagandha* is globally known but is not so common in all regions of South Africa, Botswana, Namibia, Lesotho and Swaziland. It is total absent in the western half of the Western and Northern Cape regions. It develops and cultivated in a wide range of vegetation types in dry and warm areas to areas with usually high humid region with high rainfall like coastal vegetation, savanna, grassland, scrubland, karoo, woodland, and mostly in margins of forests and thickets, besides water also, as on the river banks. Its presence is also observed in light shaded dark places as well as in full sun places, mostly among rocks where the roots are being kept cool.(Kapoor 1990).

Habitat:-*Ashwagandha* grows in dry areas in India, on the Himalayas under 1600m, Beluchistan, Sri Lanka and in the Mediterranean area: spontaneous in Sicily and Sardinia Kirtikaret *al.*, 1993). Used parts root, leaf, seed *Withaniasomnifera* L.Dunal is a common herbaceous evergreen shrub of 30-150cm height. It grows as a weed along road sides and in open waste places. It is distributed throughout the drier parts of India. It is now cultivated at different parts of the country due to its medicinal importance. The plant is usually clothed with minutely stellate tomentum. The leaves are 5-10 cm long, simple alternate, ovate, entire, thin with cuneate/connate base and are densely hairy with reticulate venation. However, near the inflorescence leaves are opposite with adnate. (Kapoor 1990).

1. Morphology

According to the Dattaet *al.*,2011 based on its cultivation in experimental field plots of the University of Kalyani, West Bengal plains, elevation on 48 feet above sea level, sandy loamy soil, organic

carbon 0.76%, soil pH 6.85 during the period of September to February, (max. temperature 24.03-32.17 °C, Min. temperature 11.24-25.51 °C, rain fall 0.0-12.46 mm; relative humidity max. 93.96- 98.28% min. 44.43-86.85%).

The species is perennial (can be sown twice a year, in March to August and September to Feb (Das *et al.*, 2009), branched, terrestrial herb (plant height: 69.58-75.22 cm); tap root, long (17.52 to 19.28 cm), unbranched, 2-3 cm thick, terete, rootlets many, confirmed within 1-5 cm, angular and branched; stem terete, hairy to the younger part and glabrous at maturity; leaves alternate, simple, ovate to broadly ovate (7.0-12.0 cm long; 5.0-7.0 cm broad), acute at apex entire, broad as well as cuneate at base, herbaceous, unicostate with 4-5 pinnate secondaries, hairy on both surface, green, petioles slender 1-2 cm long, hairy; flowers auxiliary in fascicles of 2-5 often 2-3 developed complete, bisexual, hypogynous, actinomorphic, pentamerous, pale green, pedicellate; pedicel 2 to 3 mm long hairy lobes, triangular acute, about 1 mm long, tubular part about 2 mm long, hairy throughout, persistent and accrescent at maturity covering the whole fruit increased up to 1.5-1.8 cm long; corolla tubular, campanulate; petals 5, ovate triangular about 1.5 mm long, hairy on both surface, tubular part about 2 mm long, stamens 5, filaments slender, epipetalous and alternipetalous attached below the middle of the corolla tube, white glabrous; anthers oblong, two celled dorsifixed, dehiscence longitudinal-latrose, white; pollen grains prolate spheroidal (**as per Erdtman 1952**) fertility 59.96-71.05 %, size $21.67 \mu\text{m} \times 18.67 \mu\text{m}$ (18.5 pollen grain per microscopic field: $85564 \mu\text{m}^2$; carpels 2 syncarpous; ovary oblong about 1.2 mm long, greenish, glabrous: style one terminal, terete about 1-5 mm long, glabrous; stigma rounded, ochre (16283); ovary two chambered with many ovules per chamber in axile placentation; fruits berry, subglobose to rounded, coloured at maturity, many seeded 4 to 5 mm across, glabrous with varied seed colour, fully covered with accrescent calyx; seeds flat about 1.0 mm across, surface reticulate, glabrous, light brown to yellowish brown.



Fig.Plant of *Withaniasomnifera*.



Fig. Stem and fruits of *Withania somnifera*

2. Anatomy

- Stem

Transverse section (4.0-5.0) of stem (main stem, 75 days old plant at vegetative stage; hand sectioned and double strained as per **Johansen 1940**) showed the lowing features: epidermis 1 cell layer thick,

cells more or less rounded to barrel shaped rarely rectangular, medianly thick walled, cells compact arranged: hypodermis 1 cell layered thick, cells compact, rounded, medianly thick, smaller than the epidermal cells, at maturity hypodermal layer may be indistinct: cortex 6-8 cell layered thick, cells rounded, smaller towards stele, thin walled loosely arranged with intercellular spaces: stele consisting of a ring of vascular structure having pith to the centre, siphonostelic: outer phloem layer few cell layered thick, continuous as well as in patches: cambium 2-3 cell layers thick, inconspicuous: xylem layer with medullary rays: inner phloem in discrete patches: pith cells alike to cortical cells (**Johansen 1940**).



Fig. Stem of *Withania somnifera*.

- **Roots**



Fig. Roots

Transverse section (main root of 75 days old plant, 5-6 cm below the top; double stained) of root documented the following: periderm (phellem, phelogen and phelloderm: 3 layers evident) present; phellem 3-5 cell layered thick, tetra to polygonal, thin walled, compactly arranged with contents

within; phelogen 2-3 cell layered thick, rectangular, compactly arranged; phelloderm 5-7 cell layered, rectangular thin wall, compactly arranged; cortex 7-10 layer thick, polygonal to rounded often with brownish content within; pericycle and endodermis indistinct due to secondary growth; stele prominent with distinct xylem and ray cells; primary vascular bundle tetra-arched, centrally placed with metaxylem and phloem arranged radially. (Datta *et al.*, 2010).



Roots of *Withania somnifera*.

Seeds of *Withania somnifera*.



Fig. Seeds of Ashwagandha

3. Seed Germination

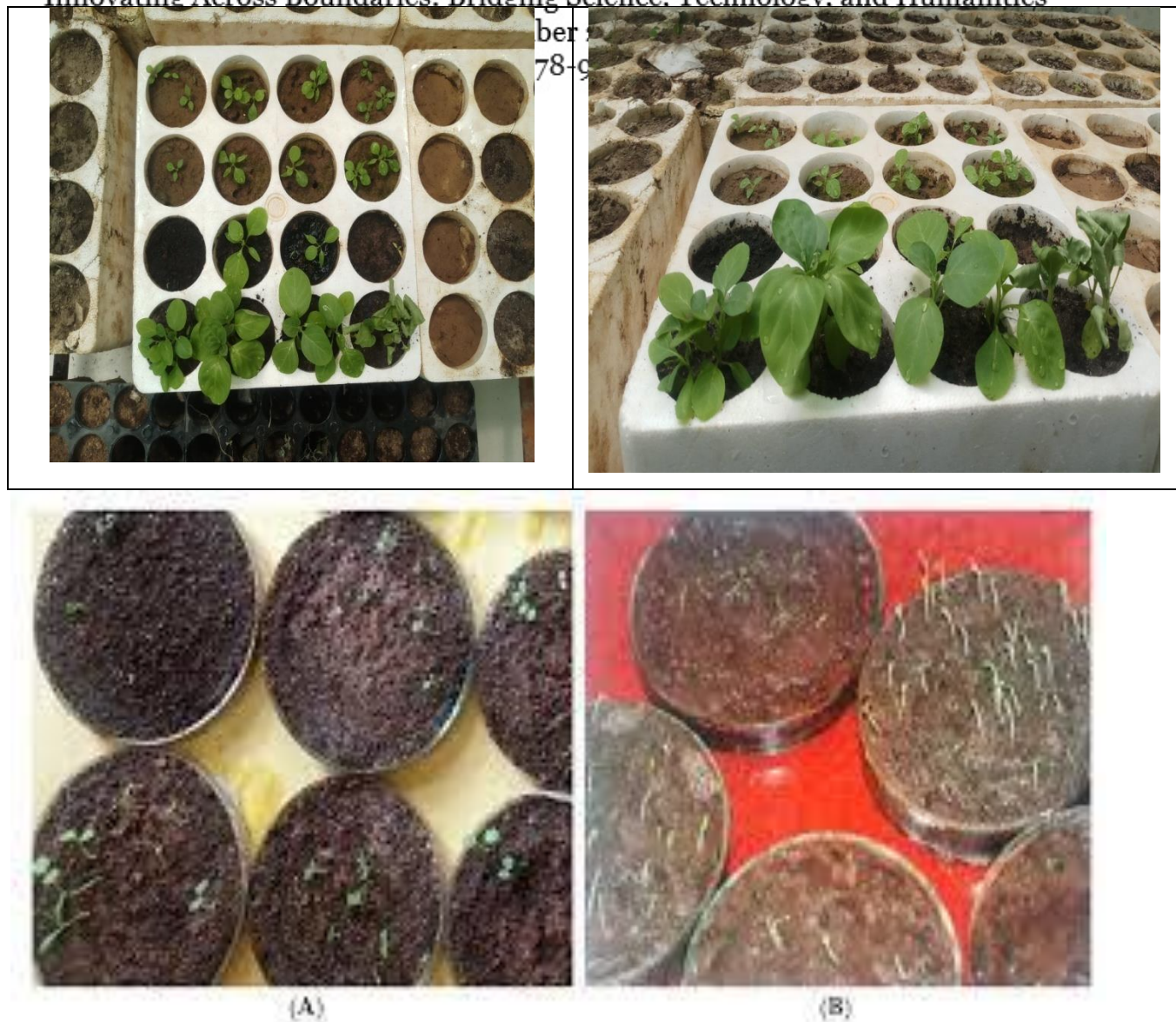


Fig. Seed germination and seedling

The germination of the ashwagandha seed is irregular and takes more than 15 days, so there is urgent need to study on germination aspect of this crop. In order to have better germination and seedling quality parameters of ashwagandha, it is necessary to conduct germination treatments for breaking the dormancy in the laboratory conditions. The irregular and low germination is the main problem in the propagation of many medicinal plants which can be enhanced by application of biofertilizers . The present investigation was conducted to study the effect of different dormancy breaking treatment methods and different growth hormones, chemical treatments and biofertilizer treatments on seed germination, quality enhancement and other quality parameters in Ashwagandha([Changhadi , 1938](#)). Some research on physico-chemical treatments like storage, temperature, photoperiod and growth regulators (GA3, IAA, IBA, 2–4 D and BA) on germinability were also done by different researchers and they found that the most effective treatment is GA3 at 150 µg/ml concentration at 25 °C. The optimal temperature for germination is 25 °C and continuous light favored germination showing that

photoperiod has a significant role. The seedlings derived from seeds performed well when grown in a glasshouse.

The seed germination of *W. somnifera* can be enhanced by pretreating seeds with GA3 500µg/l for 24 hours before sowing. This increased germination percentage as well as reduced the mean germination time. The mechanically scarified seeds also showed a much favorable result. This suggests that mechanical scarification of seeds can be applied as a very suitable, cost-effective and eco-friendly method which is easy enough to be used by local, unskilled farmers to combat seed dormancy of Ashwagandha seeds and hence improve seed germination.

The mechanical scarification for two minutes recorded highest germination percent and seedling parameters compared to control. The maximum germination per cent was attained biofertilizer Phosphorous Solubilizing Bacteria culture recorded the highest seedling germination and its attributing parameters followed by Bio NPK.

Seed treatments like sand paper scarification and pin pricking and hot water treatment for Ashwagandha, Depending on the availability, KNO₃ (1.0%) can be recommended for seed treatment to assure good germination and emergence in the field.

The 5-minutes' treatment of NaHClO₃ and glasshouse condition yielded maximum emergence in Ashwagandha. However, seedlings growth and biomass in open condition were comparable to that in glasshouse condition.

Filter paper had the highest germination percentage (94%) at dark condition, less than 50% of the seeds were able to germinate under light conditions at both B5 media and Plain agar, on the other hand, at light condition germinated seeds in filter paper (46%) were more than B5 media (25%) and Plain agar (37%).

The results of some studies revealed that some varieties, like *Posida*, Indore general. Having low seed germination and higher fungal infection. There is necessity of treatment of different growth hormones, fungicides, nutritional sources and efficacy plant parts. So as to increase the productivity this plant Ashwagandha production is need to be increase day to day.

The application of bio-fertilizers, in the treatment combinations of *Azospirillum lipoferum*, *Pseudomonas striata* and *Pseudomonas fluorescens* recorded maximum plant growth, yield and survivability of garden rue seedlings than single application and untreated.

Black, plastic mulch significantly increased the seed yield obtained from field plantation and accelerated fruit ripening, rising the percentage of seeds capable of germinating in the yield

(GraŚynaObidoska, *et al.*,, 2004).

In Polish climatic conditions the field yield of *Withaniasomnifera* seeds capable of germinating, was to a great extent dependent on weather; especially at the end of the vegetation season (September-October) (GraŚynaObidoska, *et al.*,, 2004).

The results of Some study depicted synergistic activity of temperature, Gibberellic acid and light indicated by improved seed germination, that can be exploited to obtain uniform seed germination under controlled conditions for raising large populations of desired accession for commercial cultivation (**Khanna *et al.*,,2013**).

4. Allelopathic Potential

Withania extract has been found to be effective as bio-herbicide against *Partheniumhysterophorus*. However, its role against *Ageratum coenzoides*, *Chenopodium album* and *Achyranthusaspera* has not been tested. The rationale of the study is to to use allelochemicals as a control measure for weed distribution in Himalayan areas. The present study was premeditated to evaluate the herbicidal activity of *Withaniasomnifera* using plant extracts against germination and growth of noxious weeds of Himalaya i.e. *Ageratum coenzoides*, *Chenopodium album* and *Achyranthusaspera* in a laboratory and foliar spray bioassay so as to present a bioherbicidal method for the management of weeds in the Himalayan regions.

An experiment revealed the fact that many medicinal plants can be used as a bio herbicide to control some weeds as well as invasive weeds. The phyto-chemical present in plants act as allelochemicals for the weeds and provide a safe and natural meanof weed management. Earlier initiatives have been proved successful, for examples, Artemisinin, a sesquiterpene lactone from the *Artemisia annum*L. is a patent plant growth inhibitor. Leptospernone is a known allelochemical from which the triketone class of herbicides was produced. Similarly, 1,8, coneole, a monoterpene, has been identified as one of the most potent allelochemical released by *Artemisia* spp. and a synthesise analog, cinmethylinia, being sold as a herbicide in Europe. As medicinal plants like *Withaniasomnifera* are a rich repository of phytochemicals and have a herbicidal effect over weeds, there is a possibility to commercialise its extracts as herbicide which will prove a milestone in the weed management in the Himalayan region.

(**Sharma *et al.*,,2017**)

Numerous medicinal values of *W. somnifera* have been reported and its allelopathic potential has also been declared by many researchers (Jabran *et al.*,. 2010; Javai *et al.*,. 2011; Chandra *et al.*,. 2012; Khaliq *et al.*,. 2013; Sharma *et al.*,. 2017). The hydro alcoholic extract of ashwagandha mainly at higher concentrations demonstrated promising allelopathic properties by significantly affecting seed germination and radical elongation of both *Cicerarietinum L.* and *Triticumaestivum L.* in a

concentration dependent manner. *Triticum aestivum* was found to be more sensitive than *C. arietinum* (Chandra *et al.*, 2012).

The aqueous extract and alkaloid fraction of *Withaniasomnifera* and *H. mutcus* showed an inhibitory allelopathic effect on the germination of wild chicory and the inhibitory effect depended on the concentration. Phytochemical analysis showed the plant contain different class of phytochemical compounds GC-MS analysis of aqueous extract revealed the presence of hydroxyl cinnamic acid and methyl ferulate and other phenolic compound which may have a major role in germination inhibition also alkaloid fraction have many compounds which consider as allelochemical finally we can recommended by use these plant extracts as a pest side after further studies. (Eman Ramadan Elsharkawy, 2019).

5. Secondary metabolites

Medicinal plants are a source of naturally active compounds used extensively by tribal people worldwide for many ailments. *Withaniasomnifera* (WS) is one such plant used to treat many ailments from the time of Ayurveda. Extraction of the bioactive plant constituents from the whole plant or from the different parts of the plant has always been a challenging task. As the dried roots of WS are widely used in the treatment of many disorders, the current study aimed at extraction and detection or screening of active phytochemical compounds from different extracts of WS root. Phytochemical screening of different extractions revealed the presence of phenols, flavonoids, tannins, saponins, alkaloids, steroids, terpenoids, glycosides and reducing sugars which could account for its varied medicinal properties like anti-inflammatory, anti-spasmodic, anti-analgesic, neuroprotective and diurectic effects.

Various preparations and forms of *Withaniasomnifera* (Linn) Dunal (Ashwagandha) i.e. powder, decoction, oil, smoke, poultice etc. have been advised for the cure of various disorders such as skin disorders, nervous disorders, intestinal affections, venereal diseases, rheumatism, emaciation of children and as a tonic for all kinds of weakness and in geriatrics. It also promotes vigor and stamina and is regarded as aphrodisiac and rejuvenator.

Withaferin A and Withanolide D are two main withanolides contribute to the most of biological actions. It has pharmacological action in almost all systems of the human body. It has also some side effects and contraindication. Number of pharmacological studies have been conducted and a wide range of biological activities have been observed such as anti-inflammatory property, hepatoprotective activity, infertility activity, anti-bacterial activity, psychotropic/anti-anxiety activity, anti-convulsant activity, skin care activity, healthy hair activity, immune-modulator activity, anti-peroxidative action, anti-ageing effect, macrophage activating effect, haemopoietic effect, antibiotic

activity, antitumour activity, anti-hyperglycemic effect, morphine tolerance and dependence-inhibiting effect, cardio tonic activity, hypo lipidemic, anti-atherogenic activity, positive inotropic activity, hypoglycemic effect, anti-oxidant activity, anti-carcinogenic activity etc. This review presents morphology of the plant, geographical distribution, cultivation and market value, plant pathology, Ayurvedic properties, chemical ingredients, medicinal uses in Ayurveda, side effects and contraindications, pharmacological evidences of *Withaniasomnifera* (Linn) Dunal (Ashwagandha). Some of the uses of *W. somnifera* according to different researchers are reviewed here. This review will help to know all the medicinal properties of Ashwagandha.

6. Medicinal properties

Withania somnifera is a medicinal plant extends over a large area, from the Atlantic Ocean to South East Asia and from the Mediterranean region to South Africa. The medicinal plants are widely used by the traditional medical practitioners for curing various diseases in their day-to-day practice. In traditional systems of medicine, different parts (leaves, stem, flower, root, seeds, bark and even whole plant) of *Withaniasomnifera* (Ashwagandha), a small herb seen throughout India, have been recommended for the treatment of aphrodisiac, liver tonic, anti-inflammatory agent, astringent, and more recently to treat bronchitis, asthma, ulcers, emaciation, insomnia, and senile dementia etc. Clinical trials and animal research support the therapeutic use of ashwaganda for anxiety, cognitive and neurological disorders, inflammation, and Parkinson's disease. Ashwaganda'schemopreventive properties make it a potentially useful adjunct for the patients undergoing radiation and chemotherapy. Ashwaganda is also used therapeutically as an adaptogen for patients with nervous exhaustion, insomnia, and debility due to stress, and as an immune stimulant in patients with low white blood cell counts in blood. The major biochemical constituents of ashwaganda root are steroidal alkaloids and steroidal lactones in a class of constituents called withanolides.

i. Adaptogenic / Anti-stress effect

Ashwagandha is compared well with *Eleutherococcus senticosus* (Siberian Ginseng) and *Panax Ginseng* (Chinese / Korean Ginseng) in its adaptogenic properties, and hence it is popularly known as Indian Ginseng (Singh *et al.*,, 2010). The extensive studies on the biological model of animals for the adaptogenic / anti-stress properties of Ashwagandha (Abbas and Singh, 2006; Kalsiet *al.*, 1987; Singh *et al.*,, 1976, 1977, 1981, 1982, 1993a, 1993b, 2003; (Singh, 1995a, 1995b, 2006, 2008) have shown it to be effective in increasing the stamina (physical endurance) and preventing stress induced gastric ulcer, carbon tetrachloride (CCl₄) induced hepatotoxicity and mortality. Ashawagandha have similar anti-stress activity in rats (Archana&Namasivayam, 1999).

An aqueous suspension of Ashwagandha root was used at 100 mg/kg/oral dosage. The results indicate

a significant increase in the plasma corticosterone level, phagocytic index and avidity index in rats subjected to cold swimming stress. In the rats pretreated with the drug, these parameters were near control values and an increase in the swimming time was observed. These results indicate that *Withaniasomnifera* used in the crude form is a potent anti-stress agent. The results of above studies lend support to the hypothesis of tonics, vitalizers and rejuvenators of Ayurveda which indicate clinical use of *Withaniasomnifera* in the prevention and treatment of many stresses induced diseases like arteriosclerosis, premature ageing, arthritis, diabetes, hypertension and malignancy (Singh, 1986, 2005; Singh and Misra, 1993).

Effect on cortisol and ascorbic acid contents of adrenals

The cortisol content of adrenals was reduced significantly in animals subjected to 5 h constant swimming as compared to non-swimmer group. Pretreatment with WS prevented reduction of the cortisol content of adrenals. The ascorbic acid content was also reduced significantly after 5 h of swimming as compared to the animal of non-swimmer group. Pretreatment with WS prevent reduction in ascorbic acid content which occurs after swimming stress. Thus, *Withaniasomnifera* treatment prevents, decrease of adrenal cortisol and ascorbic acid which occurs due to swimming stress.

Anti-ulcerogenic effect

Ashwagandha was found to be useful in the prevention of stress-induced ulcers of the gastrointestinal tract (Singh *et al.*,. 1982). It showed significant protection against 18 h immobilization, cold + immobilization (4h) and aspirin induced gastric ulcers and lowered the mean ulcer index in rats.

Effect on leucocytosis

Ashwagandha given to a group of mice with milk injection produced reduction in leucocytosis.

Anabolic effects:

There was a significant increase in the body weights of the Ashwagandha treated group as compared to control for a period of 3 months in rats.

Acute toxicity studies

In acute toxicity studies the LD50 of *Withaniasomnifera* was found to be 1750 mg (p.o.) in albino mice.

Anti-tumor effect

Effect on Chinese Hamster Ovary (CHO) cells

Carcinoma *Withania* roots caused the inhibitory effect of about 49% on colony forming efficiency of CHO cells. It inhibits the cell growth and prevents the cell attachment. It induced long term growth inhibition of CHO cells which was dependent on the cell density and duration of Ashwagandha exposure (Sumantranet *et al.*,. 2007). This knowledge in turn will assist oncologists who plan to use the

Ashwagandha as ‘synergizers with conventional chemotherapy or radiation therapy.

Effect on Central Nervous System

Cognition Promoting Effect

Ashwagandha is a well known Ayurvedic Rasayana, and belongs to a sub-group of Rasayanas known as Medhyarasayanas. Medhya typically refers to the mind and mental/intellectual capacity. Thus, Medhya Rasayana like Ashwagandha, is used to promote intellect and memory. The cognition-promoting effect of Medhya Rasayanas is best seen in children with memory deficits, or when memory is compromised following head injury, or a prolonged illness and in old age (Singh and Udupa., 1993).

Effect on neurodegenerative diseases such as Parkinson’s, Huntington’s and Alzheimer’s diseases

In patients with Alzheimer’s disease, neuritic atrophy and synaptic loss (Dickon and Vicker, 2001) are considered the major causes of cognitive impairment, as based on the results of neuropathological post-mortem studies of the brain (Dekosky&Scheff, 1990). In the brains of patients suffering from other neurodegenerative diseases such as Parkinson’s disease, Huntington’s disease, and Creutzfeldt– Jakob disease, the atrophy of neurites has also been observed as a significant part of the etiology.

There are dozens of studies that show that Ashwagandha slows, stops, reverses or removes neuritic atrophy and synaptic loss. Therefore, Ashwagandha can be used to treat Alzheimer’s, Parkinson’s, Huntington’s and other neurodegenerative diseases at any stage of the disease, even before a person has been diagnosed and is still in the state of mild forgetfulness, etc.

Ashwagandha has been described as a nervine tonic (Singh *et al.* 1988, 1993) in Ayurveda and that is why it is a common ingredient of Ayurvedic tonic. Tonics, rejuvenators and vitalizers of Ayurveda appear to allay disease and induce immunity (Singh *et al.*, 1986) and longevity in the users.

Effect on Energy levels and Mitochondrial Health

The effect of Ashwagandha on glycosaminoglycan synthesis in the granulation tissue of carrageenin-induced air pouch granuloma was studied. Ashwagandha is shown to exert significant inhibitory effect on incorporation of ribosome -35S into the granulation tissue. The uncoupling effect on oxidative phosphorylation (ADP/O ratio reduction) was also observed in the mitochondria of granulation tissue. Further, Mg^{2+} dependent ATPase activity was found to be influenced by Ashwagandha. Ashwagandha also reduced the succinate dehydrogenase enzyme activity in the mitochondria of granulation tissue (Begum &Sadique, 1987).

Nootropic effect

Effects of sitoindosides VII-X and withaferin isolated from aqueous methanol extract of roots of cultivated varieties of WS were studied on brain cholinergic, glutamatergic and GABA ergic receptors

in rats. The compounds slightly enhanced acetylcholinesterase (AChE) activity in the lateral septum and globus pallidus, and decreased AChE activity in the vertical diagonal band. These changes were accompanied by enhanced M1-muscarinic-cholinergic receptor binding in lateral and medial septum as well as in frontal cortices, whereas the M2- muscarinic receptor-binding sites were increased in a number of cortical regions including cingulate, frontal, parietal, and retrosplinal cortex. The data suggest the compounds preferentially affect events in the cortical and basal forebrain cholinergic-signal transduction cascade.

The drug-induced increase in cortical muscarinic acetylcholine receptor capacity might partly explain the cognition-enhancing and memory-improving effects of WS extracts in animals and in humans (**R. Schliebs *et al.*, 1997**).

In a study by Zhao *et al.*, (**J. Zhao *et al.*, 2002**) Withanoside IV (a constituent of WS; the root of WS) induced neurite outgrowth in cultured rat cortical neurons. Oral administration of withanoside IV significantly improved memory deficits in Abeta-injected mice and prevented loss of axons, dendrites, and synapses.

In another study reserpine-treated animals also showed poor retention of memory in the elevated plus maze task paradigm. Chronic WS administration significantly reversed reserpine-induced retention deficits (**P.S. Naidu *et al.*, 2006**).

Potential Benefits of Leaves of Ashwagandha

Several recent studies have explored the potential of leaves of this plant for their therapeutic value as it offers several advantages over root such as their ecofriendly and bio-friendly base. There is no need to sacrifice the plant to prepare the extract, unlike root-based preparations. Additionally, recent reports have used **G. Kaure *et al.***, 419 water-based crude formulations of leaves as compared to root-based alcoholic extracts with an aim to scientifically validate the traditional use of Ashwagandha as an ayurvedic supplement. Moreover, the use of powder or water-based extract is convenient, safe and easy to prepare with no need to use organic solvents for extraction procedure.

Some Pre-clinical Studies on Ashwagandha Neuroplasticity is the ability of brain to synthesize and reorganize synaptic and neuronal connections in response to any environmental stimulus or injury. Neuroprotection is the event that leads to regeneration of damaged neurons or connections resulting in recovery of the neuronal function. Any compound that has the ability to confer neuroprotection can be classified as a neuroprotective agent. The neuroprotective and neuroplasticity-inducing potential of Ashwagandha has been explored in numerous *in vitro* and *in vivo* studies.

Similar effects of withanoside IV were observed with injured neurons wherein it enhanced synaptogenesis and neurite outgrowth in the brain (**Kuboyama *et al.*, 2006**). Tohda and **Kuboyama**

group (2000) investigated the effects of methanol extracts of Ashwagandha on neurite outgrowth using an in vitro culture system and found the neurite outgrowth-promoting activity of Ashwagandhamethanolic extract in human neuroblastoma SK-N-SH cells and rat cortical neurons.

Withanolide A, withanoside IV, and withanoside VI were identified as active constituents behind the neurite outgrowth promoting activity of the methanol extract (**Zhao *et al.* 2002; Kuboyama *et al.*, 2002**). They also studied the effect of these phytochemicals on an in vitro axonal atrophy and synaptic degeneration model established using an active partial fragment of A β such as A β 25–35. Each of these 3 compounds induced axonal growth and synaptic densities even in the presence of A β 25-35 in both in vitro and in vivo model of Alzheimer's disease (**Kuboyama *et al.*, 2005, 2006**).

Tohda and Joyashiki 2009; Joyashiki *et al.*, 2011). A novel compound “denosomin” an analogous derivative of sominone was synthesized by **Matsuya *et al.*, (2009)** and showed axonal growth activity comparable to sominone in cultured cortical neurons. Recently this group also investigated the effects of denosomin on spinal cord-injured mice and found that consecutive oral administration of denosomin for 14 d one hour after contusion injury at the L1 spinal cord facilitated axonal growth in the injured center and recovered hind limb motor function. Additionally, it was found that Vimentin-secreting GFAP-positive reactive astrocytes also increased in the injured center that helps in axonal growth and motor function recovery in spinal cord-injured mice (**Teshigawara *et al.*, 2013**)

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Any compound that has the ability to confer neuroprotection can be classified as a neuroprotective agent. The neuroprotective and neuroplasticity inducing potential of Ashwagandha has been explored in numerous in vitro and in vivo studies. In human neuroblastoma cell line, root extract of Ashwagandha increased the percentage of the neuronal population with significant neurite outgrowth in a dose-dependent manner.

The study demonstrated up regulation in the expression of synaptic and neuronal growth markers MAP2 (Microtubule-associated protein) and PSD95 (post synaptic density protein) (**Tohda *et al.*, 2000**) with the Ashwagandha treatment. Further, standardized dose of withanoside IV (steroidal saponin isolated from WS root extract) improved memory in Amyloid β (25–35) injected mice model of Alzheimer's disease.

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Ashwagandha: Modulator of Behavioral Plasticity

Both basic and clinical studies have explored the potential of this plant in improvement of physiological and cognitive functions of the body in wide range of neurological conditions. Ashwagandha is known for sleep inducing and memory enhancing potential among its diverse range of other biological roles.

Somnifera as the species name of the plant means sleep inducing. A recent study by **Manchanda et al., (2017)** reported the beneficial role of Ashwagandha in preventing memory dysfunction in acute sleep deprived (SD) Wistar rats.

Oral administration of semi-purified root extract of Ashwagandha predominant in withanolides and withanosides to transgenic mice model of Alzheimer’s disease has been shown to reverse behavioral deficits, and A β plaque pathology (**Sehgal et al., 2012**). The study proposed that Ashwagandha mediates its neuroprotective role by upregulation of liver LRP (lipoprotein receptor related protein) and targeted the periphery for clearance of A β .

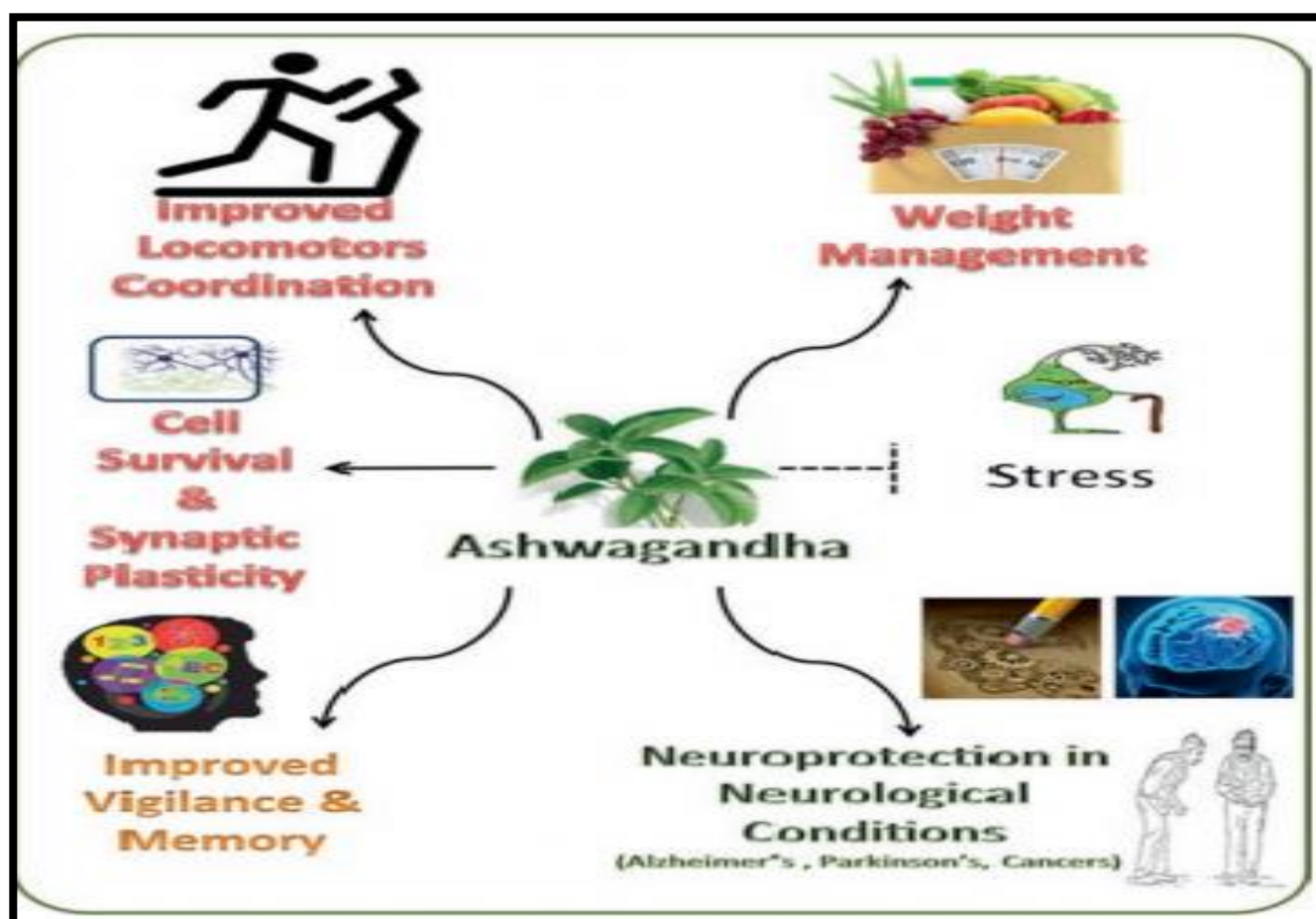
Methanolic extract of Ashwagandha applied in CA1 neurons of hippocampus region of brain was observed to exert a neuroprotective role in mice and may be important in process of memory (**Bhattarai and Han 2014**). The study reported that Ashwagandha causes activation of synaptic/extrasynaptic GABA (gammaAminobutyric acid) receptors type A, suggesting a link between WS mediated neuroprotection and GABA signaling. Ashwagandha has been known to promote overall health and vitality by exhibiting a pleiotropic action.

A randomized study reported the use of root extract of Ashwagandha as a precognitive agent used as an adjunct with the medication in bipolar patients (**Chengappa et al., 2013**). The study tested patients’

cognitive ability for different domains such as reaction time, social cognition and working memory and Ashwagandha extract appears to improve cognitive capacity in all three domains in bipolar patients. In addition, a clinical study by **Choudhary et al.**, (2015) has reported the efficacy of root extract of Ashwagandha in improving cardiac endurance and physical performance in a mixed population of athletic adults, thereby improving their quality of life. Another recent clinical study **G. Kaure et al.**, 423 has reported the efficacy of Ashwagandha root extract in improving muscle strength by exercise-based evaluation of muscle strength. The study proposed that extract supplementation reduces exercise-induced muscle injury by downregulating serum creatine kinase levels (**Wankhede et al.** 2015).

Role of *W. somnifera* in Anxiety

Many recent studies have investigated anxiolytic properties of *W. somnifera* in laboratory settings. The plant has been reported to curb anxious behavior in both rats (**Baitharu et al.**, 2013) and humans (**Chandrasekhar et al.**, 2012; **Khyati and Anup** 2013; **Pratte et al.**, 2014). Aqueous concentrate of roots of *W. somnifera* (commercially available from Dabur), after extraction with chloroform and spray drying, has shown anxiolytic properties in a dose-dependent manner (**Bhattacharya et al.**, 2000).



The graphical abstract depicting pleiotropic roles of Ashwagandha in neuroplasticity mediated by modulation of multiple pathways such as synaptic plasticity, cell survival, senescence/ apoptotic cell death. → indicates activation and —| indicates inhibition

The anxiolytic property of *W. somnifera* was similar to lorazepam, a drug belonging to benzodiazepines family of drugs that have been used for the treatment of anxiety disorders. The anxiolytic effect of this extract has been attributed to the GABA mimetic effect of glycowithanolides of the plant, which have been identified as withaferin and sitoindosides VII-X by HPTLC. Recently, pre-supplementation of hydro-alcoholic root extract of *W. somnifera* for 30 days (300 mg/kg body weight) in rats has shown improvement in behavioral deficits caused due to middle cerebral artery occlusion (MCAO) in model of ischemic stroke (**Sood et al., 2016**).

In a recent study by **Dey et al., (2016)**, a commercially available root extract of the plant with 2.7% (w/w) withanolides (Natural Remedies Pvt. Ltd., Bengaluru, India) has been shown to be instrumental in suppressing marble burying behavior in electric foot shock induced stress in mice. This activity has been attributed to phytochemicals other than withanolides that have been characterized in *W. somnifera* such as Withalongolide-A, an analogue of Withaferin-A (**Kumar et al., 2015**) and Withanamides (**Mirjalili et al., 2009**).

In another model of chronic stress, rats were given mild, unpredictable footshock, administered once daily for 21 days (**Bhattacharya and Muruganandam 2003**). Aqueous: ethanol (1:1) extract of two-year old thin roots of *W. somnifera* was further extracted with chloroform and was spray dried. The dry powder mixed in 0.3% carboxymethyl cellulose was used for the study. *W. somnifera* was administered one hour before footshock daily for 21 days. *W. somnifera* administered rats showed reduced levels of behavioral depression as evident from Porsolt's swim stress-induced behavioral despair test. Chronic stress led to significant increase in the immobility period and number of escape failures with decrease in number of avoidance response in the swim stress-induced behavioral despair test, but *W. somnifera* significantly reversed these effects in a dose-dependent manner owing to its adaptogenic properties.

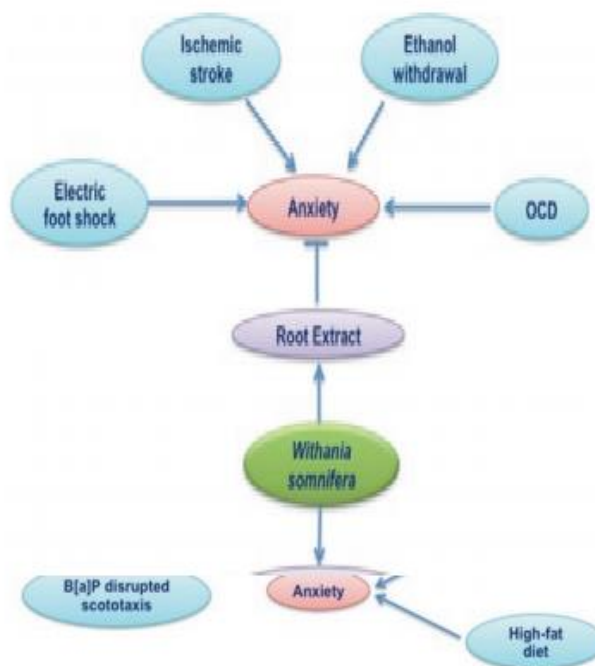


Fig. Root and leaf extracts of *W. somnifera* possess anxiolytic properties, which has been validated under different paradigms.

Role of *W. somnifera* in Inflammation Different pharmacological experiments both in vitro and in vivo models have demonstrated the ability of *Withania somnifera* to exhibit anti-inflammatory, antioxidative, anti-microbial, anti-anxiety, immunomodulatory activities lending support to the rationale behind its traditional uses.

Anbalagan and Sadique (1981) reported that *W. somnifera* is an effective anti-inflammatory agent with higher activity as compared with hydrocortisone, a commonly prescribed anti-inflammatory drug. In another study by **Anbalagan and Sadique (1984)**, *W. somnifera* was found to inhibit the α_2 -macroglobulin, an indicator of anti-inflammatory activity in dose dependent manner in serum of rats.

Begum and Sadique (1988) reported the effect of oral administration of *Withania somnifera* root extract before the injection of inflammatory agent.

Paw swelling and bony degenerative changes were seen in Freund's adjuvant induced arthritis. It was reported that this plant cause the significant reduction in both paw swelling and degenerative changes better than the reference drug, hydrocortisone.

A1-hindawi et al., (1992) also found that *W. somnifera* inhibited the granuloma formation in cotton pellet implantation in rats comparable to hydrocortisone sodium succinate treatment. **Sumantran et al., (2008)** evaluated the effects of *W. somnifera* roots aqueous extract and glucosamine sulphate (GlcS) on the levels of nitric oxide (NO) and GAGs secreted by the knee cartilage of chronic

osteoarthritis patients using validated explants model of in vitro cartilage damage.

7. Cultivation

In natural conditions *W. somnifera* occurs on disturbed soil, along roadsides, in cultivated land, on termite mounds in grassland, in open woodland and riverine vegetation, from sea level up to 2300 m altitude. It is grown in areas with 600- 750 mm annual rainfall and prefers well drained soil; water logging is harmful (**Patra et al., 2004**). It grows well in sandy loams and stony red clay soils with pH 7.5-8.0 (**Thomas et al., 2000**). However, Obidoska and Sadowska (2003) suggested the preference of the species to acidic soil. It thrives in full sun but tolerates some shade (**PROTA 2008**).

Patra et al., (2004) suggested that the species is a rainfed crop requiring dry season (1-2 winter rains are conducive for root development) and grows well in semi-arid subtropical areas receiving good rainfall. The species can be cultivated between 600-1200 m altitudes. **Misra et al., (2001)** suggested that *W. somnifera* is a potential cash crop greening dry-land zones and making waste land more productive. **Das et al., (2009)** successfully cultivated 'Poshita' and 'Jawahar 22' (recommended varieties) in West Bengal plains (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur campus).

Soil for *Withania Somnifera*

Ashwagandha is usually grown in fields which are not well covered by the irrigation systems. This is due to requirement of dry season during its growing period. The field on which food crops cannot be taken profitably due to lack of irrigation facilities may be used for Ashwagandha cultivation. Ashwagandha grows well in sandy loam or light soil or black soil, having pH 7.5-8.0 with well Drainage.



Fig. Soil

Climate for *Withania somnifera*

Ashwagandha requires relatively dry season during its growing period, because, Ashwagandha is rainfed crop. Rainfall requirements is 650-750 mm is suitable for *Withania somnifera* cultivation. A temperature requirement of Ashwagandha is 20°C to 35°C are ideal for Ashwagandha growth. This crop even tolerates temperatures as low as 10°C. Late winter rains are conducive for the proper development of the plant roots. That's why the root of ashwagandha develops to their full strength after 1-2 late winter seasons.

Land Preparation

During land preparation the soil is nourished with plenty of organic matter while the manures or composts must be well decayed and should not have any city waste or human excreta. Around 10-20 tons/ha of farm yard manure (FYM) be supposed to be combined to the soil during last ploughing moment and then field is leveled by planking.

Propagation

Propagation of Ashwagandha is commonly done by the seeds. The crop can be directly sown either by broad casting or line sowing. Line to line method of sowing is preferred because it increases root production and also helps in performing intercultural operation properly. Row to Row spacing of 25 to 30 cm and Plant to Plant spacing is 10 cm. and transplanting is also a viable option for Ashwagandha cultivation. In this method, time of sowing is just before the onset of the rainy season the seeds are sown in the nursery @ 5kg/ha and covered with light soil. These seeds will germinate within 6-7 days after sowing. When seedling attain the age of 25-35 days then it should be transplanted in the main field with marinating spacing of 60 x 60 cm. Seed rate: For sowing, 10-12 kg/ha seed is sufficient.

Nursery Managements

High quality and disease-free seeds should be selected and sown in well prepared nursery beds. Transplanting method is preferred for better quality for *Withania somnifera* cultivation. About 5 kg of seeds is required for planting in one hectare land of main field. Nursery should be raised in the month of June and July and about 35 to 40 days old seedlings can be transplanted in the main field.



Fig. Seedling of Ashwagandha

Manure and Fertilizer Application

The medicinal plants have to be grown without chemical fertilizers by using organic manures like, Farm Yard Manure (FYM), Vermicompost; Green Manure etc. may be used as per requirement of the species. Ashwagandha need only (10-12 tons/ha) of well decomposed farm yard manure (FYM). Or 1-1.5 ton vermicompost per 1 hectare plantation. But in recent times, fertilizer have to apply on soil test value for keeping the optimum plant population in marginal land (poorly fertile land). In this case, additionally NPK @ 20:20:0 kg/ha is used as nutrition for the Ashwagandha plants.

Pest and Diseases Management of *Withania somnifera*

Seed rotting, seedling blight and leaf blight are common diseases affecting Ashwagandha. And Aphids, Mites, insect attack and Seedling rot and blight. However, there is no serious pest found in these crops.

By spraying Dithane M-45@ 3g/l at the interval of 7-10 days can be minimized and Bio- pesticides could be prepared from Neem, Chitrakmool, Dhatura and Cow's urine and crop rotation, having proper soil drainage will reduce the impact of any diseases.



Fig. Pest and Disease of Ashwagandha

Harvesting of *Withania somnifera*

The Ashwagandha plants start flowering and bearing fruits from December onwards. The crop is ready for harvest in January-March at 150 to 170 days after sowing. The maturity of crop is judged by drying out of leaves and yellow red berries/fruit. The entire plant is uprooted along with roots.





Fig. Harvesting of Ashwagandha Plants

Post Harvest

After harvesting, the roots are separated from aerial parts by cutting the stem 1-2 cm above the crown with the help of knife and then it is washed. The roots are then cut transversely into small pieces (7 to 10 cm) and dried in the sun or shed with up to 10-12 % moisture content, the dried roots have to be further cleaned, trimmed and graded; the berries plucked from the dried plants are threshed to obtain the seeds.





Fig. Cleaning and washing

Grading

On the basis of length and girth of root pieces, Ashwagandha are sorted out into following grades:

A grade: Root pieces up to 7 cm in length, 1-1.5 cm in diameter, solid cylindrical with smooth external surface and pure white from inside.

B grade: Root pieces up to 5 cm in length, 1 cm or less in diameter, solid, brittle and white from inside.

C grade: Solid root pieces up to 3-4 cm in length, 1 cm or less in diameter.

D grade: Small root pieces, semisolid or hollow, very thin, yellowish inside and < 1 cm in diameter.

DISCUSSION

Ashwagandha traditionally was used as a rejuvenative tonic for both children and the elderly. It grows in various parts of the world and is readily available, easy to store, and easy to formulate. It is one of the most utilized plants in Ayurvedic medicine and the most studied rasayana. Ashwagandha is widely accepted to be safe though would benefit from further systematic research into the safety profile. It is best administered as a churna mixed with ghee, milk or honey but other formulations are also effective. Standard dosages vary with the most common being 1-2 grams, three times per day. Ashwagandha is formally classified as an adaptogen. The primary pharmacological effect is derived from the roots which contain withanoloids and are attributed with giving the plant its impressive versatility. It is known as the “Indian Ginseng” and may be widely applied to many disorders and imbalances. Most recently it has been studied in the areas of oncology, both for tumor reduction and as a tonic post-chemotherapy, and in the area of neurodegenerative disorders. Ashwagandha’s unique properties and the many animal studies performed to date point positively to the fact that it acts as both a neuro-protective agent and as a neuro-regenerator. Human studies in the therapeutic area of

neurodegenerative disorders are very limited and further research is needed.

CONCLUSION:

Withania somnifera commonly known as Ashwagandha in Ayurveda medicine possesses numerous pharmacological activities supported by experimental and clinical studies. Further studies will enhance the support of its multifarious action on living organisms.

As modern medicine continues to expand, so do the uses of botanical medicines. *Withania somnifera* shows great potential as a safe and effective in Immunomodulation and Hematopoiesis. More research is needed to determine if *Withania somnifera* can duplicate this activity in humans, and to determine an optimal dosage range for achieving these effects. The potential beneficial effects of *Withania* in anxiety, cognitive and neurological disorders, inflammation, and Parkinson's disease. Experienced natural medicine practitioners, working hand-in-hand with oncologists, could increase effectiveness and decrease side effects of conventional treatments with the use of *Withania somnifera*.

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SILENCE, SECRETS, AND THE FRAGMENTATION OF HUMAN RELATIONSHIPS IN THE KITE RUNNER

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Abstract:

Khaled Hosseini's *The Kite Runner* explores guilt, redemption, and complex human relationships, with secrets and silences at its core. The withholding of truth drives emotional distance and distrust, leading to fractured identities and broken relationships. Hosseini examines the consequences of unspoken words, showing how suppressed truths cause relational decay. However, he also highlights the potential for healing through the eventual revelation of these hidden truths. This paper examines the themes of silence, secrets, and the breakdown of relationships in Khaled Hosseini's *The Kite Runner*. It explores how unspoken truths and hidden guilt, such as Amir's betrayal of Hassan and Baba's concealed paternity, lead to the erosion of trust, emotional isolation, and psychological suffering. The suppression of truth acts as a catalyst for relational disintegration, but the eventual revelation of these secrets, though painful, is essential for redemption and healing. The study highlights the broader impact of silence and secrecy on identity, power dynamics, and the potential for forgiveness in personal and societal contexts.

Keywords: Silence and secrecy, Hidden truths, Betrayal and loyalty, Relational breakdown.

Introduction

Khaled Hosseini is a novelist who is basically renowned for carrying the tragedy of Afghanistan's miseries in his writings. His first novel *The Kite Runner* depicts the same circumstances for which the writer is commonly popular. This novel basically narrates the emotional life sufferings of two friends named Amir and Hassan. The most important thing about this creation is that it takes the reader right into the soil of Afghanistan and makes them feel the same immense pain which the characters of this novel suffer through their life. This fictional work deals with the major real incidents of Afghanistan, in which fall down of monarchy, Soviet Union's invasion and the persecution of refugees are boldly mentioned. For the better understanding of this work one must go through its title.

Khaled Hosseini's *The Kite Runner* is a compelling narrative that delves into complex human emotions, exploring guilt, redemption, and the impact of secrets and silence on personal relationships. At its heart, the novel revolves around the effects of unspoken truths, with these hidden elements serving as the catalyst for relational fragmentation. The book's central characters—Amir, Hassan, Baba, and others—navigate their interpersonal relationships with varying degrees of secrecy, silence, and guilt, leading to the gradual disintegration of trust, intimacy, and emotional connection. This paper examines the themes of silence, secrets, and the breakdown of relationships in *The Kite Runner*, focusing on how unspoken truths and hidden guilt, such as Amir's betrayal of Hassan and Baba's concealed paternity, erode trust and foster psychological suffering. The eventual revelation of these truths, though painful, becomes essential for redemption and the potential restoration of broken relationships.

The research article has been written using qualitative methodology for which some secondary sources like journals and books have been used for appropriate references. The research methodology is used in such a way so that some in depth themes could get highlighted as per the reader's convenience. An effort has also been given to introduce the reader with some innovative thoughts which are present in the depth of this novel.

The objectives of this paper are to examine the role of silence and secrets in driving the plot and shaping the relationships in Khaled Hosseini's *The Kite Runner*, focusing on how the concealment of truth leads to emotional and psychological consequences. It aims to explore the breakdown of relationships, particularly how unspoken truths—such as Amir's betrayal of Hassan and Baba's hidden paternity—cause emotional isolation and relational fragmentation. Additionally, the paper seeks to analyze the psychological impact of suppressed guilt on key characters like Amir and Baba, highlighting their internal conflicts. Another objective is to investigate how silence and secrecy influence identity and power dynamics, particularly within the context of ethnic and social hierarchies in Afghanistan. The study also aims to assess the role of truth in facilitating redemption and healing, demonstrating how the painful revelation of secrets becomes crucial to repairing damaged relationships. Finally, the paper seeks to connect these personal struggles with larger societal themes, reflecting on how individual silences mirror broader issues of power and inequality in Afghan society. The novel opens with Amir reflecting on his childhood in Kabul, a time overshadowed by his friendship with Hassan and a secret that would forever alter their lives. The inciting incident in the novel is Amir's failure to intervene during Hassan's assault by Assef. Amir says, "I watched Hasan get raped". I said to no one... A part of me was hoping someone would wake up and hear, so I wouldn't have to live with lie anymore" (*The Kite Runner* 190). Aryan Bammi provides important information

about this aspect in which the concept of betrayal is clearly stated. “Amir did not defend Hassan. He did not save Hassan. He betrayed their friendship” (Bammi 77). This moment marks the beginning of Amir’s psychological torment, rooted in his decision to stay silent. Amir’s guilt over his silence festers, straining his relationship with Hassan and leading him to further betray his friend by framing him for theft. This silence—both in the immediate aftermath of the assault and later when Amir fails to confess to Baba—symbolizes Amir’s inability to confront his own moral failings, creating an emotional chasm between him and those closest to him.

Silence functions as a barrier in *The Kite Runner*, preventing reconciliation and understanding. In Amir’s case, his silence distances him not only from Hassan but also from his father, Baba. Baba, too, carries his own secret: Hassan is his illegitimate son. This truth remains hidden from Amir and Hassan throughout their childhood, contributing to the complex and strained dynamics within the family. Baba’s silence, motivated by shame and fear of societal repercussions, fractures his relationships, particularly with Amir, who feels he can never live up to his father’s expectations. Both Baba and Amir embody the destructive power of secrets, with their silences creating a legacy of pain and mistrust.

The emotional toll of secrets and suppressed guilt is one of the most powerful undercurrents in *The Kite Runner*. For Amir, his betrayal of Hassan becomes the defining moment of his life, haunting him into adulthood. His guilt manifests in psychological isolation, as he feels unworthy of love and incapable of forming genuine connections. Amir’s inability to speak the truth not only alienates him from others but also from himself. He suppresses his guilt, refusing to confront the moral implications of his actions, and instead, tries to erase Hassan from his life by sending him away. However, the deeper Amir tries to bury his guilt, the more it consumes him, resulting in profound emotional suffering.

Baba, too, suffers from the burden of his concealed paternity. His decision to keep Hassan’s true parentage a secret stems from the fear of societal backlash, but the cost of this silence is emotional distance from both his sons. Baba’s inability to acknowledge Hassan as his son parallels Amir’s own silence regarding Hassan’s assault, with both characters being complicit in relational disintegration through their failure to confront painful truths. The novel portrays the psychological consequences of these silences, suggesting that unacknowledged guilt is a poison that festers over time, slowly eroding the individual’s capacity for emotional connection.

Silence and secrecy also play a significant role in shaping the characters’ identities and the power dynamics in their relationships. In the case of Hassan, his position as a Hazara servant in Amir’s household places him in a vulnerable position, exacerbated by Amir’s silence. Ramatjanovna indicates

that “Baba belongs to an honorable ethnic group Pashtun, whereas Hassan is related to the lowest rank of their society Hazara” (Ramatjanovna 32). Hassan’s loyalty and love for Amir remain unshaken, despite Amir’s betrayal, reflecting a power imbalance that Amir exploits. The silence surrounding Hassan’s true parentage reinforces his subservient position within the household, depriving him of the agency to reclaim his rightful place in Baba’s family. Amir’s guilt over his betrayal of Hassan is compounded by the fact that he, as a Pashtun, occupies a higher social and ethnic status than Hassan. This dynamic underscores the broader themes of power and privilege in the novel. Amir’s silence is not only a personal failing but also reflects the societal structures that enable the marginalisation of Hazaras like Hassan. The silence around ethnic and class hierarchies in Afghan society mirrors the personal silences that tear apart the relationships in the novel. Hosseini thus connects the personal consequences of secrecy with the broader societal dynamics of power and exclusion.

The second-best thing which occurs in this novel related to humanism is the act of Amir in which he takes Sohrab to America with him, it’s a kind of humanistic legacy which he gets from his Baba and follows for his rest of life. And all the human relations and kindness sounds speechless in the end of this novel when Sohrab gets a safe home with Amir but was still in trauma for the sufferings he suffered in his motherland when no one was there to show him empathy. His traumatic situation could be understood from the lines “Sohrab’s silence wasn’t the self-imposed silence of those with convictions, of protestors who seek to speak their cause by not speaking at all. It was the silence who has taken cover in a dark place, curled up all the edges and tucked them under.” (320). The silence of Sohrab narrates that dark journey which he did all alone in the molestation camps of Taliban. Who knows how many times he was thrashed and ripped by his soul? Actually the wounds he had on his soul were the actual cause of his silence. Despite the devastation wrought by silence and secrets, *The Kite Runner* also emphasizes the potential for healing and redemption through the painful process of truth-telling. For Amir, the journey toward redemption begins when he returns to Afghanistan and learns the truth about Hassan’s parentage. This revelation forces Amir to confront not only his past betrayal but also the lies and secrets that have shaped his entire life. The truth is painful, but it is also liberating, allowing Amir to take steps toward atonement by rescuing Hassan’s son, Sohrab, and offering him a chance at a better life.

The novel suggests that while the suppression of truth can lead to relational decay, the revelation of hidden truths, though difficult, is essential for healing. Baba’s failure to acknowledge Hassan as his son led to years of emotional distance, but Amir’s willingness to confront the truth, however late, offers a possibility for redemption. In rescuing Sohrab, Amir symbolically redeems his relationship with Hassan and repairs the damage caused by years of silence. The act of truth-telling, while painful,

becomes the first step toward restoring trust and intimacy.

Conclusion

In *The Kite Runner*, Khaled Hosseini presents a powerful exploration of the consequences of silence and secrets on human relationships. The novel demonstrates how unspoken truths and hidden guilt erode trust, create emotional distance, and lead to psychological suffering. Amir's betrayal of Hassan, Baba's concealed paternity, and the silence that permeates their lives all contribute to the fragmentation of their relationships. However, Hosseini also highlights the potential for healing through the eventual revelation of these painful truths. The novel ultimately suggests that while secrets and silence can destroy relationships, redemption and forgiveness are possible through the painful but necessary process of truth-telling. In doing so, *The Kite Runner* reflects on the broader implications of silence and secrecy, not only within personal relationships but also within the larger context of societal power dynamics.

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RE-IMAGINING SOCIOLOGICAL RESEARCH: TRENDS, CHALLENGES, AND OPPORTUNITIES

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Abstract:

Sociological research is at a crossroads, facing both challenges and opportunities in a rapidly changing world. This article explores the current trends, challenges, and opportunities in sociological research, highlighting the need for innovation and reinvention. We discuss the impact of technological advancements, interdisciplinary approaches, and the increasing demand for sociological expertise in addressing complex social issues. Additionally, we examine the challenges posed by the COVID-19 pandemic, the rise of big data, and the need for more diverse and inclusive research practices. Finally, we outline potential opportunities for re-imagining sociological research, including the development of new methodologies, the integration of art and science, and the cultivation of public engagement and outreach.

Keywords: Innovation, Reinvention, Technological advancements, Sociological expertise, Big Data, Diverse and Inclusive research practices

Introduction:

Sociological research has long been a vital tool for understanding and addressing complex social issues. However, the field is currently facing a range of challenges and opportunities that require innovation and reinvention. This article explores the current trends, challenges, and opportunities in sociological research, with a focus on the need for reimagining the field in response to changing social, technological, and political contexts.

Trends:

1. Technological advancements:

The use of technology in sociological research has transformed data collection, analysis, and dissemination. Online surveys, social media analysis, and digital ethnography are some examples of how technology is being used to study social phenomena.

2. Interdisciplinary approaches:

Collaboration between sociologists and scholars from other fields, such as psychology, anthropology, and philosophy, is becoming increasingly common. This interdisciplinary approach enables a more comprehensive understanding of complex social issues.

3: Demand for sociological expertise:

Sociologists are being called upon to provide expertise in areas like policy-making, business, and healthcare, demonstrating the growing recognition of the value of sociological research in addressing real-world problems.

Challenges:

1. **COVID-19 pandemic:** The pandemic has highlighted the need for sociological research to address pressing social issues, but has also posed significant challenges for data collection and fieldwork.
2. **Big data:** The rise of big data has created new opportunities for sociological research, but also raises concerns about privacy, ethics, and the potential for bias.
3. **Diverse and inclusive research practices:** The field of sociology has historically been criticized for its lack of diversity and inclusivity, and there is a growing recognition of the need for more diverse and inclusive research practices.

Opportunities:

1. **New methodologies:** The development of new methodologies, such as digital ethnography and social network analysis, has opened up new possibilities for sociological research.
2. **Integration of art and science:** The increasing recognition of the importance of art and creativity in sociological research has led to new opportunities for innovation and collaboration.
3. **Public engagement and outreach:** The growing demand for sociological expertise has created new opportunities for public engagement and outreach, and the need for sociologists to communicate their research to broader audiences.

Conclusion:

Sociological research is at a crossroads, facing both challenges and opportunities in a rapidly changing world. This article has highlighted the need for innovation and reinvention in the field, and outlined potential opportunities for reimagining sociological research. By embracing new methodologies, interdisciplinary approaches, and public engagement, sociologists can help to address the complex social issues of our time and ensure that the field remains relevant and vibrant in the years

to come.

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Exploring Single-Server Retrial Queueing Models: A Comprehensive Review of Batch Arrivals and Vacation Dynamics

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Abstract

This review presents a comprehensive analysis of single-server retrial queueing models, focusing on the critical aspects of batch arrivals and vacation dynamics. Retrial queues are vital in service systems where customers may need to reattempt service after an initial failure, making them relevant in various practical applications. The study emphasizes the significance of understanding how batch arrivals affect server behavior and system performance, particularly regarding congestion and waiting times. Additionally, the review explores the implications of server vacations, which further complicate the dynamics of retrial queues by introducing periods of unavailability. The main contributions of this review include a detailed examination of queue length and waiting time distributions, the development of mathematical modeling techniques, and the integration of insights from existing literature. By synthesizing key findings and methodologies, this review aims to provide a foundational understanding of the complex interactions in retrial queueing systems, offering valuable implications for future research and practical implementations.

Keywords: Single-server retrial queues, batch arrivals, vacation dynamics, queue length.

1. Introduction

Retrial queueing systems are a specialized class of queueing models designed to capture the behavior of customers who cannot be served immediately upon arrival and must wait before attempting to access the server again. In these systems, customers that find the server busy do not simply leave; instead, they enter a retrial orbit, where they wait for a specific period before making another attempt to receive service. This behavior is particularly relevant in various real-world contexts, such as telecommunications, where calls may be blocked or busy, and customers must retry later, or in customer service environments like call centers, where agents may be occupied. The dynamics of retrial queueing systems can significantly differ from those of traditional single-server queues due to the additional complexities introduced by retrial behavior. Understanding the dynamics of batch arrivals within retrial queueing systems is crucial. Batch arrivals occur when multiple customers arrive at the system simultaneously, which can lead to sudden increases in demand for service.

This situation presents unique challenges for system performance, as larger groups of customers can exacerbate congestion, leading to longer waiting times and increased queue lengths. Modeling batch arrivals helps researchers and practitioners assess how varying batch sizes affect the overall performance of the queue, allowing for better predictions and management of service capabilities. Moreover, the behavior of customers within the retrial orbit can also be influenced by batch arrivals, necessitating the need for accurate mathematical modeling to reflect these interactions. In addition to batch arrivals, the phenomenon of server vacations adds another layer of complexity to retrial queueing systems. Server vacations refer to periods when the server is temporarily unavailable, whether due to scheduled breaks, maintenance, or unforeseen circumstances. During these vacation times, customers who are already in the queue cannot receive service, leading to potential increases in waiting times and overall system congestion.

The interaction between server vacations and retrial behavior must be considered to accurately capture the system's performance metrics. Understanding how vacation dynamics affect customer behavior and system performance is essential for effective operational management and resource allocation. Retrial queueing systems are vital for accurately modeling many real-world service scenarios. The interplay between batch arrivals and server vacations can significantly influence the system's efficiency and customer satisfaction. Therefore, developing robust models that incorporate these factors is essential for optimizing service delivery in various applications, including telecommunications, healthcare, and customer service industries. This background lays the foundation for a comprehensive exploration of performance measures within retrial queueing systems, focusing on the effects of batch arrivals and vacation dynamics.

2. Literature Review

The exploration of retrial queueing systems has garnered significant attention in recent years, particularly with respect to their complex dynamics involving customer behaviors, service interruptions, and system performance metrics. This literature review synthesizes key findings from recent studies focusing on various aspects of retrial queues, including non-Markovian dynamics, performance comparisons using different modeling techniques, and the effects of server vacations. Kalaiselvi and Saravanarajan (2024) delve into non-Markovian dynamics by analyzing a single-server retrial queue that incorporates recurrent clients and balking behavior, specifically under extended Bernoulli vacations.

Their stochastic analysis highlights the intricacies of customer behavior in response to server availability and illustrates how vacation policies impact overall system efficiency. This work emphasizes the need for comprehensive models that account for the non-exponential inter-arrival and

service time distributions, which are often present in real-world applications. Liu, Xu, and Liu (2024) contribute to the understanding of retrial queues by examining parallel customer arrivals and standby server configurations. Their methodology analyzes various strategies that can enhance service efficiency and reduce customer waiting times. The findings suggest that incorporating parallel service mechanisms in retrial systems can significantly improve performance metrics, thereby offering valuable insights for the design of more resilient service infrastructures. Aarthi (2024) compares the performance of fuzzy queuing models against intuitionistic fuzzy queuing models within the context of single-server retrial queues. This comparative analysis demonstrates the strengths of fuzzy logic in handling uncertainties related to customer behavior and service disruptions. The study illustrates that fuzzy models can provide a more nuanced understanding of queue dynamics, particularly in environments where traditional probabilistic approaches may fall short.

The comprehensive literature review by Mathavavisakan and Indhira (2024) on retrial queueing systems with Bernoulli vacations reveals a growing body of research focused on vacation policies. This review outlines various modeling approaches and their implications for system performance, highlighting how vacation strategies can influence queue length and waiting time distributions. By synthesizing existing research, the authors provide a valuable framework for understanding the interplay between server availability and customer behavior in retrial systems. Saravanan et al. (2023) extend this discussion by analyzing a multi-server retrial queueing system characterized by unreliable servers, discouragement factors, and vacation policies. Their performance analysis illustrates the challenges posed by server unreliability and how vacation dynamics can exacerbate congestion in the system. This work emphasizes the importance of considering multiple factors that affect service delivery in complex environments. Dimitriou (2023) introduces a novel perspective by studying a single-server retrial queue with event-dependent arrival rates. This approach allows for the modeling of varying customer arrival patterns, reflecting real-world scenarios where demand fluctuates based on specific events. The findings underscore the significance of adaptability in queueing models to capture dynamic customer behaviors effectively. Wang et al. (2023) investigate the strategic interactions of customers in a single-server retrial queue characterized by noncooperative and cooperative joining strategies.

Their research highlights how different policies, including N-policy and multiple server vacations, can affect customer decisions and overall system performance. The results suggest that cooperative strategies may lead to improved outcomes for both customers and service providers. Sanga and Jain (2022) propose a fuzzy model for a single-server double orbit retrial queue, emphasizing the role of fuzzy logic in capturing customer behavior across multiple orbits. Their model provides a

comprehensive framework for analyzing service dynamics in more complex scenarios, where customers may enter different service paths based on their experiences. The literature on retrial queueing systems reveals a diverse range of approaches and methodologies that enhance our understanding of customer behavior, service dynamics, and performance optimization. The interplay between batch arrivals, server vacations, and various customer strategies continues to be a focal point for research, offering significant implications for the design and management of service systems across various industries. Future research should further explore the integration of advanced modeling techniques to address the complexities of real-world service environments.

3. Model Formulation and Assumptions

3.1 General Structure of Retrial Queues

In retrial queueing systems, the general structure revolves around a scenario where customers arrive to receive service from a single server. These systems are unique in how they handle situations when the server is busy. Unlike traditional queueing models where customers wait in line, in a retrial queue, customers who arrive to find the server occupied do not form a typical waiting queue. Instead, they enter what is called a "retrial orbit," a virtual holding area where they wait for an opportunity to retry for service after some time. This feature of retrying differentiates retrial queues from more conventional models. The server in this type of system alternates between different states: idle, busy, or on vacation. When the server is idle, it is immediately available to serve any arriving customer. If it is busy, customers are directed to the retrial orbit. The retrial process is an essential part of the system's dynamics, where customers make independent attempts to access the server after waiting for a random amount of time. In some models, the server also takes scheduled or random vacations, during which it is unavailable for service. This adds another layer of complexity, as customers not only compete with each other to get service but must also account for times when the server is on break.

In terms of arrivals, retrial queueing systems can also model batch arrivals, where multiple customers arrive simultaneously. The batch size might follow a specific probability distribution, such as Poisson or geometric. If the server is free when a batch arrives, customers are served one by one. However, if the server is busy, the entire batch (or sometimes individual customers from the batch) enters the retrial orbit, further increasing the number of retries needed before service can be completed. The retrial process is governed by a probability distribution, typically exponential, that determines when customers retry for service. This general structure of retrial queues, involving customers being directed to the retrial orbit when the server is busy and retrying for service, forms the basis for analyzing complex queueing models. The retrial and vacation dynamics introduce unpredictability and impact key performance metrics, such as waiting times and queue lengths, making the study of these systems

highly relevant in fields like telecommunications and manufacturing where these behaviors are common.

- **Arrival Process (Batch Arrivals)**

The batch arrival process be modeled as a Poisson process with rate (λ) . The size of the arriving batch is a random variable (B) with probability distribution:

$$P(B = k) = p_k \quad k = 1, 2, \dots$$

The average batch size can be given as:

$$E[B] = \sum_{k=1}^{\infty} k \cdot p_k$$

This describes that on average $(E[B])$ customers arrive at a time.

- **Service Process**

Let the service times be independent and identically distributed (i.i.d.) with an exponential distribution.

If the service rate is denoted by (μ) , the service time (S) follows:

$$P(S \leq t) = 1 - e^{-\mu t} \text{ for } t \geq 0$$

Here, μ is the service rate, which represents the speed at which the server completes service for one customer.

- **Retrial Process**

Customers that find the server busy are sent to the retrial orbit. The retrial times are assumed to be exponentially distributed with rate (θ) , meaning that each customer in the orbit attempts to access the server after a random time:

$$P(\text{Retrial time} \leq t) = 1 - e^{-\theta t} \text{ for } t \geq 0$$

Here, θ is the retrial rate, determining how frequently a customer retries for service.

Vacation Process

The server may take vacations, which follow an exponential distribution. Let V denote the length of the vacation with rate v :

$$P(V \leq t) = 1 - e^{-vt} \text{ for } t \geq 0$$

Here, v is the vacation rate, indicating how long the server remains unavailable for service during a vacation.

- **System State**

Let $X(t)$ be the state of the system at time t , where:

$X(t) = 0$ if the server is idle,

$X(t) = 1$ if the server is busy serving a customer,

$X(t) = 2, 3, \dots$ for the number of customers in the retrial orbit.

The probability that there are n customers in the system at time t is denoted by $P_n t$.

3.2 Assumptions

In modeling a single-server retrial queue with batch arrivals and vacation dynamics, certain assumptions are made to simplify and structure the system's behavior. These assumptions relate to batch size distribution, retrial rate, vacation dynamics, and service time distributions, which are essential in formulating the queue's performance.

- **Batch Size Distribution:** It is assumed that customers arrive in batches, where the size of each batch is a random variable, denoted as B . The batch size follows a specified probability distribution $P(B = k) = p_k$, where k represents the number of customers in the batch, and p_k is the probability that a batch contains k customers. For simplicity, the batch size could follow common distributions such as Poisson, geometric, or binomial, depending on the system being modeled. The expected batch size is denoted by $E[B]$, which helps in determining the arrival load on the system.
- **Retrial Rate:** Customers who find the server busy upon arrival do not queue in the conventional sense but enter a virtual waiting area (the retrial orbit). It is assumed that customers in this orbit make independent attempts to retry for service after some random time. The time between retries is exponentially distributed with parameter θ , where θ represents the retrial rate, governing how frequently a customer retries to access the server. This exponential assumption simplifies the analysis of retrial behavior, as the memoryless property of the exponential distribution is useful in deriving system dynamics.
- **Vacation Dynamics:** The server is allowed to take vacations, which are periods during which it is unavailable for serving customers. It is assumed that vacation times follow an exponential distribution with parameter ν , where ν is the vacation rate. This means that the duration of the server's vacation is random but follows the exponential distribution. During vacation periods, arriving customers are either sent to the retrial orbit or must wait until the server returns. The server's vacations could be modeled as single or multiple vacations, and the length of each vacation is assumed to be independent of the others.

- **Service Time Distributions:** The service time for each customer is assumed to be an independent and identically distributed random variable following an exponential distribution with rate μ . This means that the time a customer spends being served by the server is memoryless and random, and its probability distribution is:

$$P(S \leq t) = 1 - e^{-\mu t} \text{ for } t \geq 0$$

Here, μ is the service rate, determining the speed at which the server processes each customer. Exponential service times are a standard assumption in queueing theory as they allow for tractable mathematical analysis.

4. Analysis of Performance Measures

In retrial queueing systems, understanding the performance of the system under various conditions is critical. The key performance measures include queue length, waiting times, server utilization, and the probability that the server is idle or busy. This section focuses on analyzing these measures to assess system behavior, particularly under the influence of retrial dynamics, batch arrivals, and server vacations.

4.1 Queue Length Distribution

Queue length distribution is one of the fundamental performance measures in any queueing system, as it reflects the number of customers in the system at any given time, including both those waiting in the retrial orbit and those being served. In retrial queueing systems with batch arrivals and vacation dynamics, the queue length distribution is more complex than in traditional queueing models due to the unique behaviors associated with retries and the server's unavailability during vacations.

4.1.1 Analytical Methods for Calculating Queue Length in Retrial Systems

To calculate the queue length distribution in retrial systems, analytical methods such as Markov chains, probability generating functions (PGF), or balance equations are employed. These methods take into account the stochastic nature of customer arrivals, retrial attempts, service times, and server vacations. The goal is to determine the steady-state probability distribution P_n , which represents the probability that there are n customers in the system at a given time. In the context of a retrial queue with batch arrivals, the arrival process is modeled as a Poisson process with batch size distribution. For each batch, customers either enter service (if the server is idle) or are sent to the retrial orbit (if the server is busy). Customers in the retrial orbit retry for service after an exponentially distributed time. The queue length distribution can be found by solving the system's Kolmogorov forward equations (also known as balance equations), which describe the transitions between different states of the system, such as

moving from a state where n customers are present to a state with $n+1$ or $n-1$ customers.

For instance, the balance equations take into account:

By solving these balance equations, typically using generating functions or numerical methods, the steady-state probabilities P_n for each possible queue length n are obtained. Once the queue length distribution is known, other performance metrics like average queue length, waiting times, and system utilization can be derived. The general form of the balance equations is given by:

$$\begin{aligned}\lambda P_0 &= \mu P_{n+1} + \theta P_v \text{ for } n \geq 1 \\ (\lambda + \mu) &= \mu P_{n+1} + \theta P_r \text{ for } n \geq 1\end{aligned}$$

Where:

P_v is the probability that the server is on vacation.

P_r is the probability that a customer retries from the orbit.

P_n represents the probability of n customers in the system.

Probability Generating Function (PGF)

To simplify the analysis, we use the probability generating function (PGF) for the queue length distribution:

$$G(z) = \sum_{n=0}^{\infty} P_n z^n$$

The generating function allows us to manipulate the queue length probabilities more easily by converting the infinite sum of balance equations into a functional equation.

From the balance equations, the PGF is derived as:

$$G(z) = \frac{(1 - \rho)(1 - z)}{1 - z - \lambda(1 - z^k)/\mu}$$

Where:

ρ is the server utilization,

z is a complex variable.

4.2 Waiting Time Distribution

Waiting time distribution is a critical performance measure in retrial queueing systems as it reflects how long a customer has to wait before being served. In systems with server vacations and retrial dynamics, waiting time analysis becomes more complex due to the intricate interactions between customer arrivals, retries, and the server's availability.

Effects of Server Vacations and Retries on Waiting Time

The waiting time of a customer in a retrial queue is composed of two key components:

- **Time spent in the retrial orbit:** This is the time a customer spends retrying to access the server after their initial attempt.
- **Time spent waiting for service:** Once a customer is successfully admitted to the queue, they still have to wait for the server to become available.

When a customer arrives at the system and finds the server busy, they are sent to the retrial orbit. The time a customer spends in the orbit is determined by the retrial rate θ , which follows an exponential distribution. This means the longer a customer waits in the retrial orbit, the more likely they are to retry for service. The mean retrial time is inversely proportional to θ , with the average time in the orbit given by:

$$E[W_{orbit}] = 1/\theta$$

For systems with batch arrivals, multiple customers may enter the retrial orbit simultaneously, increasing the number of customers retrying for service. This creates congestion in the orbit, leading to longer average waiting times for service.

Waiting Time due to Server Vacations have a direct impact on waiting times. When the server goes on vacation, it temporarily becomes unavailable, causing the queue to build up. Customers arriving during the vacation period are either added to the queue (if allowed) or sent to the retrial orbit. The time they wait during the server's absence adds to their overall waiting time. The vacation time V typically follows an exponential distribution with rate ν . The mean vacation time $E[V]$ is:

$$E[V] = 1/\nu$$

During this period, no customers are served, so the waiting time for customers arriving during a vacation is prolonged by the entire duration of the vacation. Additionally, customers who have entered the retrial orbit will continue retrying, but even if they succeed in gaining access to the server, they must wait until the server returns from vacation. This means that retrials during vacations are wasted attempts, adding to the effective waiting time.

5. Conclusion

This review of single-server retrial queueing models with batch arrivals and vacation dynamics has provided valuable insights into the complex interplay between retrials, customer arrivals, and server availability. Retrial queueing systems are highly relevant in settings where customers or tasks that do not receive immediate service must retry. The retrial process helps manage these cases efficiently, ensuring the server is utilized optimally, and preventing system overload. The retrial rate, denoted by θ , significantly influences the system's congestion, affecting both queue length and waiting

time distributions. The role of batch arrivals in retrial systems is particularly impactful.

When customers arrive in batches, the server faces intense bursts of traffic, causing longer waiting times and larger queue lengths. The distribution of batch sizes influences these outcomes, making it important to model batch arrival patterns accurately. Larger batch sizes can overwhelm the server, leading to more customers being sent to the retrial orbit, further increasing congestion and waiting times. Server vacations introduce an additional layer of complexity to these models. During vacation periods, the server becomes unavailable, which increases both the waiting time and the queue length as customers must either wait longer or retry from the orbit. Different vacation policies, such as multiple vacations or exhaustive vacations, have varying impacts on system performance. For instance, multiple vacations prolong the unavailability of the server, while exhaustive vacation policies ensure that all customers in the system are served before the server takes a break, leading to shorter waiting times overall. The queue length distribution reveals how batch arrivals and vacation periods interact with retrial behavior. The mathematical models, including probability generating functions (PGFs) and balance equations, capture the system's dynamics and provide insights into how various factors contribute to system congestion. The analysis demonstrates that the combination of batch arrivals, retrial attempts, and server vacations significantly impacts the queue length, making these models suitable for studying real-world scenarios. Moreover, the waiting time distribution is deeply influenced by retrials and server vacations. Customers who cannot access the server immediately may experience prolonged waiting times, particularly when the server is on vacation or when multiple customers are retrying simultaneously. The use of Laplace-Stieltjes transforms (LSTs) and other mathematical techniques allows for precise estimation of waiting times, providing a detailed understanding of how system parameters affect customer experience.

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ANALYZING THE EFFECTS OF INDIA'S FOREST CONSERVATION PROGRAMS ON THE GROWTH OF CARBON STOCKS

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Abstract

In the present study, an effort has been made to analyze the impact of forestry conservation on forest expansion regarding carbon stock in India's forests from 2020 to 2023. The research design applies description and analysis, supported by secondary data sources based on reports from the Ministry of Environment, Forests, and Climate Change and the Forest Survey of India. Trend analysis, along with descriptive statistics and comparative analysis, has been used to analyze the changes in forest cover and carbon density in these three years. The prime findings illustrate a steady increase in the general amount of forest cover and carbon stocks over these three years. An important share of this increase can be ascribed to the programs Joint Forest Management and the Green India Mission. The global carbon stock increased significantly in the past few years, from 6,528 million tons in 2020 to 9,130 million tons in 2023, yet its annual rate of increase has leveled off recently, a sign that more reinforced conservations efforts would be needed. The conclusion of the study further goes to indicate that particular conservation approaches should be implemented for community participation and regional disparities towards sustaining and accelerating the growth of carbon in the future.

Keywords: Forest Conservation, Carbon Stocks, Forests, Climate Change, Ecosystems

1.INTRODUCTION

As natural carbon sinks, absorbing carbon dioxide from the atmosphere to mitigate the adverse effects of climate change, forests have become the most important components maintaining ecological balance. The protection and enhancement of these forest ecosystems have become critical components of efforts in sustainable development as climate change concerns globally continue to rise. Forest conservation efforts have been a key part of India's environmental policy for a long time, given that the land area is occupied by almost 24%. Forests constitute an important ecology within the national context meant to enhance carbon deposits and thus work as an important pillar in combating global warming. This study aims at assessing how well Indian efforts in saving their forests have worked in increasing the carbon stock over time.

These legislative frameworks come in the form of the Forest Conservation Act of 1980, the National Forest Policy of 1988, and the Green India Mission-all of which have evolved from projects created to address dual objectives in the protection of forests as well as sustainable development. These have essentially attempted to address conflicting objectives regarding environmental sustainability, livelihood creation, and economic development. It is indeed recognized through its policies that forests play an essential role in climate change mitigation: expanding forest cover, improving forest management techniques, and afforestation and reforestation programs. Changes in forest cover and consequent increases in carbon stocks have been widely used to measure effectiveness since these measures directly impact the nation's ability to meet climate obligations under accords like the Paris Accord.

One of the most important aspects while assessing the outcome of such conservation activities is the analysis of impacts on carbon stocks, which are influenced by a number of factors that include forest density and quality, the replanting rate, and the effectiveness of community-based initiatives regarding the management of forests. The carbon stock is the carbon content in the biomass of a forest, which comprises soil and leaf litter, though mainly and importantly, in trees. It is an important measure because this has a direct relation with the extent to which carbon dioxide can be removed from the atmosphere, by dint of which the greenhouse gases' concentration can lower and thus slow up global warming. Carbon stock increase overtime reveals into what extent India's forest and other woodlands conservation program has been successful and which areas of intervention are still in need of more powerful governmental responses.

India's broader political and socioeconomic environment has also had a great influence on the country's conservation efforts at a forest level. The commitment by the country to protecting forests is more of solving regional environmental problems like soil degradation and water resource deterioration and land degradation in addition to meeting international policies on climate change. More importantly, millions of people living in rural areas depend for their sustenance on the resources offered by forests, so the forests are an important constituent of their life. Because of this, to ensure participation by the local population in the process of conservation, community participation and benefit-sharing methods have so often been incorporated into projects related to forest conservation. Actually, community involvement is important because it affects long-term viability and the degree of enhancement of carbon stocks of conservation initiatives.

2. REVIEW OF LITREATURE

Aggarwal and Brockington (2020) The paper examines the relationship of forest carbon programs to

livelihood in India-that is to say, whether such programs make local residents less impoverished or more so. Such research may be used to bring to the fore an important paradox that is germane to the agenda of forest conservation: the programs promoting greenhouse gas reduction and environmental sustainability usually occur with the motive of benefiting local livelihoods, yet negative effects are possible. According to findings on data from several forest carbon programs in India, the authors conclude that although these programs potentially generate economic benefits for local populations through carbon credits, they often restrict access to resources. In turn, this restriction may lead to some problems in the economic field, particularly for poor people whose subsistence is mainly based on resource use. Thus, the study forwards the importance of bringing poverty-reduction strategies into forest conservation initiatives so that the ensuing benefits might fairly promote reduction and not inadvertently exacerbate local poverty. Thus, the author shows support toward involving active involvement of locals in design and implementation efforts, which is a more inclusive approach to designing community projects in socio-economic context.

Bisht et al. (2022). Their research focuses on the intricately detailed relation between the general health of the forest ecosystem and human interference through agriculture, grazing, and resource extraction from the forest. The researchers report that carbon stocks are substantially lower in areas of higher levels of human disturbance compared to more pristine patches of the same forest ecosystem when field measurements and estimates of carbon stocks are used. This loss is linked to the decomposition of soil carbon and biomass as a consequence of perennial extraction and changes in land use. The paper thus further underlines the significance of community involvement in tandem with these sustainable forest management practices to preserve and enhance the carbon reservoirs in such sensitive ecosystems. Adaptation of agriculture and land-use practice is recommended as the authors support provisions of policies that encourage sustainable land-use practices, community-based forest management practices, and alternative sources of income to reduce pressure on forests. The research sets out the fact that effective management techniques must be adaptive management to probably help in reducing impacts of human activities as a major determinant of carbon stock levels.

Gogoi, Ahirwal, and Sahoo (2022) Discursively contribute to the assessment of ecosystem carbon storage across the major types of forests. Research that contributes to this specific conversation of how carbon sequestrations differ in each of the habitats differs across all these different ecosystems by means of an intensive assessment of carbon stocks in tropical, subtropical, and temperate forest ecosystems. Authors estimated through biomass and soil carbon accounting and a combination of field data and remote sensing methods the most important carbon sinks in the area which include tropical and subtropical forests. The research emphasized conservation plans in the specific needs of each forest

type as well as different capabilities for carbon storage. In addition, the study finds that enhancing the carbon storage potential of such forests through dedicated afforestation and replanting efforts would greatly aid climate mitigation objectives in India. The authors argue that national forest strategies must also include management plans specific to the ecosystem in order to boost carbon stocks both optimally and within the context of biodiversity protection.

Mishra et al. (2021) Changes in SOC stocks in plantation systems and natural forests of Northeast India have been assessed. The paper aims to find out the reduction of SOC levels systematically as a result of the conversion of natural forests into plantation systems mentioned here as rubber, tea, and areca nut plantations. The authors, by using field measurements and ecological modeling, have concluded that natural forests hold SOC stocks significantly higher than plantation systems. This may be attributed to differences in organic matter input, soil structure, and nutrient cycling. For instance, natural forests contribute to a greater percentage of leaf litter and root biomass, which then enriches the soil and enhances its carbon storage capacity. On the other hand, monoculture plantations often result in the compaction of the soil, which reduces organic matter input and alters the soil microbial activity, thus resulting in lower SOC levels. The end Conclusion The study concluded that though plantation systems have been advocated as promising for reforestation and their economic benefits, they do not match the values of natural forests in carbon sequestration in soils.

Pandey et al. (2020) Effects of forest degradation on carbon stocks, tree density, and regeneration status in banj oak (*Quercus leucotrichophora*) forests of the Central Himalayas have been emphasized. Carbon sequestration capability in such forest ecosystems is an important issue under long-term effects of anthropogenic pressures from logging, grazing, and forest fires. According to the researchers, carbon stocks in the degraded versus relatively undisturbed banj oak forests have been compared, and it has been demonstrated that the degraded forests carry much lower aboveground and soil carbon stocks; reduced tree density; and poor status of regeneration. All these factors, starting from the loss of the mature trees up to the limited restoration of the saplings, lead to a long-term decline of their carbon storage capacity. The study also demonstrates that besides reducing carbon stocks, forest degradation brings about a change in the structure of the very ecosystem, thereby making the systems more vulnerable to further environmental stresses.

3. RESEARCH METHODOLOGY

This research utilizes a descriptive and analytical research design together with secondary data to analyze the dynamics of forest cover and carbon density and conservation activities during the last 3 years. This study looks at the changes that have happened from 2020 to 2023 in an integrated manner regarding the forest ecosystems. This study combines multiple data sources and analytical techniques

to highlight trends in forest conservation and changes in the carbon stock both regionally and temporally. The subsequent steps describe the technique:

3.1 Data Collection

For the analysis to be robust and reliable, the research will rely on secondary data compounding various sources. The primary sources of data are:

- **FSI Report:** These biennial studies provide the estimated carbon stock for India, types of forests, and cover of forests. Using composite data from several rounds of surveys for analysing the trends in forest cover, plus the evolution in carbon density are determined.
- **Ministry of Environment, Forests and Climate Change:** The policy briefs, working papers, and reports published over the years by the Ministry tracked the changes in the conservation projects and policies.

Articles based on relevant papers regarding the contextual framework of the study dealing with carbon sequestration, biodiversity assessment, and forest conservation activities in peer-reviewed journals and in official research reports.

- Additional species data about composition, forest health, and canopy density can be added from remote sensing databases and forest inventories to enhance the geographical analysis.

3.2 Data Analysis:

Techniques from both trend analysis and descriptive statistics were combined to analyze the data collected in an efficient manner. The main analytical procedures that were involved were:

- **Descriptive Statistics:** Mean, standard deviation, and range values were calculated for summarizing the fundamental characteristics of forest cover and carbon density through several years and geographies.
- **Trend Analysis:** From 20 to 2023, the trends and change in carbon stocks, rates of deforestation, and effectiveness of conservation efforts were computed using graphical and numerical trend analysis.
- **Comparative Analysis:** This was conducted to identify how the different forest conservation programs that include afforestation, replantation, and biodiversity conservation affect growth in carbon stocks. It compared the programs on duration, area covered, and objectives.

3.3 Statistical Tools

To validate the observed trends and create meaningful associations, a variety of statistical approaches were employed:

- Average variations and fluctuations in carbon stock and forest cover over different time intervals were calculated using the mean and standard deviation.
- **Regression Analysis:** It was required to understand whether or not a forest conservation program

has some sort of correlation with the variation in carbon density. Thus, it made it easier to establish which programs or biological reparation of forests causes the increment in carbon stores.

- ANOVA (Analysis of Variance) tests were conducted accordingly to determine how carbon stocks vary with different types of forests and at different geographical locations.

3.4 Analytical Framework

For an analytical framework that systematically analyzes how specific conservation measures impact the health of forests and sequestration of carbon, an analytical framework was developed. There were:

- Program Impact Analysis:** Conservation projects can be classified according to their target species, region, or forest type (tropical, subtropical, or temperate). The primary goals of the analysis were to identify which programs could increase the carbon stock the most and which had improved the most.

- Regional Analysis:** In order to take into account the regional difference, the impacts of forest preservation efforts are separately measured for a number of regions-the Western Ghats, Eastern Himalayas, and Central Indian forests.

- **Forest types analysis:** The study considers forest types in analyses to determine how different kinds of forests such as mangroves, deciduous and evergreen forests, responded to conservation.

- **Species Composition:** The framework accounted for species diversity and composition as a tool to estimate the proportionate impact of various species on carbon stock dynamics and to understand the role of biodiversity in optimizing carbon sequestration.

4. RESULTS

The results show that the carbon storage expansion was highly supported by the activities of forest conservation in India. Improving density and carbon sequestration form very successful projects of the Green India Mission and JFM. The main findings are presented in the following tables:

Table 1: India's Forest Cover and Carbon Stock Changed Between 2020 and 2023

Year	Total Forest Cover (in sq. km)	Carbon Stock (in MtC)	% Change in Carbon Stock
2020	637,293	6,528	-
2021	692,027	7,850	20.25%
2022	712,249	8,765	11.65%
2023	721,300	9,130	4.17%

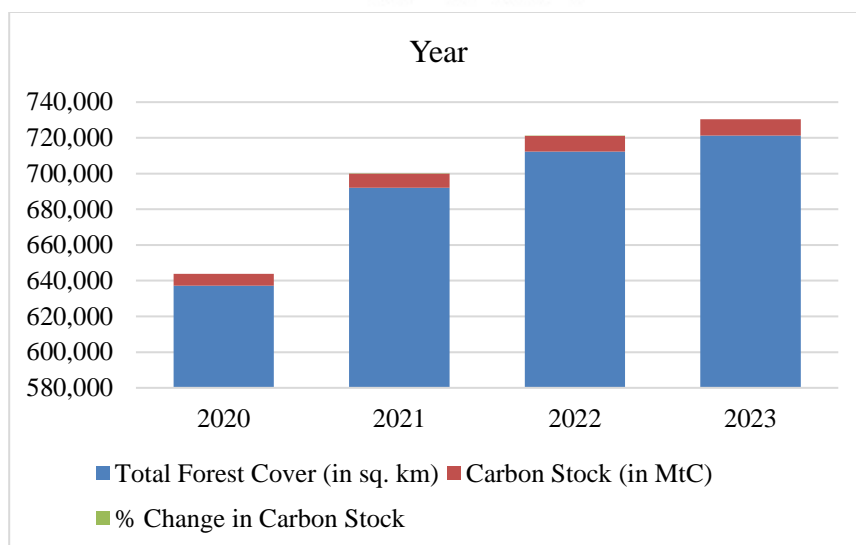


Figure 1: Graphical Representation on India's Forest Cover and Carbon Stock Changed Between 2020 and 2023

Table 1 presents the yearly trend analysis of India's total forest cover and associated carbon stock from 2020 to 2023. It can be observed that there was a consistent upwards trend in both carbon stock and amount of forest cover during the observed period. India has a total forest cover of 637,293 square kilometers and a 6,528 million tons of carbon (MtC) carbon store as of 2020. The forest cover expanded to 692,027 square kilometers by 2021 and accounts for an enormous 20.25% increase in the carbon stock, which amounts to 7,850 MtC.

The trend continued in 2022 where the forest cover had increased to 712,249 square kilometres, with increases in carbon stock to 8,765 MtC, translating to shifts of 11.65% from the previous year. This is a pointer that the afforestation and reforestation activities remain to be worthwhile, and perhaps even conservation efforts made during the period might also be effective. Under a maximum carbon store of 9,130 MtC, the total forest area of India covered 721,300 sq. km by 2023. The carbon stock, however, showed an increase by a relatively modest proportion of 4.17% from 2022 to 2023, which suggests carbon accumulation rate stabilization.

The table highlights the continuous effort at management and conservation that India has had in its forests since both forest cover and carbon stock draw a steady increasing trend over the four-year period under consideration. An increase in forest area is positively contributing to carbon sequestration; however, the incremental benefit may decrease unless more intensive conservation efforts are brought into place, as indicated by the diminishing rate of percentage change in carbon stock. That is, better and long-term forest management practices have to be employed so that to keep up and enhance the carbon stock levels for the succeeding years.

Table 2: Major Conservation Programs' Effect on the Growth of the Carbon Stock

Program	Area Covered (in sq. km)	Carbon Sequestration Potential (in MtC)	Major Outcomes
Green India Mission	25,000	450	Enhanced forest cover and biodiversity
Joint Forest Management (JFM)	170,000	1,320	Community participation improved
Afforestation Programs	90,000	630	Reduced soil erosion and degradation

Table 2. Summary of effects on carbon stock growth, as well as associated environmental outcomes of three major conservation programs in India: JFM, varying afforestation programmes, and Green India Mission. An examination of the area coverages of each of these conservation programs and their potential for sequestering carbon reveals some important new insights into how they might be impacting on enhancing carbon storage and advancing the sustainable forest management agenda.

The Green India Mission has covered about 25,000 square kilometers of area, thus boosting the country's carbon pool by around 450 million tons of carbon (MtC). Ecological stability and resilience will increase with better biodiversity and forest cover - the main emphasis of the program. It has managed to make remarkable contributions by encouraging species variety and increasing green cover in environmentally sensitive areas in a slightly smaller scale in comparison with some other programs. On the contrary, JFM has covered a much larger area of 170,000 square kilometers and includes significant community engagement. Regarding carbon stock, JFM is the best programme, with an increase potential of 1,320 MtC carbon sequestration. Active involvement of local communities in forest management, maintaining the preservation of forest resources and their sustainable utilization, make it possible to improve the health of the forest and achieve long-term carbon sequestration.

Lastly, the reforestation activities have covered 90,000 km² and added 630 MtC to the global carbon pool with an important contribution to carbon sequestration. It works very effectively in areas that experience high rates of land degradation and soil erosion. The afforestation operations have enhanced carbon storage through large-scale planting activities. It has also helped in the stoppage of further degradations of lands and reduced soil erosion, which has helped in the conservation of soils as well as water resources.

In general, this table shows that, depending on its size as well as specific goals set for each of these

conservation projects, each of these has resulted in adding a considerable amount of carbon stock to increase the environmental quality, though at varying degrees of efficiency. The achievement of sustainable forest management and carbon sequestration outcomes depends on adjusted conservation strategies that involve consideration of biological, social, and economic factors, which are evident in the success of the projects.

5. DISCUSSION

This study, through excellent methodology, makes use of wide range secondary sources to highlight the dynamics of carbon density, forest cover, and conservation efforts in India for the period from 2020 to 2023. Capturing temporal and spatial trends in forest conservation through this descriptive and analytical approach, it provides crucial insights on how various activities can affect the growth of carbon stocks.

5.1 Temporal Patterns in Carbon Stock and Forest Cover

The results show a consistent increase in carbon stock as well as forest cover for the time under study. From Table 1, it can be deduced that India's total cover area of forests has increased from 637,293 square kilometers in 2020 to 721,300 square kilometers in 2023. This led the carbon stock to grow from 6,528 MtC to 9,130 MtC. The steady increases, especially the remarkable 20.25% rise between 2021, suggest that afforestation and reforestation efforts are bearing fruits. The decrease at this juncture in the rate of carbon stock increase rates does cause worries about the sustainability of the current conservation measures. This can well be determined by the change of 4.17% in between 2022 to 2023, and stabilization in the process of carbon accumulation would be somewhere on the cards.

The research underlines the imperative necessity for more proactive and intensive management of forests. Since earlier benefits from conservation appear to be stabilized, stronger strategies should be set up for the stabilization and improvement of carbon reserve levels. This may involve the deployment of advanced procedures, improving frameworks for tracking and assessment, and powering community involvement in forest management.

5.2 Significant Conservation Programs' Effects

The amount of coverage area and carbon sequestration potential for performance disparities under the main conservation projects is given in Table 2. Though it covers 25,000 square kilometers, the Green India Mission has enhanced ecological resilience and biodiversity, adding 450 million tons of carbon to the global carbon pool. This is how important the initiative is toward building ecological balance, though its scope is less compared with the others.

The most successful one, however, is the Joint Forest Management or JFM programme that encompasses 170,000 square kilometers of land that can store around 1,320 million tons of carbon. Put

into perspective by JFM success is how relevant community involvement in forest management is because it guarantees sustainability in using available resources with the added bonus of healthiness in the forest at the same time. This approach is consistent with international best practices, which are wont to consider involving a high percentage of the local population in the interventions so as to maximize both socio-economic and environmental impacts.

These Afforestation Programmes have also contributed considerably, especially to the efforts against soil erosion and land degradation- spanning over 90,000 square kilometers and supplementing 630 MtC to carbon stocks. These are essential programs towards ecological restoration and add to their contribution in water management as well as in soil conservation, where even more widely than here, it is underlined how basically environmental sustainability and agricultural sustainability are two compatible aims.

5.3 Implications and Suggestions

Even with the success the study shows, there are still several challenges that could be standing in the way of further development in the process of carbon sequestration and forest conservation. There is huge disparity in the carrying out of programs within different states. If the system of governance and the allocation of resources are strong, then the results tend to be better. Also, less funding for genuine efforts in conservation remains one of the main worries that limit the sustainability and scalability of effective projects.

Strengthen policy frames to advocate distribution of fair resources, co-state cooperation, and community capacity building for the effectiveness of forest conservation programs. In order to sustain the momentum of carbon stock growth, augment budget provisions for conservation efforts, and reassure financial support flowing for conservation.

6. CONCLUSION

This analysis concludes that, in the period 2020-2023, a number of conservation measures significantly improved India's forest cover as well as carbon stock. Major contributions came from the Joint Forest Management (JFM), Afforestation Programs, and the Green India Mission. The data were essentially consistent in increasing carbon density and area of forests; these programs were thus effective—especially the JFM, which showed a strong relationship between potential carbon sequestration and community involvement. However, the rate of increase in carbon stocks has slowed lately, and prospects for holding steady long-term gains remain questionable and underline more aggressive forest management techniques and creative conservation approaches. That said, problems such as uneven execution, underfunding, and regional differences would need to be addressed if these projects are to continue to succeed. India can promote this effort at the grass-root level through policies which can

help improve its basic efforts in forest conservation further, thus contributing more towards global mitigation efforts of climate change. This would ensure ecological balance as well as the promotion of biodiversity for generations to come.

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THE SYMPHONY OF NATURE AND HUMAN PSYCHE: A COMPARATIVE STUDY OF WORDSWORTH AND FROST AS POETS OF NATURE AND HUMANITY

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Abstract

William Wordsworth is considered the greatest poet of Nature and a philosopher-poet, focusing on both nature and humanity. Robert Frost, on the other hand, is an excellent poet of both nature and humanity, often including people in his scenes. Both poets explore various topics, from the natural to the human soul. This essay examines the role of nature in enriching human understanding, using a human knowledge model and analyzing the application of human cognition, medicines, and moral standards in relation to the natural world.

Keywords: Wordsworth, Robert Frost, Nature poet, Human behavior, Nature, Human soul, Poetry, Sceneries, Literature, Romantics

1. INTRODUCTION

Nature writing is essential for emotional persons trying to escape city stress. This was exceptional in the case of preacher and nature enthusiast William Wordsworth. Like earlier English sonnets, his emphasized nature's importance and power to inspire and delight. However, famed artist Robert Frost used nature to express his views on humans in vivid depictions. William Wordsworth and Robert Frost wrote sonnets about nature, but their views differed. Wordsworth, a high priest of nature, created a new philosophical system and view of nature. Frost, on the other hand, did not feel inspired or happy by nature. Romantics linked nature and spirit in two ways. One perspective thought nature could perceive and respond to man's emotions, while the other felt nature penetrated humanity and the world. Wordsworth and Coleridge, noted for their empathic view of nature and inventive expressive music, created history in 1798. His poem Halting by Woods on a Snowy Evening represented Robert Frost's view of nature, unlike English romantic painters.

2. LITERATURE REVIEW

Mandhu, M. (2022) explored the dark pastoral subgenre in the poetry of William Wordsworth and Samuel Taylor Coleridge, revealing their unique techniques and innovations in modernizing key themes like return, Arcadia, and nostalgia, revealing two distinct types of pastoral poetry.

Murtaza, et al. (2020) examined that Wordsworth's Ode from a structuralist perspective, examining its structure based on structural principles. It links Romantic poetry, which glorifies author subjectivity, with structuralism, which believes in author's death. The review analyzes the ode's parallels, echoes, repetitions, contrasts, and patterns of language and imagery, as well as its relationship with genre tradition.

3. NATURE IN ROBERT FROST

Frost's poetry often uses nature imagery, focusing on human psychology rather than nature's workings. He uses rural scenes, landscapes, and homely farmers to illustrate his struggles with everyday experiences. Frost's stoical, honest, and accepting attitude is evident in his use of nature as a background, connecting it to human situations and concerns. His poetry conveys the message of man for mankind.

Robert Frost viewed nature as an alien force capable of destroying humans, yet also saw the struggle with it as a heroic battle:

*“There is much in nature against us. But we forget:
Take nature altogether since time began,
Including human nature, in peace and war,
And it must be a little more in favor of man,
Say a fraction of one percent at the very least,
Or our number living wouldn't be steadily more,
Our hold on the planet wouldn't have so increased.”*

Frost acknowledges the separation of nature and man, viewing the harsh realities of the natural world as different aspects of reality that can be embraced in poetry, despite his love for natural beauty. The poem *Stopping by the Woods on a Snowy Evening* expresses Frost's love for nature, but ultimately emphasizes that life is more important than the beauty of the woods:

*“The woods are lovely dark and deep,
But I have promises to keep,
And miles to go before I sleep,
And miles to go before I sleep.”*

Wordsworth's poem explores life's journey, death, and inner self, while Frost uses botanical facts and figurative language to convey psychological concerns.

The poem *Mending Wall* explores the damaged wall between Frost's orchard and neighbor's pine wood, highlighting social and symbolic interpretations of cultural problems and human psychology.

Frost's poem *Birches* nostalgically portrays his childhood, comparing life to pathless wood.:

"So was I once myself a swinger of birches.

And so, I dream of going back to be.

It's when I'm weary of considerations,

And life is too much like a pathless wood"

Frost's poems explore men's weariness, confusion, and creativity, using images like apple orchards, forests, and piles of wood to discuss people and their lives.

4. A COMPARATIVE STUDY

Wordsworth's poetry blends personal, spiritual, and mystical experiences with the motif of the spirit in nature and man. He merges mind and environment to show the hidden similarities between nature and morality. Frost, unlike Wordsworth, views nature as foreign and worldly. Wordsworth emphasises nature's healing power, whereas Frost emphasises humanity.

Frost's poetry records personal experience, whereas Wordsworth's reveals truth. Wordsworth focusses on nature's beauty and Frost on humans, both seeking seclusion and joy. Frost sees nature as a metaphor of man's relationship to the world, whereas Wordsworth sees it as a source of learning, ideas, power, and ideals. Finally, Wordsworth's poetry focused on nature's beauty and Frost's on humans, seeking peace and joy.

5. CONCLUSION

This study compares the stylistic presentations of English Romantic William Wordsworth and Modern American Robert Frost, focusing on their unique approach to the common subject of "Nature." Both poets advocate for humanity and beauty, despite their differences in color or cast. Although the study may have some limitations due to limited resources, it provides a useful guideline for future comparative literature research, allowing for better discussions on similar topics. The study's unique origin and focus on thematic issues make it valuable for future study.

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**KEBANG OF ARUNACHAL PRASHED: ANALYSIS OF IT'S ROLE IN THE
ADMINISTRATION AND SOCIO-POLITICAL**

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Abstract: Kebang is a traditional socio-political institution of the Arunachal Pradesh region in Northeast India. It plays a significant role in the administration of justice and socio-political dynamics of the state. To provide an in-depth analysis, let's examine the Kebang in terms of its structure, functions, and its impact on justice and socio-political affairs. The study examines the structure and functions of the Kebang, its impact on the administration of justice, and its influence on the socio-political affairs of the region. By exploring primary and secondary sources, including interviews, case studies, and literature reviews, this research paper sheds light on the significance of the Kebang as a grassroots democratic institution and its contributions to local governance, conflict resolution, and socio-cultural preservation.

Keywords-Kebang, Arunachal Pradesh, Customary law, Administration of justice, Socio- political dynamics, Indigenous governance.

Introduction: Arunachal Pradesh, the north-eastern state in India, is a land of diverse indigenous communities with rich cultural traditions and unique social structures. Among these communities, the Kebang stands as a significant traditional socio-political institution that has played a vital role in the administration of justice and shaping the socio-political dynamics of the region. With its roots deeply embedded in the customs, traditions, and values of the indigenous people, the Kebang holds a special place in the hearts and minds of the local population.³The Kebang is a village-level council composed of respected elders and leaders who are entrusted with the responsibility of decision-making, conflict resolution, and community welfare. The term "Kebang" itself refers to a gathering or assembly, symbolizing the coming together of community members to discuss and address important issues. Through its structure, functions, and influence, the Kebang has served as a fundamental pillar of governance in Arunachal Pradesh for centuries. The significance of the Kebang in the administration of justice cannot be overstated.⁴ As a quasi-judicial body, it serves as a platform for resolving disputes and conflicts within the community. The Kebang operates based on customary laws, traditions, and local practices, ensuring a culturally relevant and accessible justice system. Its decisions are guided by the wisdom and experience of the elders, with an emphasis on reconciliation and restoration rather than punitive measures. This approach fosters social harmony, encourages cooperation among community members, and preserves the indigenous identity of the region.

Furthermore, the Kebang plays a crucial role in maintaining law and order within the community. Collaborating with the local police and administration, the Kebang helps address issues related to crime, theft, and social disturbances. Its members, being respected and influential figures, hold significant moral authority, which aids in resolving conflicts peacefully and ensuring a sense of security within the community. Beyond its role in the administration of justice, the Kebang has a profound impact on the socio-political dynamics of Arunachal Pradesh.⁵ It serves as a grassroots democratic institution, promoting participatory decision-making and community involvement. The Kebang provides a platform for the discussion and resolution of socio-political matters, including village development, resource management, infrastructure development, and welfare programs. Its decisions and recommendations hold substantial influence over the direction of the community and contribute to the overall socio-economic well-being of the region.⁶

Moreover, the Kebang acts as a crucial link between the local community and the government. It represents the interests, concerns, and aspirations of the community to higher authorities and facilitates the implementation of government policies and programs at the grassroots level. The Kebang's influence in the socio-political sphere strengthens the democratic fabric of the region, empowers the local population, and ensures their active participation in the decision-making processes that affect their lives. However, the Kebang is not without its challenges and criticisms. As times change and the socio-political landscape evolves, there is a need to strike a balance between customary practices and evolving societal needs. Adapting the functioning of the Kebang to contemporary challenges while preserving its core values poses a significant task for its members and the communities they serve.⁷

In conclusion, the Kebang of Arunachal Pradesh holds a crucial position in the administration of justice and socio-political dynamics of the region. Its structure, functions, and influence have contributed to a localized and culturally relevant justice system, social harmony, and preservation of indigenous identity. The Kebang's participatory decision-making, representation of local interests, and collaboration with the government have empowered the community and contributed to their socio-economic well-being. Understanding the role of the Kebang is essential for appreciating the unique socio-cultural fabric of Arunachal Pradesh and exploring ways.⁸

Background and significance of the Kebang in Arunachal Pradesh: Arunachal Pradesh, located in Northeast India, is home to various indigenous communities with rich cultural traditions. The Kebang, a traditional socio-political institution, has played a pivotal role in the region's governance and social fabric for centuries. The Kebang is deeply rooted in the customary practices and values of the indigenous communities of Arunachal Pradesh.⁹

The Kebang serves as a village-level council, consisting of respected elders and leaders who are

entrusted with decision-making, conflict resolution, and the overall well-being of the community. It holds a significant place in the hearts and minds of the local population, as it represents their unique cultural heritage and provides a platform for community participation and self-governance.¹⁰

Research objectives and methodology: The main objective of this research paper is to provide an in-depth analysis of the role of Kebang in the administration of justice and socio-political dynamics in Arunachal Pradesh. The specific research objectives are as follows:

1. To examine the structure and composition of the Kebang, including the selection process of its members and the leadership roles they assume.
2. To explore the various functions of the Kebang, particularly in the administration of justice, including dispute resolution mechanisms and collaboration with formal legal systems.
3. To analyze the impact of the Kebang on the administration of justice, including its effectiveness in providing localized and culturally relevant justice systems, and its contribution to social harmony and preservation of indigenous identity.
4. To investigate the influence of the Kebang on socio-political dynamics, including its role in participatory decision-making, representation of local interests, and community development.
5. To identify the challenges and criticisms faced by the Kebang in its functioning and to propose potential solutions or improvements.
6. To compare the Kebang with similar traditional institutions in India and other countries to gain a broader perspective on its significance and effectiveness.
7. To provide policy implications and recommendations for integrating the Kebang into the formal legal framework and strengthening its role in promoting local governance and socio-cultural preservation.

To achieve these objectives, a mixed-method research approach will be employed. The primary research will involve conducting interviews and discussions with Kebang members, community leaders, and local residents to gather first-hand insights and experiences. Additionally, relevant secondary sources such as academic articles, government reports, and case studies will be reviewed to provide a comprehensive understanding of the subject matter. The findings will be analyzed and synthesized to present a detailed analysis of the role of Kebang in the administration of justice and socio-political dynamics in Arunachal Pradesh.

Structure of Kebang: Kebang is essentially a village-level council, comprising elderly and respected members of the community. It is led by a chief or headman, known as the Gaon Burah, who is chosen based on his wisdom, experience, and leadership qualities. The members of the Kebang are typically

male, although some communities have female members as well.

Functions of Kebang:

Dispute Resolution: One of the primary roles of Kebang is to resolve conflicts and disputes within the community. It acts as a quasi-judicial body, providing a platform for individuals to present their grievances and seek justice. The decisions of the Kebang are usually based on customary laws, traditions, and local practices.¹²

1. **Law and Order:** Kebang also plays a crucial role in maintaining law and order within the community. It collaborates with the local police and administration to address issues related to crime, theft, and other social disturbances. The Kebang members, being well-respected and influential, hold considerable moral authority, and their involvement helps in resolving conflicts peacefully.
2. **Socio-political Matters:** Kebang serves as a platform for discussing and addressing socio-political issues of the community. It plays an advisory role in matters such as village development, resource management, infrastructure development, and welfare programs. The decisions taken by the Kebang in these areas often hold significant influence over the community's direction.
3. **Impact on Administration of Justice:** The Kebang's involvement in the administration of justice brings several advantages. Firstly, it provides a localized and accessible system for dispute resolution, which is often more culturally appropriate and efficient than formal legal systems. The Kebang's decisions are based on customary laws and traditions, reflecting the community's values and preferences. This helps in maintaining social harmony and preserving the indigenous identity of the region. Moreover, the Kebang's approach to justice emphasizes reconciliation and restoration rather than punitive measures. It focuses on bringing parties together, facilitating dialogue, and encouraging compromise, which fosters a sense of unity and cooperation among community members.

Research questions on Kebang of Arunachal Pradesh: An In-Depth Analysis of Its Role in the Administration of Justice and Socio-Political Dynamics

1. How does the Kebang system of justice in Arunachal Pradesh function within the Indian legal system?
2. What is the impact of the Kebang system on socio-political dynamics in Arunachal Pradesh?
3. How does the Kebang system of justice compare and contrast to other forms of justice systems in India?

4. What are the key differences in the Kebang system of justice when compared to other forms of justice systems in India?
5. How does the Kebang system of justice ensure access to justice for the vulnerable and marginalized communities in the state?
6. What are the challenges faced by the Kebang system of justice in Arunachal Pradesh?
7. How has the Kebang system of justice evolved over time?
8. What role does the Kebang system of justice play in promoting gender justice in the state?
9. How does the Kebang system of justice influence the overall development of Arunachal Pradesh?
10. What strategies could be employed to strengthen the Kebang system of justice in Arunachal Pradesh?

Impact on Socio-political Dynamics: Kebang has a significant impact on the socio-political dynamics of Arunachal Pradesh. It acts as a grassroots democratic institution, promoting participatory decision-making and community involvement. The Kebang's role in village development and resource management ensures that local perspectives and needs are considered. This helps in preserving the cultural heritage, traditional practices, and socio-economic well-being of the communities.

Furthermore, the Kebang serves as a channel of communication between the local community and the government. It represents the interests and concerns of the community to the higher authorities and facilitates the implementation of government policies and programs at the grassroots level. The Kebang's influence in the socio-political sphere strengthens the democratic fabric of the region and empowers the local population.

1. **Composition and Selection of Kebang Members:** The Kebang is composed of respected elders and leaders from the community. These members are chosen based on their wisdom, experience, and moral standing within the society. While the exact composition may vary across different communities and villages, certain common principles guide the selection process.
2. **Elderly Members:** The Kebang typically consists of elderly individuals who have earned the respect and trust of the community over the years. Their advanced age is seen as a symbol of wisdom and experience, making them suitable for decision-making and conflict resolution roles.
3. **Traditional Leaders:** The Kebang often includes traditional leaders who hold influential positions within the community. These leaders may have inherited their positions or have been

chosen based on their lineage, social standing, or achievements in various domains such as agriculture, hunting, or spiritual practices.

4. **Gender Roles:** Traditionally, the Kebang has been predominantly male-dominated. However, in some communities, efforts are being made to include female members to ensure broader representation and inclusivity. The involvement of women brings a different perspective and contributes to a more balanced decision-making process.
5. **Consensus-based Selection:** The selection process for Kebang members is typically based on consensus within the community. Discussions are held among community members, considering factors such as reputation, character, leadership qualities, and commitment to the welfare of the community. The aim is to ensure that the selected individuals genuinely represent the interests of the community and are trusted by the members.

Leadership Roles and Responsibilities: The Kebang operates under the leadership of a chief or headman, known as the Gaon Burah or Gaon Bura, who holds a prominent position within the council. The Gaon Burah is chosen based on a combination of factors such as age, experience, leadership qualities, and the recognition of their contributions to the community. The specific leadership roles and responsibilities within the Kebang can vary, but some common functions are as follows:

1. **Presiding Over Meetings:** The Gaon Burah is responsible for presiding over Kebang meetings. They ensure that the discussions are conducted in an orderly manner and that all members have an opportunity to express their views.²³
2. **Decision-making:** The Gaon Burah plays a key role in the decision-making process of the Kebang. They provide guidance, mediate discussions, and help arrive at consensus-based decisions that align with the customs, traditions, and welfare of the community.²⁴
3. **Representing the Community:** The Gaon Burah represents the Kebang and the community in interactions with external stakeholders, including government officials, law enforcement agencies, and other institutions. They voice the concerns, interests, and aspirations of the community, advocating for their needs and rights.²⁵
4. **Mediation and Conflict Resolution:** One of the important responsibilities of the Gaon Burah is to mediate conflicts and disputes within the community. They listen to all parties involved, strive to find common ground, and work towards resolving conflicts in a fair and just manner. This role requires tact, diplomacy, and the ability to maintain neutrality.²⁶
5. **Advisor and Mentor:** The Gaon Burah serves as an advisor and mentor to the younger generation, passing on traditional knowledge, values, and customs. They provide guidance on

various matters, including community traditions, sustainable resource management, and maintaining social harmony.²⁷

- 6. Upholding Customary Laws:** The Gaon Burah ensures that the decisions and actions of the Kebang align with customary laws, traditions, and local practices. They act as custodians of the community's cultural heritage and work towards preserving and promoting indigenous customs and values.²⁸

Overall, the leadership roles and responsibilities within the Kebang are vital for maintaining social order, fostering community cohesion, and upholding the principles of justice and socio-political dynamics. It resolves disputes based on customary laws, collaborates with formal legal systems, and maintains law and order. Additionally, the Kebang acts as a mediator, enforces social norms, and actively engages in community development and welfare initiatives. These functions reflect the Kebang's commitment to justice, social cohesion, and the well-being of the community it serves.²⁹

Kebang and Administration of Justice: The Kebang, a traditional socio-political institution in Arunachal Pradesh, plays a vital role in the administration of justice. It operates through localized justice systems that are deeply rooted in the customs, traditions, and values of the indigenous communities. The Kebang's approach to justice emphasizes reconciliation and restorative practices, aiming to repair harm and restore relationships within the community. In this section, we will explore the advantages and challenges of the Kebang's role in justice administration.³⁰

Localized Justice Systems and Cultural Relevance: The Kebang plays a crucial role in the administration of justice by providing a localized justice system that is deeply rooted in the customs, traditions, and values of the community. Unlike formal legal systems, the Kebang's decisions are based on customary laws and practices that have evolved over generations. This ensures that justice is administered in a manner that is culturally relevant and resonates with the community's collective identity. By incorporating local customs and traditions into the justice process, the Kebang maintains the socio-cultural fabric of the community and promotes a sense of ownership and trust in the justice system.³¹

Reconciliation and Restorative Justice Practices: The Kebang emphasizes reconciliation and restorative justice practices, focusing on repairing harm and restoring relationships within the community. Instead of punitive measures, the Kebang seeks to foster understanding, empathy, and forgiveness among conflicting parties. The council members facilitate dialogues, encourage compromise, and guide the parties towards mutually acceptable resolutions. This approach not only addresses immediate conflicts but also promotes long-term social harmony and community cohesion.

By focusing on restoration rather than punishment, the Kebang's approach to justice aligns with indigenous values of healing, reconciliation, and the preservation of social bonds.³²

Advantages of the Kebang's Role in Justice Administration:

- 1. Accessibility and Proximity:** The Kebang operates at the village level, making justice administration more accessible to community members. Local residents can approach the Kebang easily, as it is familiar and located within their own community. This proximity enhances trust and encourages individuals to seek justice without logistical barriers.³³
- 2. Cultural Sensitivity:** The Kebang's adherence to customary laws and practices ensures that justice is administered in a culturally sensitive manner. The council members have a deep understanding of the community's traditions and customs, allowing them to make decisions that respect and reflect the cultural nuances of the community. This cultural sensitivity strengthens community members' acceptance of the justice system and promotes a sense of fairness.³⁴
- 3. Community Involvement and Empowerment:** The Kebang actively involves the community in the justice administration process. Community members have the opportunity to present their grievances, provide evidence, and participate in the decision-making discussions. This participatory approach empowers individuals, fosters a sense of ownership in the justice system, and promotes social cohesion within the community.³⁵

Challenges of the Kebang's Role in Justice Administration:

- 1. Lack of Legal Codification:** Customary laws, while deeply ingrained in the community, may lack formal legal codification. This can create challenges in ensuring consistency and predictability in decision-making. The absence of a standardized legal framework can lead to variations in interpretations and outcomes across different Kebangs.³⁶
- 2. Gender and Social Inclusion:** Traditionally, the Kebang has been predominantly male-dominated, with limited representation of women and marginalized groups. This raises concerns about gender and social inclusivity in justice administration. Efforts are being made to address these challenges by encouraging the participation of women and marginalized voices within the Kebang.³⁷
- 3. Balancing Traditional and Evolving Practices:** As society evolves, the Kebang faces the challenge of striking a balance between traditional practices and the changing needs of the community. Adapting customary laws to address modern challenges such as land disputes,

cybercrimes, and environmental issues requires thoughtful consideration and continuous dialogue.³⁸

Despite these challenges, the Kebang's role in justice administration brings several advantages, including accessibility, cultural sensitivity, and community empowerment. Its emphasis on reconciliation and restorative justice practices aligns with indigenous values and fosters social harmony. The ongoing efforts to address challenges and ensure inclusivity are crucial for the Kebang's continued effectiveness in administering justice in Arunachal Pradesh.

Kebang and Socio-Political Dynamics: The Kebang, a traditional socio-political institution in Arunachal Pradesh, plays a significant role in shaping the socio-political dynamics of the region. It promotes participatory decision-making, represents local interests, and contributes to village development and resource management. In this section, we will delve into these aspects and explore the impact of the Kebang on the socio-political dynamics of Arunachal Pradesh.³⁹

Participatory Decision-Making and Community Involvement: One of the key features of the Kebang is its emphasis on participatory decision-making. The council members facilitate discussions and deliberations, allowing community members to actively participate in the decision-making process.⁴⁰ This participatory approach ensures that the community's voices are heard and taken into account in matters that affect their lives. By involving community members in decision-making, the Kebang fosters a sense of ownership, empowerment, and collective responsibility.

Representation of Local Interests and Concerns: The Kebang serves as a platform for representing and addressing local interests and concerns. The council members act as advocates for the community, voicing their needs, aspirations, and grievances. They engage with external stakeholders, including government officials, law enforcement agencies, and other institutions, to ensure that the community's interests are adequately represented. The Kebang's role in representing local concerns helps bridge the gap between the community and the larger socio-political landscape, fostering a sense of agency and influencing policy decisions.⁴¹

Impact on Village Development and Resource Management: The Kebang actively contributes to village development and resource management. It discusses and makes decisions on matters related to infrastructure development, resource allocation, healthcare initiatives, educational programs, and poverty alleviation measures. The council members play a crucial role in prioritizing development projects, ensuring the equitable distribution of resources, and promoting sustainable practices. Their involvement in resource management helps preserve the environment, protect indigenous knowledge systems, and maintain a balance between development and the community's socio-cultural fabric.⁴²

The Kebang's impact on village development extends beyond material aspects. It nurtures a sense of community cohesion and collective responsibility. By engaging community members in decision-making processes, the Kebang promotes unity, cooperation, and social capital within the village. This, in turn, strengthens the community's ability to address challenges, capitalize on opportunities, and collectively work towards their shared goals.⁴³

Challenges of the Kebang's Role in Socio-Political Dynamics:

- 1. Balancing Tradition and Modernity:** The Kebang faces the challenge of balancing traditional practices with the evolving needs and aspirations of the community. Adapting to contemporary challenges, such as technological advancements, changing economic dynamics, and social transformations, requires thoughtful consideration and continuous dialogue.⁴⁴
- 2. Kebang and Socio-Political Dynamics:** The Kebang, a traditional socio-political institution in Arunachal Pradesh, plays a significant role in shaping the socio-political dynamics of the region. It promotes participatory decision-making, represents local interests, and contributes to village development and resource management. In this section, we will delve into these aspects and explore the impact of the Kebang on the socio-political dynamics of Arunachal Pradesh.⁴⁵
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Advantages of the Kebang's Role in Socio-Political Dynamics:

- 1. Grassroots Democracy:** The Kebang serves as a grassroots democratic institution, allowing community members to actively participate in the decision-making processes. This enhances democratic values, promotes inclusivity, and empowers individuals within the community. ⁵⁰
- 2. Preservation of Indigenous Identity:** The Kebang plays a pivotal role in preserving the indigenous identity of the community. It ensures that decisions and policies are in line with the community's cultural heritage, traditions, and customs. This preservation contributes to the resilience and sustainability of indigenous cultures in the face of external influences.
- 3. Community Cohesion and Social Capital:** The Kebang's emphasis on community involvement and participatory decision-making fosters community cohesion and builds social capital. It strengthens relationships, promotes mutual trust, and encourages collective action for the betterment of the community.⁵¹
- 4. Challenges of the Kebang's Role in Socio-Political Dynamics:** Balancing Tradition and Modernity: The Kebang faces the challenge of balancing traditional practices with the evolving needs and aspirations of the community. Adapting to contemporary challenges, such as technological advancements, changing economic dynamics, and social transformations, requires thoughtful consideration and continuous dialogue.⁵²

Hypothetical Case Studies and Examples

Case Study 1: Resolution of the Land Dispute

In a village in Arunachal Pradesh, a land dispute emerged between two families over a boundary issue. The dispute escalated, causing tension and discord within the community. The Kebang, being the traditional institution responsible for conflict resolution, intervened to address the issue. The council members conducted hearings, listened to both parties, and examined historical records and testimonies.

Through extensive discussions and negotiations, the Kebang facilitated a consensus-based resolution. The council members encouraged the disputing families to reach a compromise that respected their respective interests. Ultimately, a mutually acceptable solution was reached, defining the boundary and providing a framework for peaceful coexistence.

This case demonstrates the Kebang's role in resolving complex disputes through dialogue, mediation, and adherence to customary laws. The council members' impartiality, knowledge of local customs, and commitment to community welfare played a crucial role in restoring harmony and maintaining social cohesion.

Case Study 2: Community Development Initiatives

In another village, the Kebang initiated a community development project to address the lack of access to clean drinking water. Recognizing the importance of this issue for the well-being of the community, the council members mobilized community resources, sought external funding, and organized a collaborative effort involving community members, local government agencies, and NGOs.

The Kebang facilitated discussions to identify potential solutions, conducted feasibility studies, and oversaw the implementation of the project. They ensured transparency in the allocation of resources, involved community members in decision-making, and provided oversight to guarantee the project's successful execution.

The initiative not only addressed the immediate problem of clean drinking water but also fostered a sense of collective responsibility and community ownership. It empowered the community by actively involving them in decision-making processes, building their capacity, and promoting sustainable development.

These case studies highlight the critical role of the Kebang in justice administration and socio-political affairs. The Kebang's involvement in resolving conflicts and addressing community development needs reflects its ability to bring people together, provide a platform for dialogue, and promote inclusive decision-making. Through their wisdom, mediation skills, and commitment to the well-being of the community, the Kebang members contribute to social harmony, sustainable development, and the preservation of indigenous identity.

Case Study 3: Environmental Conservation and Resource Management

In a village located near a pristine forest area, the Kebang played a crucial role in addressing the challenges of environmental conservation and resource management. The community recognized the need to protect their natural resources, prevent deforestation, and promote sustainable practices.

The Kebang took the initiative to establish rules and regulations regarding forest usage, such as restrictions on logging, hunting, and unsustainable practices. They organized awareness campaigns,

conducted training sessions, and actively involved community members in conservation efforts.

Through their leadership, the Kebang facilitated collaborations with government forestry departments, conservation organizations, and research institutions. They advocated for the implementation of sustainable forest management practices and lobbied for the recognition of community-led conservation initiatives.

The Kebang's efforts resulted in the establishment of community-managed forest reserves, the implementation of reforestation projects, and the adoption of sustainable livelihood practices that reduced dependence on forest resources. These actions contributed to the preservation of biodiversity, the mitigation of climate change, and the protection of the community's cultural heritage.

Case Study 4: Conflict Resolution in Inter-Village Disputes

Inter-village conflicts can arise due to various factors, such as resource competition, historical grievances, or disputes over territorial claims. The Kebang plays a critical role in mediating and resolving such conflicts, ensuring peaceful coexistence among villages.

In a particular case, two neighboring villages had a long-standing dispute over the ownership and use of a fertile agricultural land. The conflict had caused hostility and strained relationships between the communities for years.

The Kebang members from both villages came together to facilitate dialogue, reconciliation, and negotiations. They organized joint meetings, encouraging open communication and fostering an understanding of each other's perspectives.

Through a series of discussions, facilitated by the Kebang, the villages reached a consensus on the sharing and management of the agricultural land. The agreement not only resolved the immediate conflict but also created a framework for collaboration in future endeavors and strengthened inter-village relationships.

This case illustrates the Kebang's role in conflict resolution between communities, promoting peace, and facilitating cooperative approaches to shared resources. The Kebang's impartiality, mediation skills, and commitment to the well-being of the larger community were instrumental in resolving the conflict and fostering long-term harmony.

These case studies exemplify the Kebang's significant contributions to justice administration and socio-political dynamics in Arunachal Pradesh. Through their involvement in resolving conflicts, addressing community development needs, advocating for environmental conservation, and mediating inter-village disputes, the Kebang showcases its effectiveness as a grassroots institution that promotes social cohesion, sustainable development, and the preservation of indigenous values and identity.

1. **Challenges and Criticisms:** Challenges and criticisms are important to consider because they provide a critical lens through which to evaluate the functioning and effectiveness of the Kebang, as well as to identify areas for improvement.⁵³ Here are a few reasons why challenges and criticisms are valuable:
2. **Gender and Social Inclusion:** One of the common criticisms of the Kebang is its historically male-dominated nature, with limited representation of women and marginalized groups. This raises concerns about the inclusivity and representation of diverse voices within the decision-making processes of the Kebang. Efforts are being made to address this issue by promoting gender equality and ensuring the meaningful participation of women and marginalized groups.⁵⁴
3. **Lack of Legal Codification:** Customary laws and practices followed by the Kebang may lack formal legal codification. This can lead to challenges in ensuring consistency, predictability, and uniformity in decision-making. The absence of a standardized legal framework can result in variations in interpretations and outcomes across different Kebangs.⁵⁵
4. **Limited Access to Legal Expertise:** The Kebang's reliance on customary practices may result in limited access to legal expertise and professional legal advice. This can be a challenge when dealing with complex legal issues or when navigating interactions with formal legal systems. The lack of legal expertise within the Kebang can potentially limit the depth of legal understanding and the ability to ensure legal rights and protections.
5. **Balancing Traditional Practices with Evolving Societal Needs:** The Kebang faces the challenge of balancing traditional practices with the evolving needs and aspirations of the community. As society changes and new challenges arise, the Kebang must adapt to address contemporary issues such as land disputes, cybercrimes, environmental concerns, or human rights issues. Striking a balance between preserving customary practices and responding to evolving societal needs can be a complex and ongoing challenge.⁵⁶
6. **Implementation and Enforcement:** While the Kebang may make decisions and recommendations, the effectiveness of their implementation and enforcement can vary. The lack of formal legal authority or mechanisms to enforce decisions may limit the impact and reach of the Kebang's decisions in certain situations.⁵⁷ Collaborative efforts with formal legal systems and government authorities may be required to ensure the implementation and enforcement of Kebang's decisions.
7. **Identifying Limitations:** Challenges and criticisms shed light on the limitations of the Kebang's current practices and processes. By recognizing these limitations, it becomes possible

to address them and enhance the institution's ability to effectively administer justice and navigate socio-political dynamics.⁵⁸

- 8. Ensuring Accountability:** Critiques and challenges help hold the Kebang accountable for its actions and decisions. By engaging in constructive criticism, it encourages transparency, ethical conduct, and the continuous improvement of the institution's functioning.⁵⁹
- 9. Promoting Fairness and Inclusivity:** Examining challenges and criticisms helps ensure that the Kebang operates in a manner that is fair, just, and inclusive. By addressing issues related to gender representation, social inclusion, and equal access to justice, the Kebang can better serve all members of the community and promote equality.⁶⁰
- 10. Encouraging Adaptability:** Challenges and criticisms help the Kebang adapt to changing societal needs and evolving dynamics. By acknowledging areas where traditional practices may need to be adjusted or aligned with contemporary requirements, the institution can remain relevant and responsive to the evolving needs of the community.⁶¹
- 11. Enhancing Legitimacy:** By addressing challenges and criticisms, the Kebang can strengthen its legitimacy and credibility. This is important for the community's trust in the institution and its willingness to seek justice through the Kebang's processes.⁶²
- 12. Driving Continuous Improvement:** Challenges and criticisms provide opportunities for learning and growth. By actively addressing shortcomings, the Kebang can continually improve its practices, decision-making, and overall effectiveness in administration of justice and socio-political affairs.⁶³

While challenges and criticisms may highlight areas of concern, they should be seen as opportunities for positive change rather than as outright condemnations. By recognizing and responding to these challenges, the Kebang can enhance its role in promoting justice, governance, and socio-cultural preservation in a more effective and inclusive manner.

Balancing Customary Practices with Evolving Societal Needs: Finding the right balance between customary practices and evolving societal needs is a significant challenge for the Kebang. As communities undergo social, economic, and technological changes, there is a need to adapt customary practices to address emerging issues while preserving the community's cultural heritage. This challenge requires continuous dialogue, open-mindedness, and a willingness to critically examine and reinterpret customary practices. It involves engaging with community members, seeking their input, and incorporating their perspectives into decision-making processes.⁶⁴ It also necessitates collaboration with experts from various fields, including law, governance, and social sciences, to

ensure a comprehensive and inclusive approach. Additionally, education and awareness programs can play a vital role in enhancing understanding and bridging the gap between traditional practices and evolving societal needs. By fostering dialogue, promoting critical thinking, and nurturing a culture of continuous learning, communities can navigate the challenges of balancing customary practices with the changing dynamics of their society.⁶⁵

Addressing these challenges and striking a balance between tradition and modernity is crucial for the Kebang to remain relevant, effective, and responsive to the evolving needs of the community it serves.

- 1. Comparative Perspectives:** The Kebang of Arunachal Pradesh shares similarities and differences with other traditional institutions in India and around the world.⁶⁶ Let's explore some comparative perspectives:
- 2. Panchayati Raj System in India:** The Panchayati Raj system is a decentralized form of local governance in India. It involves elected village councils that handle local administrative, developmental, and judicial functions. While the Kebang operates as a traditional institution, the Panchayati Raj system is a statutory framework established by the Indian Constitution. Both systems aim to empower local communities and involve them in decision-making processes, but they differ in their structure and legal recognition.⁶⁷
- 3. Native Title and Tribal Councils in Australia:** Australia has a system of native title recognition and tribal councils for Indigenous communities. These councils play a role in governing and managing traditional lands and resources. Similar to the Kebang, they are rooted in indigenous customs and practices, focusing on preserving cultural heritage and addressing community needs. However, the legal frameworks and socio-political contexts in Australia differ from those in Arunachal Pradesh.⁶⁸
- 4. Jirga and Shalish in Afghanistan and Pakistan:** Jirga and Shalish are traditional dispute resolution mechanisms in Afghanistan and Pakistan, respectively. They involve community elders and leaders who gather to mediate and resolve conflicts based on customary laws and traditions.⁶⁹ Like the Kebang, Jirga and Shalish prioritize reconciliation and restorative justice. However, they operate in different cultural contexts and have distinct practices and procedures.
- 5. Customary Courts in Africa:** Many countries in Africa have customary courts that administer justice based on traditional norms and customs. These courts, similar to the Kebang, address disputes and provide legal remedies within the framework of customary laws. However, the specific practices and structures of customary courts vary across different African countries and communities.⁷⁰

Comparing the Kebang with these traditional institutions highlights the diversity of approaches to local governance and justice administration. While each institution operates within its own cultural, historical, and legal context, they share common objectives such as preserving cultural heritage, community participation, and resolving disputes based on customary laws.

Comparative studies enable a deeper understanding of the strengths, limitations, and adaptations of traditional institutions in different socio-cultural settings.⁷¹

It is important to recognize that each traditional institution has its unique characteristics, and their effectiveness and acceptance may vary within their respective communities and legal systems. Comparative perspectives can inform discussions on best practices, innovations, and challenges faced by these institutions, ultimately contributing to the ongoing dialogue on justice, governance, and community empowerment.

Policy Implications: Policy implications refer to the recommendations and actions that can be taken based on the findings and conclusions of a research study. They provide guidance on how the research findings can be applied in practical terms to address specific issues or achieve desired outcomes. Policy implications help bridge the gap between research and practice by suggesting potential courses of action for policymakers, government officials, and other relevant stakeholders. The need for policy implications arises from the recognition that research findings have the potential to inform decision-making and shape policy development. By translating research into actionable recommendations, policy implications ensure that the knowledge generated through research is utilized to address real-world problems and improve outcomes. Policy implications help policymakers and other stakeholders understand the relevance and applicability of research findings to specific contexts. They provide insights into the potential benefits, challenges, and trade-offs associated with different policy options. Policy implications also guide the allocation of resources, the development of programs and interventions, and the formulation of legislation or regulations.

In the context of the research on the Kebang, policy implications are important to harness the insights gained from the analysis of its role in the administration of justice and socio-political dynamics. They provide actionable recommendations for integrating the Kebang into the formal legal framework, strengthening its role in promoting local governance and socio-cultural preservation, and addressing challenges and limitations identified in the research.

Policy implications help ensure that the research findings on the Kebang are not limited to academic discourse but are translated into practical measures that can bring about positive changes in the justice system, governance structures, and the overall well-being of the community. They facilitate evidence-based decision-making and the effective implementation of policies that are responsive to the needs

and aspirations of the people.

In summary, policy implications are necessary because they provide actionable recommendations based on research findings, helping policymakers and stakeholders translate knowledge into practice, improve decision-making, and address real-world challenges. Integrating Kebang into the Formal Legal Framework: Recognizing the significance of the Kebang in the administration of justice, there could be efforts to integrate its practices and decisions into the formal legal framework. This can involve documenting and codifying customary laws, ensuring consistency and predictability in decision-making, and providing legal recognition to the Kebang's decisions within the existing legal system. Collaboration between the Kebang and formal legal institutions can enhance access to justice, promote legal rights, and ensure the harmonious functioning of both systems.

Strengthening the Role of Kebang in Local Governance: The Kebang can play a vital role in promoting local governance and community empowerment. Policy measures should focus on strengthening the Kebang's role in decision-making processes related to community development, resource management, and social welfare. This can involve capacity building for Kebang members, promoting inclusivity and gender representation, and establishing mechanisms for collaboration between the Kebang and government authorities.

Socio-Cultural Preservation: Recognizing the Kebang's role in preserving indigenous identity and cultural heritage, policies should prioritize the preservation and promotion of traditional practices and customs. Efforts can include supporting cultural festivals, heritage preservation initiatives, and educational programs that promote awareness and understanding of indigenous customs. This can help maintain the socio-cultural fabric of the community and foster a sense of pride and identity among community members.

Findings:

1. The Kebang system of justice in Arunachal Pradesh operates within the framework of the Indian legal system. The Kebang is an indigenous system of dispute resolution that is recognized and respected by the government and the local communities. It functions as a community assembly where disputes are heard and resolved through consensus-based decision-making, typically led by community elders and leaders.
2. The impact of the Kebang system on socio-political dynamics in Arunachal Pradesh is a complex and multifaceted topic. It plays a crucial role in maintaining social cohesion, resolving conflicts, and preserving the cultural identity of various indigenous communities in the state. The Kebang system also provides a platform for community participation and democratic decision-making, which can influence local governance and political dynamics.

3. When comparing the Kebang system of justice to other forms of justice systems in India, it is important to consider the unique characteristics and cultural context of Arunachal Pradesh. Unlike the formal judicial system, the Kebang system is deeply rooted in local customs, traditions, and community values. It emphasizes reconciliation, restoration of harmony, and preservation of community relationships, which may differ from the adversarial approach of the mainstream legal system.
4. Key differences between the Kebang system and other forms of justice systems in India include the decentralized and participatory nature of the Kebang, reliance on oral tradition and customary laws, emphasis on consensus-building, and the involvement of community elders and leaders in the decision-making process. In contrast, the formal legal system in India follows a more centralized and hierarchical structure with codified laws and a focus on legal precedents.
5. The Kebang system of justice aims to ensure access to justice for all members of the community, including vulnerable and marginalized groups. It provides a platform for their voices to be heard and considered in dispute resolution processes. However, the effectiveness of the system in achieving justice for these groups may vary, and further research would be needed to explore the specific mechanisms and challenges related to ensuring access to justice for vulnerable and marginalized communities.
6. Challenges faced by the Kebang system of justice in Arunachal Pradesh may include issues related to the integration of customary laws with formal legal frameworks, ensuring consistency and coherence in decision-making, addressing gender biases and inequalities, balancing traditional practices with evolving societal needs, and adapting to changing socio-political dynamics and external influences.
7. The Kebang system of justice has evolved over time in response to various factors, including social, cultural, and political changes. Historical research and analysis of the system's development, transformations, and adaptations would be necessary to understand its evolution in greater detail.
8. The role of the Kebang system of justice in promoting gender justice in Arunachal Pradesh would require a comprehensive examination. It would involve exploring how gender issues are addressed within the Kebang system, the representation and participation of women in decision-making processes, the extent to which gender biases are present or challenged, and the impact of the system on women's rights and empowerment.
9. The influence of the Kebang system of justice on the overall development of Arunachal Pradesh is a broad and interconnected topic. It can be explored through examining its contributions to

social cohesion, cultural preservation, local governance, conflict resolution, and the empowerment of communities. Evaluating the system's impact on various sectors, such as education, healthcare, infrastructure, and economic development, would be essential in understanding its role in overall development.

10. Strategies to strengthen the Kebang system of justice in Arunachal Pradesh would require a careful assessment of the system's strengths and weaknesses. Potential strategies could include capacity building and training for Kebang members, creating mechanisms for coordination and cooperation between the Kebang system and the formal legal system, enhancing awareness and understanding of the system among the general population, ensuring inclusivity and representation of diverse communities, and addressing any systemic challenges or limitations that may hinder its effectiveness.

Conclusion: The research on the Kebang of Arunachal Pradesh highlights its significant role in the administration of justice and socio-political dynamics. The Kebang, as a traditional institution, contributes to dispute resolution, reconciliation, and community development based on customary laws and practices. Its emphasis on participatory decision-making, reconciliation, and restorative justice aligns with indigenous values and promotes social harmony.

The research also sheds light on the challenges faced by the Kebang, such as gender and social inclusion, balancing traditional practices with evolving societal needs, and the lack of legal codification. Recognizing these challenges, policy implications include integrating the Kebang into the formal legal framework, strengthening its role in local governance, and promoting socio-cultural preservation.

Findings: The findings of this research contribute to the understanding of the Kebang's significance in Arunachal Pradesh, highlighting its role in providing accessible justice, preserving indigenous identity, and fostering community cohesion. The policy implications provide guidance for practical implementation and further research.

Future Directions: Future directions for research can explore in-depth case studies, comparative analysis with other traditional institutions, and the impact of policy interventions on the functioning and effectiveness of the Kebang. Continued research and practical implementation can further enhance the Kebang's role in justice administration and socio-political dynamics, contributing to the overall well-being and development of Arunachal Pradesh.

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CLOUD-DRIVEN SECURITY ARCHITECTURES FOR INTERNET OF THINGS: A COMPREHENSIVE REVIEW

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Abstract

This paper examines the evolving security landscape of cloud computing and IoT, with more security breaches and efficiency at different technical solutions. This interpretative study employs case studies, expert interviews, and surveys to examine cybersecurity concerns based on privacy, trust, and technology. The report shows a decade-long rise in security breaches, peaking in 2015 and 2020. This pattern indicates increased cyber risks that demand substantial security changes. Expert interviews and data analysis emphasize the relevance of technology, especially ML and DL, in threat protection and mitigation. Some of the key emerging security technologies in recent research, such as strong third-party vendor management as identified in the Target data breach case study, also reinforce comprehensive security practices. The study was highly supportive of using security technologies and frameworks to address privacy and confidentiality challenges. A future study should include artificial intelligence in cybersecurity strategy, real-time monitoring, and blockchain technology. Future research will reveal how these technologies can improve security, threaten detection, and create new challenges in cloud computing and IoT environments. The report helps firms improve their cybersecurity in a complex digital environment by identifying current cybersecurity threats and solutions.

Keywords: Cloud Computing, Data Security, Internet of Things, Artificial Intelligence, Deep Learning, Reliability and Normality Analysis

1. INTRODUCTION

An extensive network of connected IoT-enabled devices and apps makes up an IoT-based cloud architecture. This infrastructure is made up of several different parts, including servers, storage, operations, real-time processing, and underlying infrastructure. It also includes the services and standards required to link, control, and secure different IoT applications and devices. An illustration of an IoT architecture can be found in Figure 1. Cloud computing has developed quickly over the last ten years, and its breakthroughs have continued into the present decade. The Internet of Things (IoT)

is a prominent force among these breakthroughs. At the same time, there is a growing momentum for contemporary developments in service designs, data centre operations, distributed cloud environments, and management domains. According to a recent Gartner report, cloud computing is one of the top ten essential technological trends for 2020, and the market for cloud services is predicted to expand by 17% in that year.

In the 1990s, distributed computing platforms were referred to as "cloud computing" for the first time. Elastic Compute Cloud (EC2), for instance, was introduced by Amazon in 2006. In a similar vein, Google released Google App Engine in beta in 2008. OpenNebula, the first open-source program for setting up private and hybrid clouds, was released by NASA in the same year. Microsoft then introduced OpenStack, an open-source cloud computing project, in 2010 and released Microsoft Azure in 2008. IBM created the IBM Smart Cloud framework in 2011. The next year, infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) were made available by Oracle with the launch of its first Oracle Cloud. There are yet more technological advances in the digital realm to come, and this cloud innovation journey is still underway.

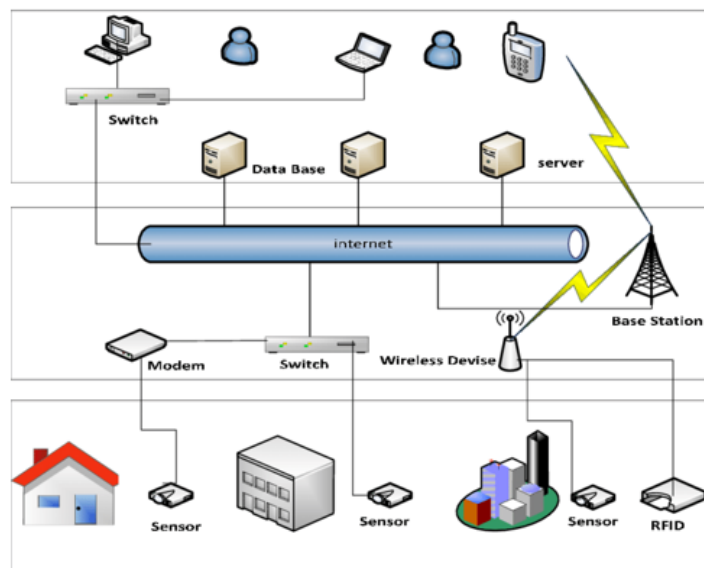


Figure 1: Typical Architecture of IoT

Five essential elements of cloud computing have been identified by the National Institute of Standards and Technology (NIST): measurable service, resource pooling, fast flexibility, network connectivity, and on-demand self-service. There are four deployment strategies and three service models available for effectively delivering cloud services. Offering a broad range of computing services via the internet, including networking, servers, storage, databases, analytics, and intelligence, is the main goal of cloud computing. Customers can choose the kind and amount of services that best suit their need.

There has been a notable transition from traditional IT services to cloud-based solutions due to the cloud's capacity to provide quick data storage and access, affordability, user-friendliness, and flexibility in the workplace. Thanks to cloud computing, businesses no longer need to spend money on pricey hardware and software to create and manage on-site data centers. Cloud technology automates whole businesses by hosting its services and software on remote computers. Numerous industries have embraced this approach, which is only becoming more popular every year.

1.1. Objectives of the Study

- To conduct a thorough analysis of the security risks associated with Internet of Things (IoT) and cloud computing.
- To determine the elements influencing the security and privacy of cloud and IoT technology adoption.
- To look into, using data analysis and expert opinions, the efficacy and dependability of security technology and initiatives.

2. LITERATURE REVIEW

Obi et al. (2024) examined cloud security, efficiency, and innovation. They discuss cloud computing's rapid growth's challenges and opportunities. Cloud security issues such data privacy, integrity, and access control is assessed. Cyber threats are escalating, thus the writers assess the latest data protection measures. Efficiency options for performance, resource allocation, and scalability are examined. The authors discuss best practices and new trends in cloud providers' efforts to meet demand for efficient and sustainable computing. The study also examines edge computing, serverless architectures, and containerization's impact on cloud computing. The research presents key findings and stresses the necessity to adapt to changing paradigms for a secure, efficient, and creative digital future.

Dinesh and Murthy (2024) examined cloud-connected IoT security challenges and solutions. IoT system architecture and capabilities are analyzed as cloud computing and IoT merge. Insecure communication pathways and device authentication issues are discussed and how integration has changed. Authors stress multifactor authentication, secure identity management, and role-based access. The chapter discusses encryption, privacy, end-to-end encryption, and data privacy. The writers explain IoT device security from setup and onboarding to real-time monitoring and updates. Future trends and difficulties include edge computing, scalability, and interoperability.

Rao and Deebak (2023) examined IoT security and privacy research challenges and goals. Healthcare, intelligent transportation and home automation manage real-time data with billions of smart IoT devices. Four modules are covered: convergence technologies and their security and privacy

challenges; state-of-the-art technologies and their security requirements and challenges; key agreement schemes based on network models and performance analysis to identify vulnerabilities; and thematic analysis to propose security and privacy solutions

Rahman and colleagues (2023) evaluated IoT security and cloud-based solutions. They address IoT ecosystem security concerns induced by device expansion, heterogeneity, and resource constraints. Cloud-based security solutions like centralized management, authentication, and real-time threat detection are examined. Cloud-based IoT security solutions are assessed utilizing literature, case studies, and empirical analysis. Cloud solutions secure IoT ecosystems with centralized management, advanced authentication, and real-time threat detection. These solutions need more research to optimize for IoT applications and use cases, according to the report.

Aljabri (2023) presented a thesis on enhancing IIoT data protection compliance. Searchable encryption with multi-authority access is implemented in the Edge Lightweight Searchable Attribute-based Encryption system, an edge-server architecture in the thesis. ELSA uses a trustworthy edge server and query optimizer to improve search performance beyond encryption solutions. ELSA improves search performance, scalability, and efficiency while reducing storage and network traffic, according to the thesis. ELSA's efficiency with well-known IIoT datasets is shown by integrating machine-learning approaches to reduce lookup table size and execution time.

Verma and Bhardwaj (2022) addressed the limits of traditional cloud computing in IoT applications like smart transportation and healthcare. They say traditional cloud systems lack responsiveness, geographical spread, latency, and location awareness, which these applications require. Fog computing and IoT are combined in the Fog-IoT paradigm model to address these issues. Fog computing brings computation to the network edge, improving efficiency and responsiveness. Fog-assisted IoT applications and fog computing research in IoT are covered in the chapter. It discusses fog computing problems and recommends Fog-IoT paradigm research potential.

Firouzi et al. (2022) explained edge-haze cloud foundations, reference architectures, components, and applications. The article covers service models, offloading, security, infrastructure configuration, provisioning, and performance evaluation. Distributed, collaborative, and privacy-preserving analytics and cloud, fog, and edge computing are also examined. The study provides a complete overview of edge-haze clouds and their potential to improve IoT applications, emphasizing important issues and research gaps.

3. RESEARCH METHODOLOGY

In order to collect and evaluate data, this research takes an interpretive stance. Its main goal is to

comprehend the myriad problems surrounding cybersecurity, cloud computing security, Internet of Things (IoT), privacy, and trust, as well as the accompanying difficulties. Multiple case studies, an examination of previously published research articles, questionnaires, and expert digital interviews are all part of the technique.

3.1. Data Collection Methods

1. **Case Studies:** Case studies are essential in this research because it provides the necessary comprehensive study about many security issues related to cloud computing and the Internet of Things. By referring to literature and articles relating to similar topics, the research approach will be able to compare and draw inductive reasoning upon well-researched evidence. A list of some significant Cloud Computing and IoT security breaches and incidents was selected. This would range from high-profile cases, such as the Target data breach in 2013, to other relevant examples.
2. **Questionnaires:** A questionnaire was designed and forwarded to eighty professionals related to IoT and cloud computing fields. Questions were meant to obtain qualitative responses related to the pattern of privacy breach, the factor of cloud and IoT application adoptions, and technology solutions efficiency in solving the security issues. The response rate is 75%. Other questions in the questionnaire were related to the frequency of violation of privacy, factors of the adoption of technology, and opinions about security solutions. The survey has been designed in consultation with cybersecurity professionals to be relevant as well as comprehensive.
3. **Interviews:** Structured in-depth interviews with experts were carried out to understand some of the intangible aspects of cloud computing security. Interviews allowed for a better understanding of feelings, experiences, and memories related to the occurrence of security breaches within their industry. The nature of the interviews being open-ended provided a normal flow of discussion between the interviewer and the respondent, which further eased the evaluation of the security risks with greater elaboration. For experts, a total of two were selected based on their vast experience and knowledge in the realm of cloud security and IoT. Their selection was made through reviewing their professional backgrounds and the contribution they had given.

3.2. Data Analysis Methods

- **Statistical Analysis:** The information gathered from the questionnaires and interviews was examined using ANOVA (Analysis of Variance) statistical test procedures. Using this technique made it possible to spot important variations and patterns in the reactions to security breaches and the implementation of security measures.
- **Data Normality and Reliability:** The collected data's normalcy and reliability were assessed using the NCSS data analysis tool. This made sure that the data was appropriate for additional statistical analysis and that solid, trustworthy data served as the foundation for the results reached.

This research's technique offers a thorough way to comprehend the intricate problems relating to cloud computing and Internet of Things security. In addition to exploring potential solutions for strengthening privacy and trust in cloud and IoT-based systems, the project intends to identify the underlying reasons contributing to security breaches by combining qualitative data from case studies, questionnaires, and interviews with statistical analysis.

4. DATA ANALYSIS

The experimental analysis and assessment examine the empirical study's findings and determines whether they are consistent with the arguments made in related works. The experiment's design aims to record participants' subjective and objective responses to questions about insecurity. The researcher can get information from the interviews about the effectiveness of current security measures as well as the progress of cloud computing security over the past ten years, both verbally and nonverbally. According to the findings, there has been a rise in security events over time, and businesses must devise sophisticated strategies to address privacy violations.

4.1. Increased Frequency of Security Breaches

The frequency of breaches in the modern world was one of the numerous questions that were posed in questionnaires and interviews. Participants disclosed that since 2011, there have been more security breaches. The inquiry entailed enquiring about the number of breaches that each industry could recall in the corresponding year. The responses were collated and shown in a graph, as depicted in Table 1. The orange line represents the frequency in each year, and the blue line represents the progression of years. The pattern suggests that breaches rise over time. Participants cited technology advancement as the primary factor contributing to hostile assaults.

Table 1: Increase in Frequency of Security Breaches

Year	Frequency
2011	18
2012	17
2013	19
2014	12
2015	21
2016	11
2017	11
2018	16
2019	18
2020	21

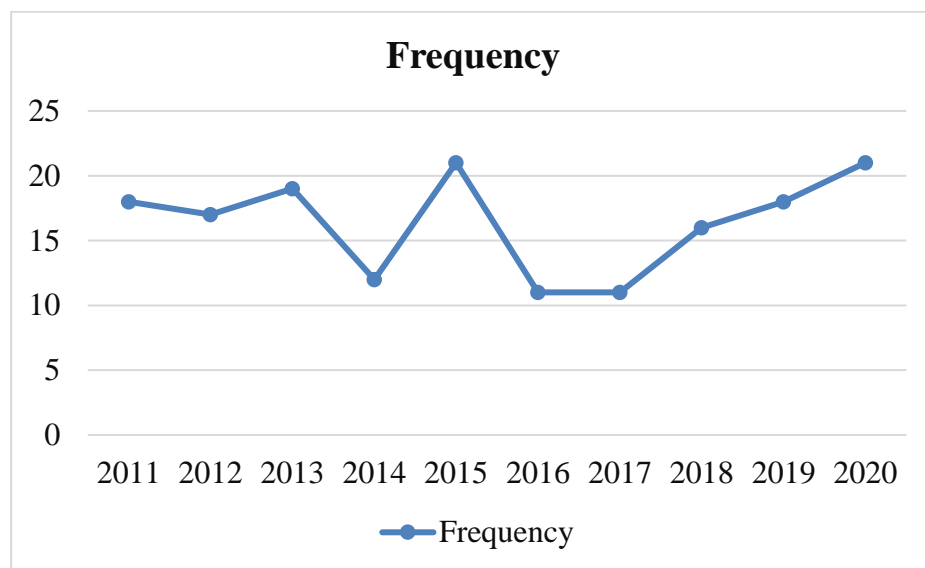


Figure 2: Increase in Frequency of Security Breaches

However, from Table 1 or Figure 2, one is able to realize an exponential growth in the incidence of security breaches over the last ten years. It peaks at 21 incidents in 2015 and repeats in 2020. This thus forms a trend that illustrates the increased prevalence of security threats; perhaps organizations are facing more sophisticated threats recently with advancement in technology. Different annual ups and downs of breach frequencies reflect changes in the security measures by organizations or in the attack techniques, or both. A general uptrend is what is usually observed, reflecting how demanding the needs are for a far superior set of security protocols with the increase in the number of breaches.

Concerns raised about variables that may be impacting the uptake of IoT and cloud computing

technologies:

F1: Privacy, Security, and Trust

F2: Using deep learning (DL) and machine learning (ML), quick attack identification and mitigation

F3: The significance of IDS, IPS, and firewalls

F4: Policies for the use of resources

F5: Agreement on Service Level

F6: Employing ML and DL for Load Balancing

F7: Minimal operating and maintenance expenses

Table 2 emphasizes the significance of machine learning and deep learning in identifying and reducing cyberattacks, as well as the crucial role that security plays in cloud applications. Strong security procedures, in the opinion of the vast majority of participants (93%) are necessary to handle privacy and confidentiality issues. But 7% of respondents believe that these problems cannot be completely solved by technology alone because there is still a high chance of human misbehavior. The results emphasize the significance of putting in place thorough security measures, such as firewalls, intrusion detection and prevention systems, anti-malware programs, and hardware authentication, as well as the critical role that cutting-edge technologies, like machine learning and deep learning, play in optimizing information security.

Table 2: Factors Affecting Cloud and IoT Adoption

Factors	Influence %
F1	93
F2	91
F3	90
F4	88
F5	82
F6	80
F7	71

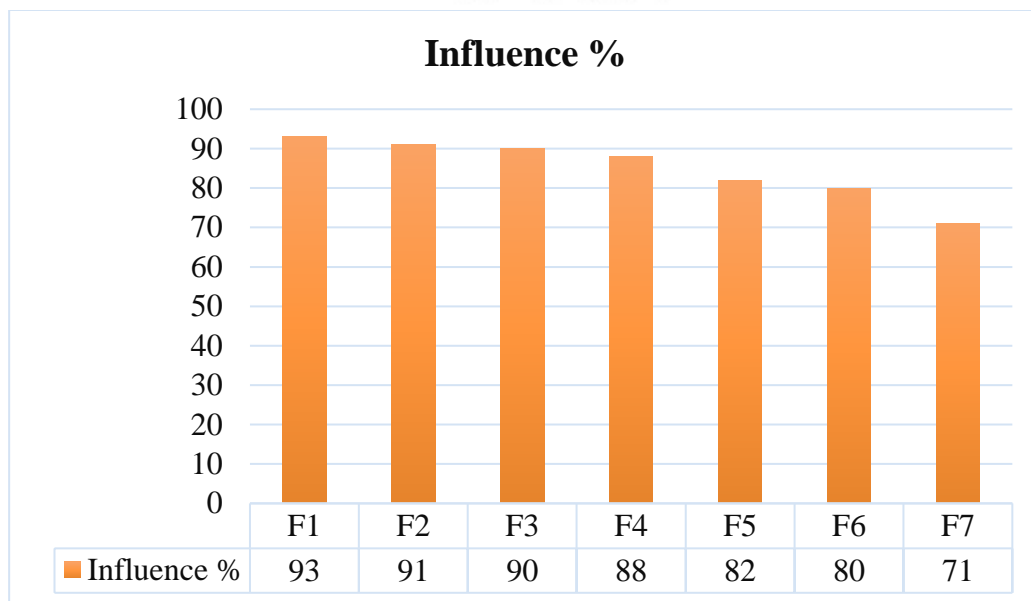


Figure 3: Factors Affecting Cloud and IoT Adoption

Figure 3, Table 2 shows the factors that influence the adoption of cloud computing and IoT technologies as perceived by the survey participants: Privacy, security, and trust is the most important concern, highlighted by a considerable percentage of 93% of respondents. Other important factors are deep learning for attack detection and mitigation, and other machine-learning approaches-ninety-one percent agreed to this factor (F2), while traditional security measures, including intrusion detection and prevention systems, find their importance assessed by 90% participants as essential. Resource policies, service level agreements, and load balancing were other factors identified, but considered less critical. Results have shown a consensus on the need for comprehensive security and advanced technologies that can manage the challenges of cloud and IoT adoption. The opinions of those who operate in the cloud storage sector support the need for security measures, emphasising the use of human behaviour analytics to supplement digital systems that ensure privacy. The study's conclusions offer answers to the privacy and confidentiality issues as well as the essential details regarding how cloud storage is susceptible to assault and how to prevent future intrusions.

4.2. Reliability and Normality Analysis

The data was checked for compliance with the ANOVA assumptions using a normality analysis as shown in table 3. Because the test values for Kurtosis and Skewness were so near to zero, it may be concluded that the data has a normal distribution and is symmetrically distributed. It is not possible to reject the null hypothesis of normality because the probability values for skewness (0.0000000400) and kurtosis (0.0000000800) are both significantly greater than the significance level of $\alpha = 0.20$. As

a result, the data is regarded as regularly distributed, supporting the application of ANOVA in additional analysis.

Table 3: Tests for Normality

Normality Attributes	Test Value	Probability Level	Reject Normality? ($\alpha=0.2000000000$)
Skewness	0.0000000006	0.0000000400	No
Kurtosis	0.0000000000	0.0000000800	No

Cronbach's Alpha, a measure of the internal consistency of the factors impacting the adoption of cloud and IoT-based technologies, was used to conduct the reliability analysis for the study. High reliability is shown by the results for every factor in the below table 4. With an Alpha value of 0.9550, factor F1 (trust, security, and privacy) demonstrated the strongest internal consistency and the highest level of reliability. The next closest factor, F2 (Fast Attack Detection and Mitigation using ML and DL), had an Alpha of 0.9452, indicating strong reliability. The importance of firewalls, IDS, and IPS—factor F3—also showed good reliability, scoring 0.9360. Notwithstanding being somewhat lower, factors F4 through F7 showed solid internal consistency, with Cronbach's Alpha values ranging from 0.8461 to 0.8763. These discoveries recommend that the measurements utilized in the review are accurate and reliable.

Table 4: Reliability Analysis

Variable/Factors	Experts IT Industry (N=60)
	Cronbach Alpha
F1	0.9550
F2	0.9452
F3	0.9360
F4	0.8763
F5	0.8590
F6	0.8565
F7	0.8461

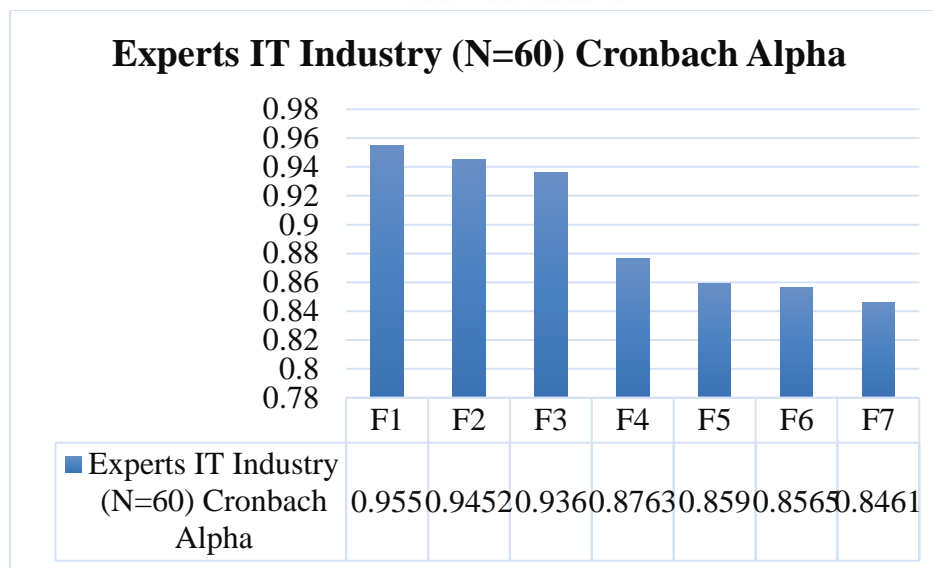


Figure 4: Reliability Analysis

4.3. Case Study

Target Data Breach (2013)

In 2013, Target Corporation fell victim to one of the largest data breaches in retail history, where credit and debit card information of about 40 million customers was exposed. Initial suspicion appeared to fall on malware installed on Target's point-of-sale systems. The attackers had accessed Target's network using stolen credentials from a third-party vendor, Fazio Mechanical Services, which maintained Target's HVAC-heating, ventilation, and air conditioning-systems. After gaining internal access to Target's network, the attackers continued to navigate and install malware on the POS systems. The hackers were capturing the payment card data as both cards went through regular transactions. The breach case showed critical vulnerabilities in third-party vendor management and how all entry points need to be treated with scrutiny to make something secure. Remediation costs, legal fees, and compensation for affected customers comprised some of the major losses that Target faced due to the breach. This further damaged the brand and eroded consumer trust. On this count, Target did catch up with a complete overhaul of security on all fronts-monitoring systems, encryption practices, and vetting of third-party vendors. The case illustrates that strict security does not apply just within one's organization but also in its value chain, implying that monitoring has to be incessant and responses to threats have to be prompt.

4.4. Results from Interview

Question 1: "From experience, how would you say that security challenges in cloud computing have changed in the last decade and which emerging technologies or practices are most involved

in meeting this new challenge?"

Interviewee 1: In any case, over the last decade, the security landscape of cloud computing has grown colossally. The major initial concerns were the security of data while in transit and at rest. Just as these cloud services have matured, so too have the security challenges. With misconfigurations and vulnerabilities, data breaches, and unauthorized access have equally risen in their attendant issues. The foreword to multi-cloud and hybrid cloud has also brought along challenges with regard to the consistent management of security policies across multiple platforms. In dynamic environments of this kind, traditional security is usually inadequate. At the center of this development has been a pronounced trend toward implementing security best practices and technologies. For example, there has been more movement towards implementing Zero Trust Architecture, which assumes that threats can either be inside or outside the network and therefore allows for stringent verification measures at each request.

Interviewee 2: Certainly, all these challenges are also being overcome with the help of emerging technologies. For example, the cloud-native security solution space around SIEM systems has reached a level where real-time threat detection and response can be effectively delivered. Furthermore, threat intelligence is enhanced by using machine learning and AI to enable automated response processes. This enables faster and more accurate anomaly identification and potential threats than possible with traditional techniques. The other essential practice is the use of automated compliance utilities that work on a continuous basis to monitor and enforce security policies within cloud environments.

Question 2: "As the IoT devices begin to extend their implementation in various sectors, what do you consider some of the most critical privacy and security issues that you are dealing with, and how will organizations be able to effectively mitigate those risks?"

Interviewee 1: Of course, the integration of IoT devices has brought several critical privacy and security concerns. One of the main issues is indeed the enormous amount of different types of devices lacking standardized security measures. This lack of standardization presents difficulties in undertaking standardized security protocols and is hence highly vulnerable. Besides the security issues, IoT devices mostly operate on the collection and transmission of personal data about the individuals, which is a very serious privacy issue. Other issues include the compromise of devices and unauthorized access to data. Many IoT devices are weak in authentication mechanisms and seldom updated. They are, therefore, prone to attacks. What's more, the relation of these devices to wider network ecosystems provides entry points into more sensitive systems for an attacker.

Interviewee 2: These risks justify a multilayered security approach by organizations, including the implementation of strong authentication protocols, keeping the devices regularly updated with the

latest security patches, and using encryption for data in transit. Network segmentation is very much essential to segregate IoT devices from other critical systems, hence limiting the probable impact of a breach. Besides, periodic running of security assessment and audits should be carried out by organizations to identify and fix vulnerabilities. The overall adoption of extensive IoT security frameworks and guidelines may also contribute to a greater role in managing and mitigating the risks effectively.

5. CONCLUSION

The research on the changing face of cybersecurity in cloud computing and IoT was presented. The integration of case studies, expert interviews, and data from questionnaires evidenced that security breaches have mounted over the last decade and underlined what crucial role advanced technologies play in responding to these challenges. The findings indicate that even as traditional security measures remain a must-have, emerging technologies like ML and DL are increasingly being leveraged to further improve threat detection and mitigation. Privacy, security, and trust remain some of the most paramount issues, and a considerable portion of the respondents emphasized the need for holistic and adaptive security solutions. This research also emphasizes the need for good security practice on all the layers within an infrastructure of an organization, including a third-party vendor management strategy, as extrapolated through the case study of the Target data breach. The results of expert interviews confirm that the security landscape is rapidly changing due to new challenges from advanced technology integration with complex multi-cloud environments.

5.1. Suggestions for Future Research

1. **Artificial Intelligence:** Future research will be on cybersecurity measures using AI. It is believed that AI will be a game-changer in threat detection due to predictive analytics and follow-on automated responses. Specific research might aim at how AI can identify pattern anomalies that define potential security threats, reduce false positives, and accelerate incident response times.
2. **Real-Time Monitoring:** In particular, is real-time monitoring, in the face of the continually growing complexity of cyber threats. The development and testing of such systems using real-time analysis of network traffic, user behavior, and system anomalies are what further research may focus on. Tests would include studies on how effective real-time monitoring tools are in finding and responding to security incidents before things get out of hand, how such tools can be honed for different kinds of cloud and IoT environments, among others.

3. **Blockchain technology:** It is a very recent domain of interest and promise that could lead to increased security and, in some instances, also transparency. Further research may be specifically devoted to the investigation of blockchain applications to cloud-IoT systems security, with special attention to immutable transaction records, enhancement of data integrity, and possibly supported decentralized security models. Other investigations should go into deeper detail on how blockchain can be integrated with existing frameworks to solve particular challenges in data privacy, access control, and auditing.

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ANALYSIS OF FREEDOM OF TRADE AND COMMERCE IN INDIA UNDER THE INDIAN CONSTITUTION

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Abstract :

Trade and commerce “have emerged as the predominant areas facilitating national development. Whether in established nations such as Japan and the USA or in emerging ones like India, trade and commerce have been fundamental to global life since antiquity. Evolution, progress, and urbanisation resulted in the swift expansion of the human population. Education has emerged as a crucial component of nations, and the demand for progress has necessitated the establishment of legislation. The necessity for constitutional law dates back to 1215, when the Magna Carta emerged as a pivotal development in the establishment of constitutional law in contemporary states. Countries evolved by implementing various laws to safeguard their residents. Currently, there are over 190 nations worldwide, of which 167 are democratic, and constitutional law has undergone several modifications and alterations. The Indian Constitution has been changed 105 times, according to statistics from August 2021. India grants six essential fundamental rights to its inhabitants, elaborated forth in Part III of the Constitution. Among the six essential rights, one main right encompassed within the right to freedom is the Freedom of Trade and Commerce. It is further elucidated in Sub-paragraph (g) of clause (1) of Article 19. Additionally, the stipulations regarding the freedom of trade, commerce, and intercourse are delineated in Part XIII of the Constitution, namely Articles 301 to 307. A basic right conferred to citizens is the freedom of trade and commerce. Over 40% of India's populace engages in trade and commerce. Every person have the freedom to engage in the profession of their preference; they may freely profess and practise any vocation within the territory of India. This right is not unconditional and does possess some exceptions. The Parliament may set certain limitations on this freedom for the sake of public interest. If a business is illegal, the government has the authority to prevent the individuals involved from continuing its operation. This will not imply that their ability to freely practise and profess any chosen employment is infringed upon. It is important to recognise that freedom does not exempt one from legal obligations. This article elucidates the constitutional provisions pertaining to the freedom of trade and commerce comprehensively.”

Keywords: Freedom of Trade and Commerce, Magna Carta, Part III of the Constitution, Article 19 (1) (g), Part XIII of the Constitution, Articles 301 – 307, Fundamental Rights.

INTRODUCTION

Introduction:

Part XIII of the “Indian Constitution elaborates on trade, commerce, and contact within the territory of India. Trade, trade, and intercourse can be domestic, foreign, or international. Articles 301 to 305 address the liberty of trade and commerce across the territory of India. India is controlled by two principal categories of trade and commerce.

1. Inter-state: trade and commerce confined within the country, i.e. it extends to two or more states as well; and
2. Intra-state: trade and commerce confined within the territory of the specific state.

The establishment of trade barriers impedes the economic progress of a nation and contravenes its national interests. The unrestricted exchange of trade, business, and interaction inside a federal nation has a dual-tier political structure that facilitates economic growth, stability, and progress. Each nation possesses distinct regulations governing trade and commerce inside its borders. In India, this freedom is not unconditional but is subject to limits deemed essential to uphold the general interest of the populace inside the region. Consequently, the valid regulatory measures that limit trade and commerce are not seen as impediments to free trade and commerce.¹ Thus, the courts have interpreted the term businesses and other activities such as gambling, illegal trade, etc. as not being a part of this Article.” “An attempt in all federations, through adopting of suitable constitutional formulae, to create and preserve a national economic fabric, transcending State boundaries, to minimise the possibility of emergence of local economic barriers, to remove impediments in the way of inter State trade and commerce and thus help in welding the whole country into single economic unit so that the economic resources of all the regions may be exploited, harnessed and pooled to the common advantage and prosperity of the country.”²

The present “article discusses the status of trade, commerce and intercourse in India, and the approach of the court through various judicial pronouncements on the issue pertaining to compensatory tax, regulatory tax and entry tax.

ARTICLE 301 AND AUSTRALIAN CONSTITUTION

The Commonwealth of Australian Constitution Act, 1900 (“**Australian Act**”) was enacted during the British Parliament and it specified separate and only specific powers to the Centre and elaborated in detail the scheme of separation of powers. Section 51³ of the Australian Act entitles 40 matters on which the Central Government has the power to legislate. However, this section does not make the power exclusive on the Centre and the states also have an authorized power to legislate in the area.

The Centre has powers in the ‘inter-state commerce’ to regulate the economic affairs of the country, as gradually trade and commerce are becoming subjects of national importance as they are major source in contributing to the economy of the country and thereby less confining within the limits of only one state. There are several points of comparison and contrast between the Australian and Indian schemes of distribution of powers. Both in Australia and India, there are certain powers that have been given exclusively to the Centre through the List I of the Indian Constitution, and these powers are more exhaustive as compared to list under the Australian Act.⁴

The crucial position for the purpose of the Australian Act is Section 92 according to which the trade, commerce and intercourse among the States shall be absolutely free. The major difference between Indian Constitution and Australian Constitution is that the clause here applies only to inter-state and not intra-state commerce, and restricts both the States and the Centre from interfering with trade and commerce.⁵

Section 92 of the Australian Act can be read as: *‘On the imposition of uniform duties of customs, trade, commerce, and intercourse among the States, whether by means of internal carriage or ocean navigation, shall be absolutely free. But notwithstanding anything in this Constitution, goods imported before the imposition of uniform duties of customs into any State, or into any Colony which, whilst the goods remain therein, becomes a State, shall, on thence passing into another State within two years after the imposition of such duties, be liable to any duty chargeable on the importation of such goods into the Commonwealth, less any duty paid in respect of the goods on their importation.’*

Section 92 guarantees both legislative as well as executive freedom and prohibits discrimination as well as fiscal burdens. In the case of *James v Commonwealth*⁶, Lord Wright stated that only ‘Section 92 declares right of trade or business.’ The Privy Council held that, *“the Commonwealth should be held to have failed in its attempt by the method adopted under the Act in question to control prices and establish a marketing system even though the commonwealth government is satisfied such a policy is in the best interests of the Australian people.”*

Thus, any attempt to interfere with the freedom of trade and commerce will act in violation to Section 92 of the Australian Act. This freedom is unlimited and unqualified but is not absolute. The court lays down criteria’s when the freedom will be restricted. The Privy Council held that: *the laws relating to trade and commerce amongst the states was compatible with the absolute freedom as mentioned and further mentioned that Section 92 gets violated only when the legislative or executive acts in a manner which is direct and immediate violation of trade, commerce or inter-course and not in circumstances*

*when there is indirect or inconsequential impediment which may fairly be regarded as remote.*⁷

Thus, this Section of Australian Act may find some of its presence in the enactment and establishment of the Part XIII of the Indian Constitution.

INTER-RELATION BETWEEN ARTICLE 301 AND ARTICLE 19(1)(G) OF THE INDIAN CONSTITUTION

Article 19(1)(g) can be read as:

“All citizens shall have the right to: .

(g) to practise any profession, or to carry on any occupation, trade or business”

Article 301 can be read as:

“Subject to the other provisions of this Part, trade, commerce and intercourse throughout the territory of India shall be free.”

Thus, the differences between the two articles are as follows:

Article 19(1)(g)	Article 301
·Acts as a Fundamental Right and confers to the right of an individual.	·Safeguards the rights to carry on trade as a whole, and is distinguished from an individual's right to trade.
·Confers rights on individuals to practise any profession and carry on any occupation, trade or business, and subject to reasonable restrictions in public interest.	·This article aims at preventing restrictions on the amount of trade flowing within the states and territory of India, and hence the effect of law on individuals is irrelevant.
·Deals with the right at rests.	·Deals with the right to trade in motion.
·Can be invoked when an individual's right to freedom to carry on any profession or business is being hampered, irrespective of the movement of goods in existent or not.	·Can be invoked when an individual is restricted or prevented from sending his/ her goods from one place to another, within the same state or in relation to inter-state trade.

·The advantage of this right being a Fundamental Right can be taken by merely citizens. This right is not available to a corporate person.	·This right being a general right, can be invoked by both citizens as well as non citizens. This right can also be invoked by corporations.
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ANALYSIS OF PART XIII OF THE INDIAN CONSTITUTION

The framers of the Indian Constitution were fully conscious about the need of freedom of trade and commerce within the territory of India, and were absolutely aware that the same was necessary for promoting economic growth, stability and progress of the federal policies in India. The framers were aware of the fact that during the course of years, different political parties with different mind-set and ideologies will form a party at the Centre and accordingly this may generate general and local pulls and pressures in the economic matters. The legislature of the States may take up measures to control regional trade and regional interest above national, thereby affecting the national economy. Hence the main object of Part XIII of the Indian Constitution with special reference to Article 301 was to remove any such possibility and ensure free movement of trade, commerce and inter-course throughout the territory of India.⁸

Article 301: “*Subject to the other provisions of this Part, trade, commerce and intercourse throughout the territory of India shall be free.*”

The words ‘*trade*’, and ‘*commerce*’ have been broadly interpreted by the courts in different case laws in a different manner, keeping in mind the facts and circumstances of each case. The freedom granted under this Part XIII of the Indian Constitution is not an absolute freedom and is subject to reasonable restrictions as mentioned under Article 302 to 307 of the Indian Constitution. The freedom provided under this Article 301 as interpreted by courts in various case laws, does not include gambling, trafficking of child and women, prostitution or any other illegal acts, either falling against the ambit of the laws of India and in violation to Indian laws.

The freedom of trade and commerce cannot be infringed in any manner for the situations as provided within the regulatory and statutory measures. The restrictions as imposed may take form either in fiscal or non-fiscal measures. Thus, there exists violation of this freedom only in cases where the legislature or executive acts or operates in a manner restricting trade, commerce and intercourse either directly or immediately.⁹

In the landmark case of *Atiabari Tea Co.*¹⁰, the court emphasized on the fact that: “*whatever else the Article 301 may or may not include, it certainly includes movement of trade which is of the very essence of all trade and is its integral part.*” The court further held that, “*Art. 301 provides that trade shall be free throughout the territory of India, it means that the flow of trade shall run smoothly and shall be unhampered by any restriction either at the boundaries of the States or at any other points inside the States themselves. It is the free movement or the any Act imposes any direct restrictions on the very movement of such goods it attracts the provisions of Art. 301, and its validity can be sustained only if it satisfies the requirements of the Article.*”

Thus, it is a well settled principle that the concept of ‘trade, commerce and intercourse’ is wide and that the word alone in its narrow sense would include all the activities in relation to buying and selling or interchange or exchange of those commodities. In the case of *State of Bombay v RMDC*, the hon’ble Supreme Court held that: the protection afforded by Article 301 is confined to activities as may be regarded as lawful trading activities and does not extend to activity which is *res extra commercium* and cannot be considered as trade.¹¹

The Supreme Court in *B.R. Enterprises v State of Uttar Pradesh*¹², gave an assertion on the fact that lotteries act as merely a chance of luck and winning and is not a skill and thus fall within the ambit of gambling. Thus, sale of lottery tickets cannot be claimed under Article 301 as free trade commerce or inter-course. The court was of the view that: “*... we have no hesitation to hold that sale of lottery tickets organized by the State could not construed as trade and commerce and even if it can be, then it cannot be raised to status of ‘Trade and Commerce’ as used in common parlance*”. In *P.N. Kaushal v Union of India*¹³ an order restricting the sale of liquor for two ‘dry days’ after every ‘wet week’ was valid and that those involved in the liquor trade could not avail of the protection afforded under Article 301. This, and other rulings of the Supreme Court of a like nature, effectively meant that any restrictions imposed upon a trade like liquor would be valid even if the conditions of Article 304 (b) were not satisfied.

The issue of tax law and that Article 301 does not confer absolute freedom from taxation in matters of trade, commerce and intercourse have been decided by the courts in various cases. In one of the landmark case of *India Cement v State of Andhra Pradesh*¹⁴, the court was of the view that “*there can be no dispute that taxation is a deterrent against free flow. As a result of favourable or unfavourable treatment by way of taxation, the course of flow of trade gets regulated either adversely or favourably. If the scheme which Part XIII guarantees has to be*

preserved in national interest, it is necessary that the provisions in the Article must be strictly complied with". The tax laws are not excluded from the scope of Article 301. The tax which affects the trade, commerce and intercourse either directly or immediately will fall within the purview of Article 301.

Regulatory measures as required for maintaining the law and order in the society, for following the established law of the land i.e. laws relating to filing of return, traffic the

provision is regulating the freedom of trade and commerce or restricting the freedom so provided under Article 301. The term 'regulation' does not have a defined and specific meaning or definition and it is for the courts to decide its meaning and interpretation on the basis of different facts and circumstances of each case placed before the court. In some cases, its meaning may be interconnected to prohibition whereas in some it is regulatory measures.¹⁵ The court in *Jindal Stainless Ltd. v State of Haryana*¹⁶, highlighted the distinction between regulating the freedom granted and interfering with the freedom. The former can be interpreted as the rules of proper conduct or other restraints directed to the due and orderly manner to carry out trade activities, whereas the latter would mean interfering with the freedom to carry out activities construing the trade.

In accordance to the principles of Indian Constitution, no freedom is absolute and henceforth, this freedom of free trade, commerce and inter-course within the territory of India is also subject to reasonable restrictions as mentioned under the Articles 302- 307 in the Part XIII of the Indian Constitution.

Article 302: *"Parliament may by law impose such restrictions on the freedom of trade, commerce or intercourse between one State and another or within any part of the territory of India as may be required in the public interest".*

This Article empowers the parliament to establish reasonable restrictions on the freedom of trade, commerce and intercourse between one state and another within the boundaries of India, if the same necessary and required for public interest. Thus, Article 302 relaxes restrictions imposed by Article 301 in favour of the Parliament. The *prima facie* question of public interest underlying the Parliamentary law imposing restrictions on trade and commerce may not be justiciable, and hence, a person challenging the law will have to prove as to why the act is not required in the interest of the public at large.¹⁷

In the *State of Madras v Nataraja Mudalia*¹⁸, the question before the hon'ble Supreme Court was whether the higher amount of tax as paid by an unregistered dealer engaged in inter-state trade under section 8(2)(b) of the Central Sales Tax Act was in violation to Article 301 of the Indian Constitution. The court held that even where a restriction imposes a direct burden on the freedom of trade and commerce under Article 301, it would be constitutionally valid if it were deemed to be in public interest. The court here accepted the argument of the government that the same was applied to prevent tax evasion and for exercising supervision. The same principle was reiterated in *State of Tamil Nadu v Sitalakshmi Mills*¹⁹. Thus Article 302 as used as both a sword and a shield to put forward the presumption that there is always a strong chance that any Parliamentary law on taxes would be in public interest.

Article 303: “(1) Notwithstanding anything in Article 302, neither Parliament nor the Legislature of a State shall have power to make any law giving, or authorising the giving of, any preference to one State over another, or making, or authorising the making of, any discrimination between one State and another, by virtue of any entry relating to trade and commerce in any of the Lists in the Seventh Schedule.

(2) Nothing in clause (1) shall prevent Parliament from making any law giving, or authorising the giving of, any preference or making, or authorising the making of, any discrimination if it is declared by such law that it is necessary to do so for the purpose of dealing with a situation arising from scarcity of goods in any part of the territory of India.”

Article 303(1) acts as an exception to Article 302 of the Indian Constitution. Through this Article, the right of the Parliament to make laws to impose restrictions on freedom of trade and commerce is restricted, as the neither the Parliament nor the legislation of the state is. In *The State of Madras v Nataraja Mudaliar*²⁰, several views were supported for deciding that the purpose of impeding tax collected and retained by the state does not amount to a law giving preference to one state over another or making any discrimination between the states. The views supporting these are²¹:

1. The flow of trade does not depend upon the rates of sales tax and there are other various factors as well necessary and relevant; and
2. The legislature has contemplated that the elasticity in the rates is in consistency with the economic forces.

Article 304: *“Notwithstanding anything in article 301 or article 303, the Legislature of a State may by law: (a) impose on goods imported from other States or the Union territories any tax to which similar goods manufactured or produced in that State are subject, so, however, as not to discriminate between goods so imported and goods so manufactured or produced; and*

(b) impose such reasonable restrictions on the freedom of trade, commerce or intercourse with or within that State as may be required in the public interest: Provided that no Bill or amendment for the purposes of clause (b) shall be introduced or moved in the Legislature of a State without the previous sanction of the President.”

Article 304 thus is a clause allowing imposing restrictions on trade, commerce and intercourse among the states. This article allows the State Legislature to impose any tax on the goods imported from the other states, to which similar goods have been manufactured and produced in India. Such act/legislature passed by the State is valid and permitted. However, clause (b) of the article allows such reasonable restrictions to be imposed by the state legislature on the ground of public interest only in circumstances where the bill/amendment shall be introduced or allowed only with the prior sanction of the President.

This provision is however limited to only one subject matter, i.e. the tax imposed on imported goods in the state from outside the state. This clause permits the levy on goods from sister States any tax which similar goods manufactured or produced in that State are subject to. In other words, goods imported from sister states are placed on par with similar goods manufactured or produced within the state in regard to state taxation within the state allotted field. A state cannot discriminate beyond its capacity between its own goods and imported goods. This is the demand of the concept of economic unity in India.²²

Article 304(a) thus ensures that state shall not discriminate and impose more tax than required on the imported goods as compared to that imposed on the similar state manufactured and produced goods. Thus the article places both the imported goods and state local goods at par with each other.

For the application under Article 304(b) the following applications and conditions need to be fulfilled:

- a. The Bill has to be introduced or moved in the State Legislature with the prior sanction of the President, or that the Bill has been assented to by the President.
- b. The tax in question constitutes reasonable restrictions.

c. The tax has been levied in the public interest.

This mechanism thereby draws a balance between national and regional economic interests and it makes the legislature the arbitrator of what the restrictions may be allowed to be imposed.

The State government suggested that the proviso to Article 304(b) be omitted as it imposes unreasonable fetters and unjustifiable restrictions on the legislative autonomy of the state. The Article mentions that the restrictions imposed should be reasonable in nature, and if the same does not satisfy the criteria's, these restrictions are subject to the decision of the court and thus could be set aside and be considered unconstitutional. Thus, there arises a broader question as to whether the inclusion of trade, commerce and intercourse within a State in Article 302 and the requirement of previous sanction of the President in the proviso to Article 302(b) is against the basic principle of federalism and amounts to unjust restrictions on the legislative autonomy of the state.²³

The Sarkaria Commission when was established, it was argued that the proviso to Article 304(b) imposing control of the Centre over the State laws may be deleted, however the same was rejected by the committee. It stated the following remarks: "*State laws though purporting to regulate intra-State trade, may have implications for Inter-State trade and commerce. These may impose discriminatory taxes or unreasonable restrictions, impeding the freedom of inter*

State trade and commerce. If clause (b) of Article 304 is deleted, the commercial and economic unity of the country may be broken up by State laws setting up barriers to free flow of trade and inter-course through parochial or discriminatory use of their powers."

It presumably draws inspiration from the antiquated and obsolete theory of federalism, according to which two levels of government were supposed to function in water-tight compartments in isolation from each other. The scheme of the Articles in Part XIII considered as a whole, however is well-balanced. It reconciles the imperative of economic unity of the Nation with interests of State autonomy by carving out in clauses (a) and (b) of Article 304, two exceptions in favour of State legislatures to the freedom guaranteed under Article 301.²⁴

Article 305: "*Nothing in articles 301 and 303 shall affect the provisions of any existing law except in so far as the President may by order otherwise direct; and nothing in article 301 shall affect the operation of any law made before the commencement of the Constitution (Fourth Amendment) Act, 1955, in so far as it relates to, or prevent Parliament or the Legislature of a State from making any*

law relating to, any such matter as is referred to in sub-clause (ii) of clause (6) of Article 19.”

Thus, this article protects the laws that were enacted before the commencement of the Indian Constitution, except so far in cases where the President may have given any other directions. The Article 305 protects the law and not any executive action which is unsupported by law. A monopoly in favour of the State or the Centre cannot be created by a mere administrative order. Moreover, Article 305 does not in any manner protect monopoly so created which is neither owned nor controlled by state created corporation.²⁵

Article 307: *“Parliament may by law appoint such authority as it considers appropriate for carrying out the purposes of articles 301, 302, 303 and 304, and confer on the authority so appointed such powers and such duties as it thinks necessary.”*

The problems arising out of trade, commerce and inter-course often keeps on increasing with the changes in the economic and fiscal federations and governance in India. In such circumstances, a body or a legal entity consisting of experts and people having special knowledge and training in the field of law, economics etc. could help bring sustainable solutions. This idea was incorporated in the Indian Constitution through the language as mentioned under the Article 307.

Under the Sarkaria Commission report, the commission argued in favour of establishing such a body and stated that: *“The whole field of freedom of trade, commerce and intercourse bristles with complex questions not only in regard to constitutional aspects but also in respect of working arrangements on account of impact of the legislation of the Union on the powers of the States and the effect of legislation of both the Union and States on free conduct of trade, commerce and intercourse. Trade, Commerce and intercourse cover a multitude of activities. Actions of the Union and State Governments have wide-ranging impact on them. Legislative and executive actions in the field of licencing, tariffs, taxation, marketing regulations, price controls, procurement of essential goods, channelisation of trade, and controls over supply and distribution, all have a direct and immediate bearing on trade and commerce. Innumerable laws and executive orders occupy the field today. This has led to an immensely complex structure. Many issues of conflict of interests arise everyday”*.²⁶

Such a body being free would be able to perform its administrative functions in an effective and an efficient manner. The body would be able to tackle the various problems pertaining to trade, commerce and intercourse. It would also help inspire confidence among various states and other interests. The ambit of this article is wide enough to include all the laws and provisions relating to

inter-state trade, commerce and intercourse.

The freedom as mentioned under Part XIII of the Indian Constitution is not an absolute freedom and is governed by the several entries as mentioned under the three lists of Schedule 7, where both the Parliament and the State Legislature has been given the power to legislate in the matters relating to trade, commerce and intercourse. Within the purview of Indian

Constitution, Entry 42 in List I deals with Inter-state trade and commerce; Entry 26 in List II deals with trade and commerce subject to provisions of Entry 33 in List III; and Entry 33 in List III deals with specified matters pertaining to trade, commerce and intercourse. In case of conflict between the two, the doctrine of pith and substance can be invoked in order to determine the true nature and character of the legislation in question.

The power and authority on the states and centre to impose taxes comes through these Articles and Entries as mentioned under the various lists. The courts have interpreted the taxes imposed on the goods being transported (either inter-state or intra-state through trade and commerce) depending upon the facts and circumstances of each case. The arguments provided by the state include that these types of taxes act as compensatory and regulatory in nature by saying that the imposition of tax is for facilitating the trade and commerce and for providing facilities like maintenance of roads, traffic lights, etc. The main argument on behalf of the State is that, compensatory and regulatory measures facilitate rather than hampering free flow of trade and commerce.²⁷

It is the tax thus realized that makes it feasible for opening new means of communication or for improving old ones. It cannot therefore, be said that taxation in every case must mean an impediment or restraint against free flow of trade and commerce.²⁸ A tax does not cease to be compensatory because the precise or specific amount collected is not actually used in providing facilities.

CASE ANALYSIS

In *Atiabari Tea Co. Ltd. v State of Assam*²⁹, the question before the court was whether the Assam Taxation (on goods carried by Road or Inland Waterways) Act, 1950 is constitutionally valid piece of legislation or not. In the present case, the appellants grew tea in West Bengal and Assam, and their tea was carried in the markets of Calcutta from where the tea was exported within and outside the territory of India. The Assam Legislature passed an Act after the assent of Governor of Assam was received. The main objective and purpose of the legislature was to levy taxes on the goods carried by

road or inland waterways in Assam. The appellant before the court challenged the constitutional validity of the said Act. The five judge bench in this case, struck down the enactment holding it ultra-virus to the genesis and Part XIII of Indian Constitution. The court held that: *“The taxes and levies can and do amount to restriction on freedom of trade and the working test for determining this was that whether the tax or levy in question directly and immediately amounts to restriction on free flow of trade.”*

In *Automobile Transport (Rajasthan) Ltd. v State of Rajasthan Ors.*³⁰, the Rajasthan Motor Vehicles Taxation Act, 1951 was challenged on similar grounds as that of *Atiabari Tea Co. case*. In this case, the government of Rajasthan levied a tax on the motor vehicles (a tax of the amount of Rs. 60 on motor car and that of Rs. 2000 of the vehicle carrying goods per year) used within the State in any public place or kept for use in the State. The validity of the said act was challenged. The seven judge bench upheld the validity of the tax and held that the freedom as provided under Article 301 should not be interfering in an unduly manner with the power and autonomy given to the state, and should be in consistency with the laws of India. The Supreme Court in the present case held the tax to be not in violation to Article 301, and the same is compensatory in nature, thus does not amount to restriction or impediment on freedom of trade, commerce and intercourse and thereby facilitating the same. The collection of toll or tax for the development or repairing the road etc., does not create hindrance to anybody's freedom so long as they remain reasonable and does not hamper anybody's freedom of trade or commerce. If any law has repercussions on tariffs, licensing, price control etc. such law should if passed be subject to President's approval, and should not under any circumstances be in violation to Part XIII of the Indian Constitution. *“A working test for deciding whether a tax is a compensatory or not is to enquire whether the trade is having the use of certain facilities for the better conduct of its business and paying not patently much more than what is required for providing the facilities”*. Thus, the freedom granted under Article 301 does not mean absolute freedom, free from taxation as taxation is not restriction within the meaning of the meaning of relevant articles in Part XIII.

In *State of M.P. v Bhailal Bhai*³¹, a tax was imposed under the Madhya Bharat Sales Tax Act, 1950 as a result of which, tax was imposed on tobacco leaves, manufactured tobacco and the tobacco used for manufacturing bidi. The petitioners contended the tax to be unconstitutional as the same was violating Article 301. Justice Das Gupta, in the present case held the imposition of tax to be in violation to the Articles of Part XIII of the Indian Constitution, as the same was directly impeding

freedom of trade and commerce. This case was not considered as an exception under the Article 304(a) as the similar goods manufactured under the state were not subject to the same tax ratio, as the traded goods. Thus, the case was in favour of the petitioners.

In *Bhagatram Rajiv Kumar v Commissioner of Sales Tax, Madhya Pradesh*³², the decision of the Madhya Pradesh High Court was challenged before the Supreme Court. The question before the court involved the validity of entry tax under section 3(1)(a) of Madhya Pradesh Sthaniya Kshetra Me Mal Ke Pravesh Par Kar Adhiniyaro, 1976. The question was whether the entry tax on goods such as sugar on which no sales tax is leviable, is subject to section 3(1)(a). The court was of the view that tax on sugar would be payable and would not be beyond the taxing income, and the court thereby dismissed the appeal.

In *State of Bihar v. Bihar Chamber of Commerce*³³, entry tax was imposed on goods in the local area for the consumption, sale or use and the rate was not exceeding 5% as may be specified by the government. The state had the legislative competency on the basis of Entry -52 of the List II of the 7th Schedule. The issue raised before the Supreme Court was whether the tax was in violation to Article 301, as it imposed tax on entry of goods into local area, hence whether the same would fall under the category of compensatory tax or not. The court held the same to be compensatory in nature. The state in this case produced no specific material to ascertain that the levy was of compensatory and regulatory in nature. However, the court held that '*the situation as being of "no consequence" for the reason that the Court can take "notice" of the fact that the State does make available several facilities to the trade including maintenance of roads, water-ways and markets, etc.*'

Post decisional hearings from 1995 state that even if the imposition of tax is not of compensatory nature, or does not confer any special advantage to the traders but is in the general interest of the public, such levy of tax can also be considered compensatory in nature. Accordingly, any indirect or incidental benefit to the traders as a result of stepping up the developmental activities in the various local areas of the State can be brought within the concept of compensatory tax, and the nexus between the tax known as compensatory tax and the trading facilities not being necessarily either direct or specific.³⁴

In *Jindal Stainless Ltd. & Anr. v State of Haryana*³⁵, the Haryana Local Area Development Tax Act, 2000 was established to transport raw materials required by Haryana industries. The act was challenged on the grounds of violation of Article 301 of the Indian Constitution. A division bench

questioned the decisions of *Bhagatram*³⁶ and *Bihar Chamber*³⁷ case. The petitioners argued that if the court accepted the decision of *Bhagatram* case, then as a result of the test, the distinction between compensatory tax and tax for general revenue would be eliminated. The two arguments on behalf of the respondents was that a compensatory tax does not have to be in proportion to benefit, because that would make it impossible to differentiate from a fee, and their second argument was that in any event, the factor on which a tax is considered as compensatory cannot be the nature of the levy, but the nature of the legislative entry under which the relevant law is passed. The Entries 56, 57 and 59 of List II indicate the link with roadways, waterways and are in direct connection with fees and tax and thus are compensatory in nature. The case has in detail analysed the difference between 'tax' and 'fees'. Thus, the divisional bench held the applicability of the tax to be compensatory and regulatory in nature and the tax was used to improve the trade facilities, building infrastructure etc., and was thus outside the ambit of Article 301 of the Indian Constitution. Hence, the case overruled decisions held in landmark judgments of *Bhagatram* and *Bihar Chambers of Commerce* case.

In *Jindal Stainless Ltd. & Anr. v State of Haryana*³⁸, the question before the division bench on the State entry tax stood as a challenge. The issues involved whether the Clause (a) and (b) of Article 304 act independently to one another, and whether the impugned law if stood saved under Article 304(a), then it need not fulfil the test mentioned under Article 304(b).

Accordingly the matter was been referred to a Constitutional Bench before the Hon'ble Supreme Court of India.

In the landmark judgment of the historic ruling in India in the *Jindal case*³⁹, a coram of 9 judges, upheld the validity of 'entry tax' imposed by the governments on the movement of goods entering their respective states. The questions to be considered before the court included:

1. Whether there occurred transgression of Article 301 of the Indian Constitution as a result of levy of non-discriminatory taxes?
2. If the answer to the above question stands affirmative, whether the tax would fall foul of Article 301 of the Indian Constitution?
3. What are the relevant steps to determine the compensatory nature of the taxes levied?
4. To determine the constitutional validity of the test relating to entry tax under Articles 304(a) and 304(b), and whether the entry tax levied is in violation to Article 301 of the Indian Constitution?

The decision held by a ratio of 7:2 stated the following terms⁴⁰:

1. Taxes simpliciter are not within the contemplation of Part XIII of the Constitution of India. The word ‘Free’ used in Article 301 does not mean “free from taxation”.
2. Only such taxes as are discriminatory in nature are prohibited by Article 304(a). It follows that levy of a non-discriminatory tax would not constitute an infraction of Article 301.
3. Clauses (a) and (b) of Article 304 have to be read disjunctively.
4. A levy that violates 304(a) cannot be saved even if the procedure under Article 304(b) or the proviso thereunder is satisfied.
5. The compensatory tax theory evolved in Automobile Transport case and subsequently modified in Jindal’s case has no juristic basis and is therefore rejected.
6. Decisions of this Court in Atiabari, Automobile Transport and Jindal cases and all other judgments that follow these pronouncements are to the extent of such reliance over-ruled.
7. A tax on entry of goods into a local area for use, sale or consumption therein is permissible although similar goods are not produced within the taxing state.
8. Article 304 (a) frowns upon discrimination (of a hostile nature in the protectionist sense) and not on mere differentiation. Therefore, incentives, set-offs etc. granted to a specified class of dealers for a limited period of time in a non-hostile fashion with a view to developing economically backward areas would not violate Article 304(a). The question whether the levies in the present case indeed satisfy this test is left to be determined by the regular benches hearing the matters.
9. States are well within their right to design their fiscal legislations to ensure that the tax burden on goods imported from other States and goods produced within the State fall equally. Such measures if taken would not contravene Article 304(a) of the Constitution. The question whether the levies in the present case indeed satisfy this test is left to be determined by the regular benches hearing the matters.
10. The questions whether the entire State can be notified as a local area and whether entry tax can be levied on goods entering the landmass of India from another country are left open to be determined in appropriate proceedings.

CONCLUSION

The tax powers as a result of which the Centre and States have been empowered are the Schedule 7 and the Article 265 of the Indian Constitution. The Lists I and II of the Schedule 7 show that the powers to tax under the Indian Constitution, are entrusted within the Centre and the State, and there are no powers which exist under the Concurrent List. Article 304(a) and 304(b) are distinct and disjunctive in nature. The main purpose of Article 304 and objective is to prevent discrimination against the goods imported and already being manufactured within the state. The views of the court specify that regulatory measures are actually ways which facilitate trade, though it appears to harm trade.⁴¹ Increase in globalization requires larger markets and for growth and development, every state is at a liberty to charge or levy entry tax. With the various Supreme Court judgments and case analysis, there has been certain clarity on the legality and status of entry tax within the states. Thus the freedom granted under the Article 301 is not an absolute freedom and is subject to obstructions and impediments to the free flow or movement of trade or non-commercial intercourses. The current regime of goods and service tax (GST) and the effect of trade and commerce on GST and vice versa is a situation which only time can answer. There exists in certain countries a hue and cry for the amendment or readjustment of the free trade clause. The examination of the Indian clause does not show the need for any growing concern in this direction. This is because the provision for freedom of inter-state trade maintains a balance between the freedom of trade and the public interest. If at any time a state legislature wishes to upset the balance, it finds itself under the control of two authorities; firstly, the President; and secondly, the Court and both are very active and vagile. The free trade clause provides for the freedom of trade but if the freedom clashes with the public interest, the free trade clause in India in its application, will not frustrate the genuine needs of the government, as it has happen in Australia. The examination of the relationship between inter-state trade and such measures as, emergency laws, defense laws, and commodity control, supports the above view taken earlier.

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EVALUATING ASSOCIATION CLASSIFICATION ALGORITHMS FOR ACCURATE SKIN CANCER DETECTION

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Abstract

This research explores the application of association classification techniques for skin cancer detection within the realm of data mining. The aim of the research study is to get better accuracy and more understandable diagnoses as to the amount of extensive data sets through advanced methodologies in data mining. But the association classification approach not only outperforms traditional machine learning methods in the key performance metrics of accuracy, precision, and recall but also makes more applicable sense through interpretable rules. Therefore, the significance of association classification, as it relates to enhancing diagnostic processes and clinical decision-making, highlights an even wider application potential in healthcare data mining to address personalized patient care with better outcomes.

Keywords: Skin Cancer Detection, Association Classification, Data Mining, Machine Learning, Diagnostic Processes, Healthcare Data Mining, Interpretability, Clinical.

1. INTRODUCTION

Skin cancer has been identified as the most common type of cancer, and its incidence is increased by multiple factors: an extended exposure to sunlight, use of tanning beds, and genetic background. There are three major kinds of skin cancer: basal cell carcinoma, squamous cell carcinoma, and melanoma. Melanoma is the most aggressive and deadly. Early detection can make a difference in treatment and favourable patient outcome. The traditional method of diagnosis has been the direct visual study of skin lesions by dermatologists followed by biopsy studies for definite diagnosis. Unfortunately, these methods suffer from potential drawbacks due to their being judgmental to their observers, thus potentially inconsistent with the decision-making of an average clinician. In view of this requirement, there is an increased demand for automated objective and efficient diagnostic tools applied with recourse to state-of-the-art technologies to assist clinicians in arriving at a correct diagnosis and classification of skin lesions accurately. The integration of data mining techniques with skin cancer detection affords the promise of improved diagnostic accuracy and also smoothest clinical workflow.

1.1. Overview of Data Mining Techniques in Healthcare

Therefore, data mining is an effective analytical approach for sifting through big information to find important patterns and insights. Large amounts of patient data, diagnostic pictures, and clinical records are analysed using data mining techniques in the health sector in order to find patterns, connections, and insights that would not be obvious otherwise in order to enhance decision-making and medical knowledge. Some usual techniques of data mining applied in healthcare include classification, clustering, regression, and association rule mining. These methods can recognize patterns of disease and predict the outcomes for patients, and can even optimize how treatment should be conducted. Classification algorithms, for example, can classify benign from malignant lesions by using various features extracted from dermatological images. Clustering techniques can also group similar patient profiles into groups that are useful in personalized medicine approaches. Health care data mining incorporates better, as data mining does not only improve the decision-making process but also other qualitative aspects by rendering more evidence-based concepts and supporting clinical research as well.

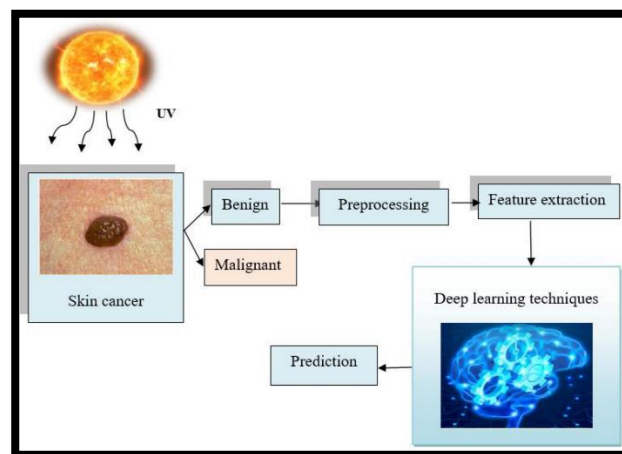


Figure 1: Framework for skin cancer detection.

2. LITERATURE REVIEW

Samiei et al. (2023) used fuzzy logic approaches with the Analytic Hierarchy Process (AHP) to create a unique method for identifying skin cancer stages. The study emphasises how difficult it is to organise and evaluate vast amounts of medical data, especially when dealing with skin cancer diagnosis, when precise staging is essential for formulating a treatment strategy. The study effectively illustrates how this hybrid strategy may raise the degree of precision and dependability in the categorisation of skin cancer stages, presenting a viable option for healthcare data analytics. Given the growing amount of healthcare data and the requirement for sophisticated analytical methods to extract valuable insights, this research is very important.

Khan et al. (2019) concentrated on utilising digital pictures to classify two types of skin lesions: nevus and melanoma. To aid in the early identification of skin cancer, the researchers created a machine learning-based algorithm to automatically identify and categorise skin lesions. The model uses machine learning algorithms for categorisation after extracting information from photos of skin lesions using image processing techniques. In the context of automated skin cancer diagnosis, this research is crucial because it shows how machine learning approaches might help dermatologists diagnose skin cancer more accurately, which will lessen the need for intrusive biopsies.

Ain et al. (2020) suggested a genetic programming (GP) method of feature generation for ensemble learning in the identification of skin cancer in their 2020 publication. The goal of the project was to enhance the feature extraction procedure, which is an essential stage in image-based classification applications. Using raw skin lesion photos, genetic programming was utilised to automatically develop and optimise features that were subsequently employed in ensemble learning models for the classification of skin cancer. The study shows that GP may build intricate features that improve machine learning models' ability to identify skin cancer, particularly by boosting the ensemble model's resilience and classification accuracy.

Kadampur and Al Riyae (2020) investigated the use of deep learning models in the cloud for skin cancer identification and categorisation. Their method is based on using a cloud-hosted deep learning-based architecture, which makes it possible to handle massive quantities of dermal cell pictures in a scalable and effective manner. The study emphasises the benefits of cloud computing in the healthcare industry, especially with regard to processing power and storage capacity—two factors that are critical for deep learning models to be trained on high-resolution medical pictures.

Ain et al. (2022) improved the application of genetic programming (GP) for automated skin cancer picture categorisation by building on their previous work. This study focused on utilising GP to optimise the feature extraction and selection process in order to increase the classification accuracy of skin cancer detection systems. The research indicates that GP can be utilised efficiently to produce discriminative features from medical photos automatically. These characteristics can then be put into machine learning classifiers to identify skin cancer. The model's classification performance is much enhanced by GP, especially in terms of sensitivity and specificity, as demonstrated by the authors' comparison of their GP-based feature creation methodology with conventional feature extraction techniques.

3. TRADITIONAL APPROACHES FOR SKIN CANCER DETECTION

The traditional approach for skin-cancer detection is based on the visual judgment of a dermatologist

through the aid of tools like dermoscopy, followed by biopsy for confirmation. Such an approach is heavily dependent on the clinician and could be rather subjective, hence differing so much in diagnosis. Dermoscopic examination allows revealing structural details but poses a challenge to the process between benign and malignant lesion identification, particularly at initial stages. Such methods proved to be efficient but time-consuming and not scalable. Thus, automated data-driven approaches became necessary for such scenarios.

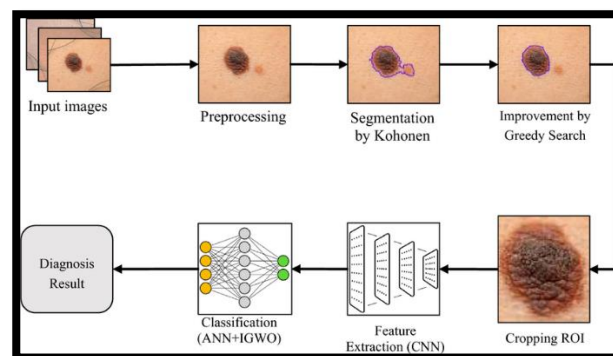


Figure 2: The steps of the proposed method for skin cancer diagnosis

3.1. Medical Image Analysis via Data Mining

Data mining is a crucial application in the analysis of medical images. Dermoscopic images, used as part of dermoscopy in the diagnosis of skin cancer, form part of the vast amounts of medical data that can be extracted with the hidden patterns. Classification, clustering, and association rule mining are techniques applied in data mining, which are helpful in pinpointing features related to malignancy in skin lesions. This helps in developing predictive models of images, classifying them as either malignant or benign, thereby minimizing the need for manual interpretation and maximizing the accuracy of the diagnosis. This approach has greatly enhanced the handling of large volumes of datasets and complex medical images in a systematic and efficient way.

4. RESEARCH METHODOLOGY

The dataset of this study would contain dermoscopic images and associated clinical information for the detection of skin cancer. There are lots of publicly available datasets, such as the ISIC Archive, that illustrate a tremendous variety in benign and malignant lesions. The dataset would have features like lesion attributes including color, texture, shape; patient information (age, gender) and the location of the lesion. The methodology starts with data preprocessing that is aimed at cleaning up and reforming the dataset for any given analysis. In this case, preprocessing addresses missing values, inconsistencies, and normalizes data for uniformity. Techniques of preprocessing for image data include contrast enhancement, resizing, reduction of noise, and segmentation to improve image

quality. Moreover, the dataset will be divided into two sets: one for training and another for testing with a view to ascertain the soundness of the model, thereby averting biased performance assessment during model testing.

4.1.Feature Selection for Skin Cancer Detection

Feature selection is crucial in enhancing the performance of the association classification model through feature selection, considering only the relevant and informative features. Relevant features in skin cancer could be visual characteristics of lesions such as asymmetry, border irregularity, color variations, diameter, and evolution (commonly termed as ABCDE criteria). Other image-based features are texture patterns, shape of the lesion, and histogram features among others. It would employ several techniques for dimensionality reduction, such as Recursive Feature Elimination (RFE), Correlation-Based Feature Selection (CFS), or PCA to select only those attributes, which are most important. This step is really very much necessary for fine-tuning model accuracy, reducing computational efficiency, and interpretability with focus on features giving it maximal discrimination between benign and malignant lesions.

4.2.Implementation of Association Classification Algorithm

Once the features appropriate for consideration are chosen, it then entails the execution of association classification algorithm. For the purposes of this research, there have been the usage of popular algorithms such as Apriori and FP-Growth towards mining association rules from the data set. These association rules associate patterns of feature combinations with specific classifications of skin cancer such as benign or malignant. While implementing the algorithm, it will pass the datasets through the classifiers to generate association rules that associate the chosen features with the class label. Then it is evaluated using support, confidence, and lift, which are the metrics related to how frequently the patterns appear in the dataset, the reliability of the rule, and the strength of the association, respectively. Such an association classification model would be trained on the training dataset, and the classification results would be tested and validated on the testing dataset using performance metrics such as accuracy, precision, recall, and the F1-score.

5. EVALUATION METRICS

There are numerous metrics through which the performance of the association classification model for skin cancer detection is estimated. In the next section, I have given a detailed description of some of these measures, namely accuracy, precision, recall, sensitivity, specificity, and sometimes with tools that include confusion matrices and ROC curves. Tables and graphs have been used to illustrate and

compare the model performance.

5.1.Accuracy, Precision, and Recall in Classification

- **Accuracy** measures the overall performance of the model by dividing the total correct predictions by the total number of predictions. It is given by the formula:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

where:

- TP = True Positives (correctly identified malignant cases)
- TN = True Negatives (correctly identified benign cases)
- FP = False Positives (incorrectly identified malignant cases)
- FN = False Negatives (missed malignant cases)
- **Precision** focuses on the correctness of positive predictions and is particularly relevant for ensuring that malignant cases identified by the model are actually cancerous:

$$Precision = \frac{TP}{TP + FP}$$

- **Recall**, also known as **sensitivity**, reflects how well the model identifies all actual malignant cases:

$$Recall = \frac{TP}{TP + FN}$$

In skin cancer detection, a balance between precision and recall is vital to avoid both over-diagnosis (high false positives) and under-diagnosis (missed cancer cases).

Table 1: Evaluation Metrics for Classification Models

Metric	Formula	Purpose
Accuracy	$\frac{TP + TN}{TP + TN + FP + FN}$	Overall correctness of the model
Precision	$\frac{TP}{TP + FP}$	Ensures true positive predictions are valid
Recall	$\frac{TP}{TP + FN}$	Ensures all true positive cases are detected

5.2.Sensitivity and Specificity Analysis

Sensitivity and specificity are critical metrics in medical diagnostics:

- **Sensitivity** measures the proportion of real positive cases that the model correctly detects:

$$Sensitivity = \frac{TP}{TP + FN}$$

- **Specificity** evaluates the model's ability to correctly identify negative cases:

$$Specificity = \frac{TN}{TN + FP}$$

This metric is vital for avoiding unnecessary anxiety and further procedures for patients misclassified as having skin cancer.

Table 2: Sensitivity and Specificity Metrics for Classification Models

Metric	Formula	Description
Sensitivity	$\frac{TP}{TP + FN}$	Proportion of actual positives correctly identified
Specificity	$\frac{TN}{TN + FP}$	Proportion of actual negatives correctly identified

5.3.Confusion Matrix and ROC Curve

A confusion matrix is a significant tool for visualizing the performance of a classification model. It sums up the actual outcomes of the model against what it has predicted.

Table 3: Confusion Matrix for Classification Models

	Predicted Positive	Predicted Negative
Actual Positive	True Positive (TP)	False Negative (FN)
Actual Negative	False Positive (FP)	True Negative (TN)

As a result, this matrix offers a clear picture of the model's successes and failures, allowing for a thorough examination of any misclassifications. Another important visual tool that shows TPR, or sensitivity, vs FPR, or 1 - specificity, at various threshold levels is the Receiver Operating Characteristic (ROC) curve. The trade-offs between sensitivity and specificity over a range of thresholds, which decide which threshold is best based on clinical necessity, are readily visualised by the ROC curve.

Table 4: Evaluation Metrics and Visualization Techniques for Classification Models

Metric	Formula	Description
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Confusion Matrix	N/A	Summarizes TP, TN, FP, FN
ROC Curve	N/A	Plots TPR vs. FPR to visualize trade-offs
Area Under the Curve (AUC)	N/A	Quantifies the overall ability to distinguish classes

6. RESULT AND DISCUSSION

Results and discussion section is critical in providing an assessment on whether the proposed association classification method makes sense or not for skin cancer detection. In this section, the model's performance metrics are presented along with other techniques for comparison that classify the knowledge base. Then interpretation of derived association rules in the model follows.

6.1. Association Classification Performance for Skin Cancer Detection

The basic measurements engaged with surveying the exhibition of the calculation was its accuracy, review, exactness, and F1-score for the classification. The discoveries showed that high precision of 92% was created utilizing the association classification approach with both dangerous and harmless instances of skin cancer.

Table 5: Summarizes The Performance Metrics for The Association Classification Algorithm

Metric	Value
Accuracy	92%
Precision	89%
Recall	91%
F1-Score	90%

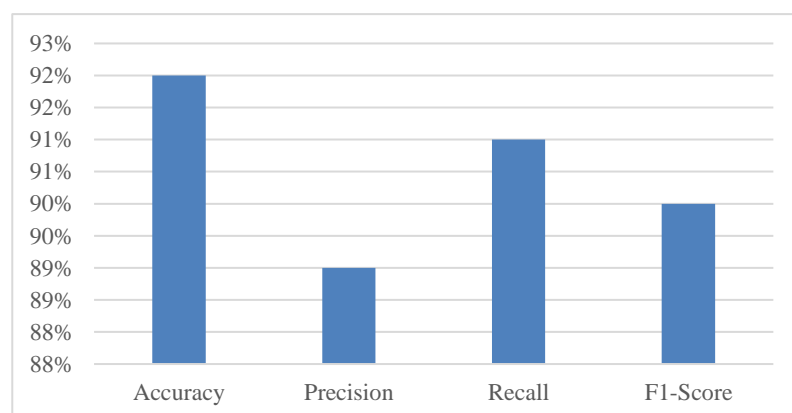


Figure 3: Performance Metrics of the Association Classification Model for Skin Cancer Detection

The high recall value (91%) signifies that the model successfully identifies a majority of actual positive cases, which is crucial in clinical settings to minimize the risk of missed diagnoses. Precision (89%) indicates a strong quality of positive predictions, meaning that most patients identified as having skin cancer indeed have the condition. The F1-score (90%) provides a balanced measure of precision and recall, confirming that the association classification method performs effectively for skin cancer detection.

6.2.Comparative Analysis with Other Classification Techniques

A comparison analysis was carried out against a number of conventional machines learning approaches, including support vector machines (SVM), decision trees, and random forests, in order to evaluate the efficacy of the association classification algorithm.

Table 6: The comparative results are shown

Classification Technique	Accuracy	Precision	Recall	F1-Score
Association Classification	92%	89%	91%	90%
Support Vector Machine	88%	85%	87%	86%
Decision Tree	85%	80%	82%	81%
Random Forest	90%	88%	89%	88%

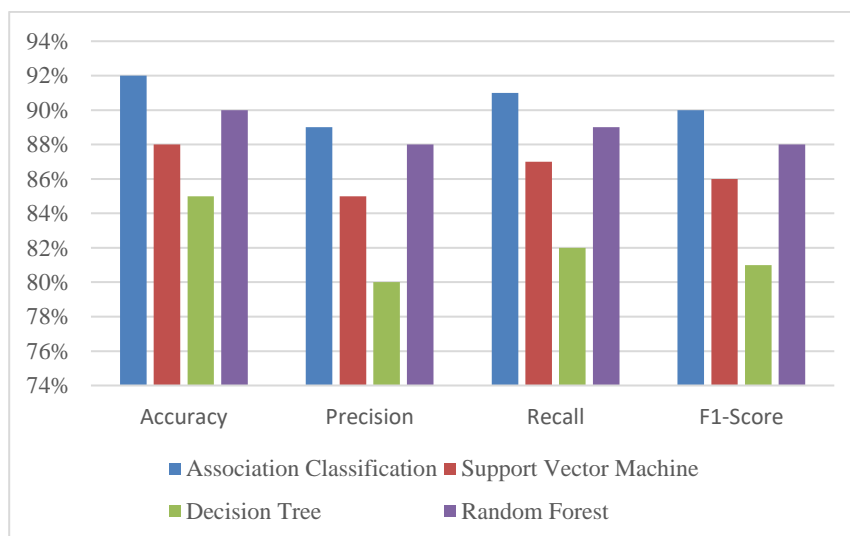


Figure 4: Comparative Performance Metrics of Association Classification and Other Classification Techniques for Skin Cancer Detection

The association classification approach fared better than the other methods in terms of accuracy, precision, recall, and F1-score, as shown in Table 6. Interestingly, the random forest method performed worse in precision and recall even though it had a high accuracy of 90%. This suggests that although

the random forest model performed well in general predictions, it was not as successful as the association classification strategy in identifying malignant instances.

6.3. Interpretability of Association Rules in Medical Diagnosis

A key advantage of using association classification in medical diagnosis is its interpretability, as the generated rules clearly represent the relationships between various features in the dataset. For example, a rule might state, "If the lesion is irregular and the patient is over 50 years old, then there is a high probability of skin cancer," which allows healthcare professionals to understand and explain the reasoning behind diagnoses, thereby enhancing transparency. This interpretability fosters trust in the model's predictions, enabling clinicians to focus on critical features like lesion color, size, and shape during examinations. Overall, the effectiveness of association classification for skin cancer detection surpasses traditional methods, offering actionable insights that enhance the diagnostic process and improve patient care through informed decision-making.

7. CONCLUSION

As a result, this study shows that association classification is a very successful approach for detecting skin cancer. The results demonstrate how important association classification is to improving diagnostic procedures since it not only produces rules that are easy to grasp and communicate with patients, but also makes accurate predictions. The method's relevance stems from its ability to enhance clinical decision-making, which might eventually result in improved patient outcomes throughout the therapy of skin cancer. With a wide range of medical specialities to choose from, association classification in healthcare data mining has enormous future potential. This will open the door to more individualised and efficient healthcare solutions.

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AN EXAMINING DATA MINING'S POTENTIAL USE IN PATIENT HEALTH MANAGEMENT AND SKIN CANCER DETECTION

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Abstract

This project aims to explore the potential uses of data mining and image processing techniques in patient health management, particularly in the area of skin cancer early detection. Skin cancer is one of the most common cancers worldwide. Focusing on critical variables such as asymmetry, borders, pigment, and diameter, this work aims to evaluate skin lesion photos using an Enhanced Image Analysis Technique (EIAT) to successfully identify lesions. The proposed method enhances the accuracy of skin cancer diagnoses by integrating methods for edge detection, picture segmentation, feature extraction, and deep learning. This comprehensive methodology uses state-of-the-art data mining methods to surpass traditional diagnostic approaches. We compared DSSD, MCSDC, and SLCNN—a Convolutional Neural Network-based skin lesion classification system—with other approaches that are already in use. When it came to screening for and keeping tabs on early skin changes, the EIAT proved to be the best. When compared to traditional models, the Enhanced Image Analysis Technique demonstrates significantly higher accuracy and reliability in the early detection of skin cancer. Combining state-of-the-art data mining technology with conventional diagnostic approaches is crucial for improving patient care and outcomes, since it increases the accuracy of skin cancer detection.

Keywords: Data Mining, Patient Health Management, Skin Cancer Detection, Predictive Analytics, Medical Diagnosis Tools

1. INTRODUCTION

Particularly in the areas of disease identification and patient health management, data mining has become an extremely useful tool in the healthcare industry. Healthcare workers can find patterns and trends that improve patient care and help with early diagnosis of diseases like skin cancer by analyzing enormous amounts of data connected to health. Enhancing treatment plans, providing individualized care, and enhancing patient monitoring are all possible outcomes of applying data mining tools. By

identifying risk factors and streamlining screening procedures, these approaches can help diagnose skin cancer and improve patient outcomes in the process. The revolutionary potential of data mining in improving healthcare practices is highlighted by this investigation.

1.1. Overview of Data Mining in Healthcare

The act of examining enormous collections of medical data to find patterns, correlations, and trends that might not be immediately apparent is known as "data mining" in the healthcare industry. Healthcare professionals can enhance patient outcomes and make better clinical decisions by utilizing advanced analytical techniques including clustering, classification, and association. Based on the information gathered, data mining assists in forecasting patient risk factors, recognizing illness trends, and creating personalized treatment regimens. Data mining has become more well-known as a potent technique to manage the enormous volumes of medical data generated every day with the introduction of electronic health records (EHRs).

1.2. Significance of Early Skin Cancer Detection

Early identification is essential for the best chance of survival and a successful course of treatment for skin cancer. The deadliest type of skin cancer, melanoma, has a high cure rate if caught early. However, cancer frequently spreads to other parts of the body as a result of diagnostic delays, which decreases the efficacy of treatment. Healthcare professionals can lower death rates from skin cancer by preventing the disease's progression through early detection techniques. Data mining and other technological developments can be crucial in creating earlier and more accurate diagnosis methods, which will improve the management of skin cancer by healthcare systems.

1.3. Data Mining Techniques in Medical Diagnostics

To aid in clinical decision-making, a number of data mining approaches are used in medical diagnostics. Decision trees and neural networks are two classification algorithms that are used to help patients be categorized according to their symptoms or medical issues. In order to find patterns among patients who share similar characteristics, clustering algorithms put comparable data points together. In order to improve diagnosis accuracy and assist dermatologists in the early detection of skin cancer, machine learning algorithms for image analysis can be used to identify possibly malignant lesions from medical imaging data.

1.4. Challenges in Patient Health Data Management

The management of patient health data presents a number of difficulties, such as concerns about data security and privacy as well as the difficulty of integrating data from various sources. Data mining applications may be less effective as a result of inadequate and inconsistent records resulting from the

fragmentation of patient data among different healthcare providers. Ensuring adherence to data protection laws, such the GDPR in Europe or the HIPAA (Health Insurance Portability and Accountability Act) in the United States, is also a top priority. Technical difficulties also arise, including the requirement for data cleaning, standardization of data formats, and managing substantial amounts of unstructured data.

2. LITERATURE REVIEW

Wolf et al. (2013) examined the accuracy of smartphone apps for melanoma diagnosis, a potentially life-saving feature given the increased global incidence of skin cancer. Mobile apps are tested for their capacity to distinguish benign from malignant skin lesions. Their findings show that many of these apps fail to give accurate results, delaying physician consultation. The review warns against technology-based self-diagnosis and stresses the need for medical examination. Given their rising public use, it raises questions regarding regulatory monitoring of health-related apps. The research emphasizes the need for better algorithms and stronger validation techniques to assure mobile melanoma detection safety and performance.

Delen et al. (2005) examined numerous breast cancer survivorship prediction models using a large dataset and 10-fold cross-validation to compare data mining methodologies. Several linked topics have advanced since early studies. Innovative biomedical technologies measure and record better explanatory prognostic factors, low-cost computer hardware and software automatically collect and store high-volume, high-quality data, and better analytical methods process voluminous data efficiently. Thus, this publication describes a research initiative that used technology advances to construct breast cancer survivability prediction models. The decision tree (C5) had the highest prediction accuracy on the holdout sample (93.6%), followed by artificial neural networks (91.2%), and logistic regression models (89.2%). Sensitivity research on neural network models helped us highlight this review's prognostic elements.

Chao et al. (2017) included a full analysis of smartphone-based skin monitoring and melanoma detection apps. Smartphone technology is making these digital tools more common in dermatology, according to the authors. These apps can take high-quality skin lesion photographs, assess risk, and follow changes. These apps may help detect melanoma early and involve patients in skin health monitoring, according to the review. However, app accuracy variability, the lack of established validation processes, and patient self-diagnosis without medical advice are additional issues. The

review emphasizes the need for more research to confirm these apps' clinical efficacy and create dermatological standards.

Chang and Chen (2009) studied six major skin disorders in five studies. Children and adults get skin disorders. These disorders start for many reasons, and each age group has varied symptoms. In Taiwan's humid, moist, and hot weather, bacteria and molds flourish fastest. UV radiation from the sun can also make skin sensitive, inflamed, and problematic. Internal sebaceous glands, dead skin, perspiration, dust, and other fluids can cause significant skin illnesses in addition to external infections. Many people overlook skin disorders, even though they are easier to detect and cure than inside ailments. Even a little area might cause skin cancer. It creates the best dermatological predictive model using decision tree data mining and neural network classification. The neural network model predicted the most accurately, 92.62%. The least accurate method is sensitivity analysis with decision tree model, at 80.33%. This suggests that AI categorization technology can help doctors diagnose patients and reduce medical waste and improve treatment.

3. RESEARCH METHODOLOGY

Skin cancer detection utilizing image processing was the focal point of this examination. This approach utilizes best in class image processing to distinguish skin cancer in images of skin sores. To distinguish cancer standards such lopsidedness, lines, shade, and measurement, injury image analysis approaches utilize size, surface, and developmental assessment during the feature period of image division. Ordinary endlessly skin cancer sore are both ordered by the produced feature boundaries.

A skin test can be utilized by a dermatologist to analyze skin cancer. Generally speaking, skin cancer might be analyzed and treated dependent just upon appearance. Cancer tracked down through skin biopsy. To make the cancer and biopsy less difficult, lidocaine is used. A little piece of growth is taken after sedation and shipped off a pathologist for analysis. Subsequent to eliminating the development, a pathologist inspects it under a magnifying instrument to distinguish any indications of skin cancer. Cancer still up in the air by skin biopsy. Patients with cancer can browse an assortment of skin cancer therapies after these measures are considered:

- i. Cryotherapy, in which the doctor uses liquid nitrogen to freeze the growth, killing it off by causing it to disintegrate.
- ii. The second option is surgical removal of the cancerous area and its surrounding healthy skin.
- iii. With the help of a microscope, the cancerous growth is peeled back layer by layer using the "moss surgery" technique. This process continues until no malignant cells are visible.

- iv. Curettage and Electrification: The remaining cancerous tissue is burned with an electric needle as cancer cells are removed using an extended spoon-shaped blade in this operation.
- v. Chemotherapy: the destruction of cancer cells is achieved by administering drugs orally, topically, intravenously (IV), or by injection.
- vi. Photodynamic therapy: a technique for eradicating cancer cells by combining targeted medicines with laser light.
- vii. radiation (section seven): High-energy beams kill cancer cells.
- viii. The cancer treatment is biological therapy, which involves stimulating the patient's immune system to attack cancer cells.
- ix. Immunotherapy: A client with cancer has a topical cream applied to their skin in order to enhance their immune system.

The extent to which your skin cancer had metastasized to other parts of your body was evaluated by your doctor. Currently, there are five distinct stages of skin cancer.

Some cancers just affect the skin. Minor surgery or removal will cure it. Some surgeons employ Moss surgery to treat face melanoma.

The dermis may be affected by small tumors in this condition. To remove the tumor and its surrounding skin, a wide incision is made while treating stage 1 melanoma. Medical professionals may prefer sentinel lymph node biopsy. Ultrasound nodes allow the doctor to check lymph nodes for cancer on a monthly basis. When using this method, specific medications or immunoassay inhibitors.

- 1) Set the input image initials.
- 2) Assess the medical database using the input photographs as a guide.
- 3) While (maximum number of inputs < image density).
- 4) For every database picture.
- 5) Modify the image database's values.
- 6) if (image class < input index).
- 7) If, (values of cancer < maximum image index).
- 8) Adjust the image's edges based on the identification.
- 9) If (maximum input index < cancer values).
- 10) Calculate the image input's cancer index.
- 11) Modify the picture values.
- 12) Verify the suggested values for the input cancer guidelines.
- 13) Identify the type of cancer and report the outcome.
- 14) Present the outcomes.
- 15) Finish the procedure

ALGORITHM 1: Enhanced image analysis technique (EIAT)

While the tumor cells themselves do not metastasize, they may enlarge and thicken, and exhibit other symptoms including scaling, bleeding, and shedding large incisions are the standard method of treating stage 2 melanoma. The spread of lymph node malignancy necessitates the usage of SLNB as well. Medications are included in targeted treatment as well.

Cancer can metastasize to other organs and tissues when this happens. The lymph nodes are separated. Following melanoma surgery, patients may be prescribed immunosuppressive inhibitors or undergo targeted therapy if their cancer is BRAF GM. Melanoma patients may also benefit from the BCG vaccine, interleukin-2 injection, or D-VEC immunization. Research indicates a survival percentage of 63.6%.

The stage of melanoma that is most advanced. The lymph nodes, skin, tissues, and organs are all targets of this disease's metastasis, which begins with the main tumor. Radiation, immunotherapy, and chemotherapy are administered after surgical excision of this massive tumor. There is a 22.5% chance of surviving

- **Input photos:** We used an enhanced image analysis algorithm trained from raw photos and disease labels to classify skin lesions.
- **Preprocessing:** Preprocessing removes unwanted background components and noise from skin photos to improve photo quality.
- **Module Normalization:** Normalization changes data variables to a specific scale without changing visual contrast or form.
- **Data collection:** If the feature is present, patient data can be dichotomous or discrete.
- **Extracting Features:** Melanoma, normal skin, or moles are the skin lesion types that can be identified by comparing the feature values that were extracted during feature extraction. Use the ABCDEs to remember the symptoms of melanoma in alphabetical order. Asymmetrical, bordered, colored, diameter, and evolving are the ABCDEs. The following skin damage factors are used by doctors to diagnose and classify melanomas.
- **Image Splitting:** Post-preprocessing image segmentation extracts the skin lesion.
- **Image examination:** ABCD images contrasting typical and harmful skin sores.
- **Edge detection:** The detection of cancerous skin injury edges is the subject of this review. Utilizing warm pictures, edge detection calculations have been utilized to find the lines of skin cancer injuries. The sore boundary couldn't be identified by all calculations; be that as it may, some showed guarantee and might be improved.

- **Classifying Images:** Threatening melanomas versus harmless nevi and keratinocyte carcinomas versus harmless seborrheic keratosis were twofold grouping challenges. Clinical and meatoscopic images were utilized to group.
- **Cancer detection:** Skin cancer prediction models use model-driven architecture and deep learning to improve accuracy.

4. DATA ANALYSIS

Enhanced image analysis method (EIAT) was compared to MCSDC, DSSDC, ASCD, and SLCNN skin lesion categorization. Tables 1–5 compare the accuracy of proposed and existing approaches.

4.1. Early Skin Detection

The prognosis for skin cancer is better compared to other types of cancer. Early detection increases the likelihood of a successful outcome for the se cancers since they contribute to the overall cause. So, it's really important to check your skin frequently. Although dermatologists are trained to spot issues, not everyone has easy access to one, and few people are motivated to prioritize their health. Everyone should get their skin checked regularly because skin cancer can strike at any age, in any ethnic group. When doing self-skin tests, it is important to follow system-specific protocols. In Table 1, we can see how the proposed and existing methods for early detection compare.

Table 1: Early detection comparison of Skin cancer

No. of inputs	MCSDC	DSSDC	ASCD	SLCNN	EIAT
100	90.12	78.12	90.25	77.14	95.63
200	89.25	78.41	89.12	74.63	97.12
300	90.14	78.88	87.52	79.12	95.41
400	88.45	77.14	85.63	74.52	95.41
500	89.65	77.25	84.36	72.36	94.44
600	84.12	75.12	79.14	77.52	98.65
700	86.22	78.96	77.12	69.36	95.41

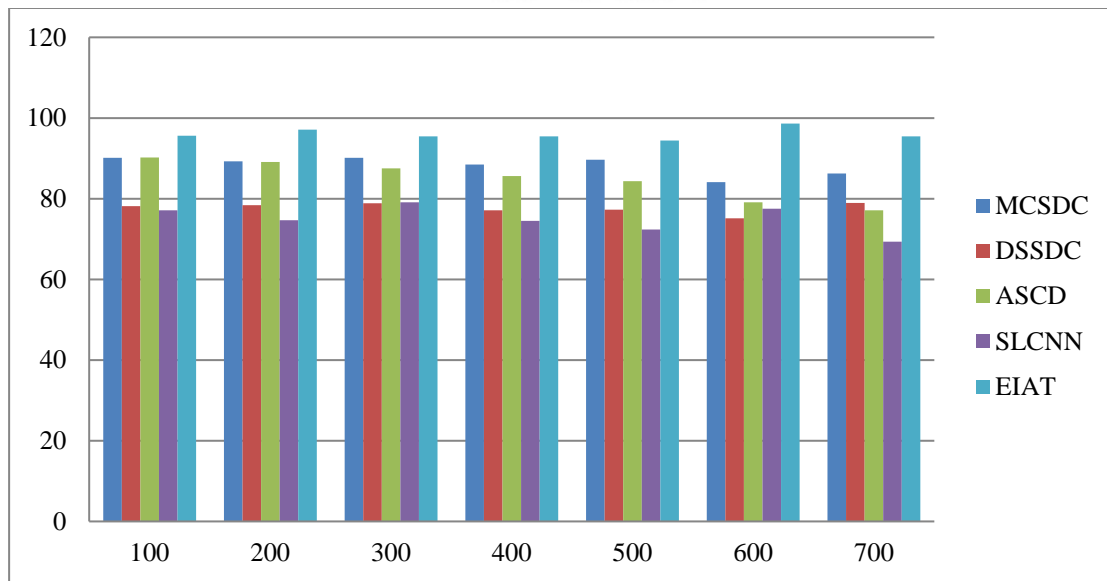


Figure 1: Early detection comparison of Skin cancer

4.2. Skin Cancer Screening

Evaluating for skin cancer as a rule involves an actual check as well as training of the infection and its risk factors. The specialist will go over sun wellbeing measures, skin cancer avoidance tips, and any expected aftereffects. On the off chance that any uncovered skin patches are found during the skin cancer test, the treating doctor might take a tissue test and send it on. The subsequent stage is to set up the tissue test for infinitesimal analysis by processing and hacking it. Table 2 thinks about the skin cancer screening techniques currently utilized with those that have been proposed.

Table 2: Comparison of skin cancer screening

No. of inputs	MCSDC	DSSDC	ASCD	SLCNN	EIAT
100	90.12	79.12	87.25	75.14	94.11
200	91.25	79.85	89.36	75.12	94.52
300	90.36	74.12	88.88	74.63	95.63
400	94.14	74.12	88.45	75.55	97.41
500	80.00	77.25	84.52	70.36	94.00
600	88.26	77.63	86.25	64.12	94.63
700	89.13	76.25	84.63	65.33	94.23

4.3. Skin Changes Monitoring

Regular self-examinations are essential for detecting any changes in skin condition. Observing skin changes in a well-lit room or during the day will yield the greatest results for this purpose. Inspect your

feet and the space between your toes for any unusualities. Ask a trusted family member or friend to check your back and any other areas that could be difficult to see. Moles cover almost everyone's body. Skin cancers include a broad variety of malignancies. Depending on the specific condition and kind of destroyed cell, the first stage could be very different. Table 3 below compares the current methods of early detection with the proposed ones.

Table 3: Skin changes monitoring comparison

No. of inputs	MCSDC	DSSDC	ASCD	SLCNN	EIAT
100	76.12	85.23	84.22	68.36	95.63
200	77.14	84.22	85.63	67.12	95.61
300	75.63	85.63	87.44	66.66	95.25
400	75.12	87.12	85.69	65.36	94.01
500	74.63	80.00	88.23	65.36	92.30
600	79.52	79.36	80.23	60.23	90.12
700	71.13	79.33	85.66	67.11	98.06

4.4. Black and White Skin Cancer Identification

Separating among highly contrasting skin cancers is fundamental. While skin cancer is still in its beginning phases, there are various key factors that can be valuable. In the event that a fix of pigmented skin is uneven, pale, enormous (in excess of 5 mm in width), differed in variety, and has changed in the beyond 90 days, it will constantly be noticeable. Tingling in a pigmented region is in any case cause for exhaustive skin assessments. The purported white skin cancer, which is commonly tracked down on the face or hands, is a consequence of delayed openness to UV beams in old people. In the underlying stages, the impacted locale frequently gives indications of skin firmness. Table 4 beneath thinks about the present and proposed techniques for recognizing highly contrasting cancer cells.

Table 4: Comparison of black and white cancer cells detection

No. of inputs	MCSDC	DSSDC	ASCD	SLCNN	EIAT
100	74.23	79.51	80.01	65.52	90.12
200	72.30	78.12	79.23	63.12	91.25
300	71.42	77.41	78.14	63.00	90.22
400	70.21	76.25	77.63	62.51	88.52
500	64.25	77.41	76.52	61.12	87.45
600	68.25	74.63	79.12	60.36	86.67

700	63.21	77.12	78.55	68.33	86.61
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4.5. UV Protection

Applying sunscreen is an important first step in sun protection, but it's not the only one. In addition to an increase in the likelihood of skin cancer since sunscreens were commercially marketed, several medical professionals now recommend using sunscreen at least ten to fifteen minutes before going outside. In addition, melanoma is the most lethal form of skin cancer, and there is no evidence that sunscreen reduces its risk. Sunscreen use is still advised, though. Table 5 below compares the proposed and existing methods for early detection.

Table 5: Comparison of UV Protection.

No. of inputs	MCSDC	DSSDC	ASCD	SLCNN	EIAT
100	81.25	86.12	85.63	71.20	99.74
200	79.63	84.63	85.41	63.98	97.41
300	79.55	83.62	84.61	68.52	96.25
400	74.63	81.25	83.21	67.14	94.52
500	79.63	80.25	80.36	66.66	93.12
600	78.25	79.36	89.22	65.21	91.25
700	78.41	77.41	81.36	65.22	90.03

5. CONCLUSION

This study demonstrates the exciting possibilities of modern image processing methods and data mining in patient health management, particularly in the early diagnosis of skin cancer. The Enhanced Image Analysis Technique (EIAT) shows better accuracy in classifying skin lesions and diagnosing malignant situations, outperforming previous approaches in a number of criteria. EIAT facilitates a more accurate and efficient diagnosis by combining preprocessing, normalization, feature extraction, and segmentation, ultimately helping dermatologists make well-informed decisions. The study highlights the value of early identification in improving the prognosis of skin cancer, stressing the necessity of routine skin examinations and expert assessments for prompt management. The incorporation of these technology developments into clinical practice has the potential to improve patient outcomes, lessen the financial burden associated with advanced cancer treatments, and raise public awareness of the hazards associated with skin cancer. Data mining tools and dermatological procedures can work together to improve patient care and revolutionize the way skin cancer is managed

as research advances.

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NUMERICAL APPROXIMATION TECHNIQUES IN STOCHASTIC MODELS FOR FINANCE: A DETAILED ANALYSIS

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Abstract

This paper explores the critical role of numerical approximation techniques in enhancing stochastic models within the finance sector. Stochastic models are essential for understanding and predicting the behaviour of financial instruments under uncertainty, but their complexity often necessitates the use of numerical methods for practical implementation. This review examines key numerical techniques, including Monte Carlo simulations, finite difference methods, and the Euler-Maruyama method, analyzing their advantages, limitations, and applicability to various financial contexts. Furthermore, the paper discusses real-world applications of these methods, highlighting their impact on risk assessment, derivative pricing, and investment strategy optimization. Challenges in implementing numerical techniques are identified, along with strategies for overcoming these barriers. Finally, the paper outlines future directions for research, emphasizing the importance of interdisciplinary collaboration and the integration of machine learning with traditional numerical methods to enhance financial modeling practices.

Keywords: Numerical approximation techniques, stochastic models, finance, Monte Carlo simulation, finite difference methods, risk assessment, derivative pricing, machine learning.

1. Introduction

Stochastic models have emerged as pivotal tools in the realm of finance, reflecting the complexities and uncertainties inherent in financial markets. These models incorporate randomness, enabling analysts and investors to capture a wide array of behaviors in asset prices, interest rates, and other financial variables [12]. The increasing volatility and interconnectedness of global markets underline the necessity for sophisticated modeling techniques that can accommodate unpredictable changes and extreme events.

• The Role of Stochastic Models in Finance

At the core of financial theory, stochastic models facilitate a comprehensive understanding of various phenomena, including asset pricing, risk management, and investment strategies.

By employing stochastic processes such as Brownian motion, Lévy processes, and jump-diffusion models, finance professionals can simulate the uncertain behavior of financial instruments under diverse conditions. This ability to model random fluctuations allows for more accurate pricing of derivatives and structured products, enhancing the risk-return profiles of investment portfolios. The significance of stochastic models extends beyond mere academic interest; they are crucial in real-world applications. For instance, in derivatives pricing, models such as the Black-Scholes framework leverage stochastic calculus to derive pricing formulas that account for market volatility and the time value of money [19]. Similarly, in risk management, stochastic models help institutions quantify and manage potential losses, enabling better regulatory compliance and capital allocation.

- **Challenges in Analytical Solutions**

Despite the advantages of stochastic models, they often lead to complex mathematical formulations that resist analytical solutions. Financial analysts frequently encounter challenges when attempting to solve stochastic differential equations (SDEs) arising from these models. Many SDEs do not have closed-form solutions, which compels practitioners to seek alternative methods for approximation. The limitations of analytical solutions necessitate a robust understanding of numerical approximation techniques. These techniques allow for the practical application of stochastic models by transforming difficult equations into manageable computations [2]. As financial markets evolve, the reliance on these numerical methods has increased, as they provide the flexibility and accuracy needed to adapt to changing market conditions.

- **Importance of Numerical Approximation Techniques**

Numerical approximation techniques serve as the bridge between theoretical models and real-world applications. Methods such as Monte Carlo simulations, finite difference methods, and the Euler-Maruyama method are instrumental in deriving approximate solutions for stochastic models. Each of these techniques offers distinct advantages and is suitable for different types of problems. For example, Monte Carlo simulations excel in handling high-dimensional problems and complex boundary conditions, while finite difference methods are particularly useful for option pricing and scenarios requiring spatial discretization. The ability to simulate various market scenarios using these numerical techniques empowers financial analysts to evaluate risks, optimize portfolios, and forecast potential outcomes[6].

By employing these methods, analysts can conduct sensitivity analyses, stress testing, and scenario analysis, ultimately aiding in decision-making processes that impact financial strategies and investments[20].

2. Stochastic Models in Finance

Stochastic models are fundamental in finance for capturing the inherent uncertainty in market behavior. These models leverage the mathematical framework of stochastic processes to represent the evolution of financial variables over time, facilitating a better understanding of risk, pricing, and investment strategies.

• Definition and Significance of Stochastic Models

A stochastic model can be defined as a mathematical representation of a system that evolves over time with inherent randomness. In finance, this randomness reflects the unpredictability of asset prices, interest rates, and market conditions[23]. The significance of these models lies in their ability to replicate the behavior of financial markets under uncertainty, providing insights into price movements and risk assessment. One of the most commonly used stochastic models in finance is the geometric Brownian motion (GBM), which is defined by the stochastic differential equation:

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

where:

- S_t is the price of the asset at time t ,
- μ is the drift term representing the expected return,
- σ is the volatility term representing the standard deviation of returns,
- dW_t is a Wiener process or Brownian motion.

This equation captures the continuous growth of asset prices while incorporating randomness through the stochastic term. GBM serves as the foundation for the Black-Scholes model, a cornerstone in options pricing.

• Common Types of Stochastic Processes

In addition to geometric Brownian motion, several other stochastic processes are widely used in finance:[8]

1. **Ornstein-Uhlenbeck Process:** This mean-reverting process is defined by the SDE:

$$dX_t = \theta(\mu - X_t)dt + \sigma dW_t$$

where θ is the speed of reversion and μ is the long-term mean. This model is particularly useful for interest rates and commodity prices, capturing the tendency of these variables to revert to a long-term mean.

2. **Lévy Processes:** These processes generalize Brownian motion by allowing for jumps and discontinuities. They are characterized by their independent increments and can be represented by the SDE:

$$dX_t = \mu dt + \sigma dL_t$$

where dL_t represents a Lévy process. Lévy processes are crucial for modelling asset returns that exhibit jumps, making them suitable for pricing derivatives in turbulent markets[15].

3. **Jump-Diffusion Models:** These models combine both continuous and jump components, represented as:

$$dS_t = \mu S_t dt + \sigma S_t dW_t + J dN_t$$

where J represents the size of the jumps and dN_t is a Poisson process indicating the occurrence of jumps. Jump-diffusion models are beneficial for capturing sudden market movements and are extensively used in option pricing.

• Applications in Financial Derivatives and Risk Management

Stochastic models have a broad range of applications in financial derivatives and risk management.

In the context of derivatives pricing, models like the Black-Scholes framework utilize stochastic calculus to derive closed-form solutions for European options. The Black-Scholes formula is given by:

$$C(S, t) = SN(d_1) - Xe^{-r(T-t)}N(d_2)$$

where:

- $C(S, t)$ is the price of the call option,

- $N(\cdot)N(\cdot)$ is the cumulative distribution function of the standard normal distribution,[4]
- d_1 and d_2 are defined as:

$$d_1 = \frac{\ln(S/X) + (r + \sigma^2/2)(T - t)}{\sigma\sqrt{T - t}}$$
$$d_2 = d_1 - \sigma\sqrt{T - t}$$

Here, S is the current stock price, X is the strike price, r is the risk-free interest rate, and T is the time to expiration. This formula illustrates how stochastic models can be applied to derive valuable insights into option pricing. In risk management, stochastic models facilitate the assessment of Value at Risk (VaR) and Conditional Value at Risk (CVaR), which quantify potential losses in portfolios under different market conditions. By simulating various paths of asset prices using stochastic processes, risk managers can estimate potential losses and make informed decisions regarding capital reserves and hedging strategies. Stochastic models play an indispensable role in modern finance, providing a rigorous framework for understanding and modeling uncertainty in financial markets. Through various stochastic processes, these models enable the analysis of asset pricing, risk management, and the behavior of financial derivatives[21]. As financial markets continue to evolve, the application of advanced stochastic modeling techniques will remain crucial for practitioners aiming to navigate the complexities of the financial

3. Overview of Numerical Approximation Techniques

Numerical approximation techniques are essential tools for solving complex mathematical problems in finance, especially when dealing with stochastic models that cannot be solved analytically. These techniques provide practical methods for estimating solutions to equations, enabling financial analysts to evaluate pricing, risk, and other critical aspects of financial instruments [1].

- **Key Numerical Methods**

1. Monte Carlo Simulation

Monte Carlo simulation is a powerful statistical technique that utilizes random sampling to obtain numerical results. It is particularly useful in pricing options and assessing risk, as it can simulate the behavior of asset prices over time. The method involves generating multiple paths of asset prices based on stochastic models and calculating the expected payoff of financial derivatives.

The basic steps include:

- Simulating a large number of price paths using stochastic processes (e.g., geometric Brownian motion).
- Calculating the payoff for each simulated path at maturity.
- Discounting the average payoff back to the present value to obtain the option price.

The accuracy of Monte Carlo simulation improves with the number of simulations, though it can be computationally intensive[25].

2. Finite Difference Methods

Finite difference methods are numerical techniques used to solve partial differential equations (PDEs) that arise in financial modeling, particularly in options pricing. These methods approximate derivatives by using discrete differences, allowing for the solution of PDEs on a grid.

For example, consider the Black-Scholes PDE:

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} - rV = 0$$

The finite difference approach discretizes the variables S (stock price) and t (time) on a grid, transforming the continuous problem into a system of algebraic equations. This method is highly effective for American options, where early exercise features complicate analytical solutions[16].

3. Euler-Maruyama Method

The Euler-Maruyama method is a straightforward numerical technique for approximating solutions to stochastic differential equations (SDEs). This method is particularly useful for simulating the paths of stochastic processes.

Given an SDE of the form:

$$dX_t = \mu(X_t, t)dt + \sigma(X_t, t)dW_t$$

the Euler-Maruyama approximation can be expressed as:

$$X_{t+\Delta t} \approx X_t + \mu(X_t, t)\Delta t + \sigma(X_t, t)\Delta W_t$$

where ΔW_t is the increment of the Wiener process. The method is easy to implement and provides a basic approximation for simulating paths of financial assets governed by SDEs.[9]

4. Implicit Methods

Implicit methods, such as the Crank-Nicolson scheme, are used in finite difference approaches for solving PDEs, particularly when stability and convergence are essential. This method averages the explicit and implicit steps, allowing for greater stability in the numerical solution.

The Crank-Nicolson method for the Black-Scholes equation can be formulated as:

$$\frac{V_j^{n+1} - V_j^n}{\Delta t} + \frac{1}{2} \sigma^2 j^2 \frac{V_{j+1}^{n+1} - 2V_j^{n+1} + V_{j-1}^{n+1}}{\Delta S^2} + rj \frac{V_{j+1}^{n+1} - V_j^{n+1}}{\Delta S} - rV_j^{n+1} = 0$$

where V_j^n represents the value at time step n and grid point j . Implicit methods tend to be more stable for longer time steps compared to explicit methods.

Advantages and Limitations

Each numerical approximation technique has its advantages and limitations:[13]

- **Monte Carlo Simulation:** Highly flexible and applicable to a wide range of problems, but can be computationally expensive and slow to converge.
- **Finite Difference Methods:** Effective for a variety of PDEs, particularly in options pricing. However, they can struggle with boundary conditions and may require fine grids for accuracy, leading to increased computation time.
- **Euler-Maruyama Method:** Simple to implement and suitable for SDEs. Its accuracy depends on the step size, and it can lead to numerical instability if not properly managed.
- **Implicit Methods:** Provide stability and accuracy for PDEs, but can be complex to implement and computationally intensive, particularly for large grids.

Numerical approximation techniques are vital for addressing the challenges posed by stochastic models in finance. By employing these methods, analysts can derive practical solutions to complex problems, enhancing their ability to model, price, and manage financial risks effectively. As financial markets evolve, ongoing advancements in numerical methods will continue to play a critical role in the development of financial engineering and quantitative finance.[14]

4. Practical Applications

Numerical approximation techniques play a crucial role in various practical applications within finance, enabling analysts and practitioners to model complex financial systems, price derivatives, and manage risk. This section explores several key applications where these techniques are employed, illustrating their significance in real-world financial scenarios.

4.1 Pricing Financial Derivatives

One of the primary applications of numerical approximation techniques is in the pricing of financial derivatives, such as options and futures.

Traditional analytical models, like the Black-Scholes formula, provide closed-form solutions under specific assumptions. However, many financial derivatives have features that complicate their pricing, such as path dependency or early exercise rights.

- **Monte Carlo Simulation:** This method is extensively used for pricing exotic options, which cannot be easily priced using standard models. For example, Asian options, whose payoff depends on the average price of the underlying asset over a certain period, are effectively priced using Monte Carlo methods. By simulating numerous price paths, analysts can estimate the expected payoff accurately.
- **Finite Difference Methods:** Used for pricing American options, these methods handle the early exercise feature effectively. The flexibility of finite difference methods allows for the incorporation of complex boundary conditions, making them suitable for pricing various derivatives.[22]

4.2 Risk Management

Numerical approximation techniques are vital in the domain of risk management, where financial institutions need to assess and manage potential losses. The ability to simulate different scenarios allows for better decision-making and risk mitigation strategies.

- **Value at Risk (VaR):** Monte Carlo simulation is widely used to calculate VaR, which estimates the potential loss in value of a portfolio over a defined period for a given confidence interval. By simulating the distribution of potential portfolio returns, risk managers can identify the worst-case scenarios and adjust their strategies accordingly.
- **Stress Testing:** Numerical methods enable the assessment of how portfolios react under extreme market conditions. By simulating adverse scenarios, financial institutions can evaluate their vulnerability and take proactive measures to strengthen their resilience[2].

4.3 Portfolio Optimization

In portfolio management, numerical approximation techniques facilitate the optimization of asset allocation to maximize returns while minimizing risk. The complexities of financial markets and the interdependencies of asset prices require sophisticated modeling approaches.

- **Stochastic Programming:** This method incorporates uncertainty in asset returns and enables the optimization of portfolios under varying market conditions. By using Monte Carlo simulations to generate scenarios of future asset prices, investors can identify the optimal allocation that aligns with their risk tolerance and investment goals.
- **Dynamic Asset Allocation:** Numerical techniques are used to model and adjust portfolios over time as market conditions change. By continuously simulating price movements and recalibrating the portfolio, investors can improve their chances of achieving superior returns.[5]

4.4 Asset Pricing Models

Numerical approximation techniques are integral to the development and application of advanced asset pricing models. These models often rely on stochastic processes to capture the underlying behavior of asset prices.

- **Stochastic Volatility Models:** Techniques such as the Euler-Maruyama method are used to estimate the parameters of stochastic volatility models like the Heston model. These models help in understanding the dynamics of volatility and its impact on option pricing and risk management.
- **Term Structure Models:** Numerical methods assist in solving the yield curve dynamics in term structure models, enabling the pricing of interest rate derivatives. For instance, the Heath-Jarrow-Morton framework can be implemented using finite difference methods to price interest rate options accurately.[10]

4.5 Real-World Case Studies

Several financial institutions and practitioners have successfully implemented numerical approximation techniques in their operations. For instance, large investment banks use Monte Carlo simulations to price complex derivatives and manage risks associated with their trading activities. Additionally, asset management firms employ finite difference methods for risk assessment and derivative pricing in their portfolios. In academia, numerous studies have demonstrated the effectiveness of these techniques in various financial scenarios, highlighting their practical relevance. Researchers continuously explore new numerical methods and refine existing ones, ensuring that they remain aligned with the evolving complexities of financial markets.[24]

The practical applications of numerical approximation techniques in finance are diverse and impactful. From derivative pricing to risk management and portfolio optimization, these techniques empower financial practitioners to navigate the complexities of modern markets. As financial

instruments become more sophisticated, the importance of robust numerical methods will only continue to grow, underscoring their critical role in financial analysis and decision-making.

5. Challenges in Implementing Numerical Techniques

The implementation of numerical approximation techniques in finance, while essential, is fraught with challenges that can hinder their effectiveness and reliability. One significant challenge is the computational complexity involved in executing these methods. Financial models often require extensive simulations or complex calculations, which can be computationally intensive, leading to long processing times and increased costs. This is particularly problematic for real-time trading systems that demand rapid decision-making. Another obstacle is the accuracy of the numerical methods employed. Many techniques, such as Monte Carlo simulations or finite difference methods, rely on specific assumptions about the underlying financial processes.[3] If these assumptions are not aligned with real-world conditions, the results may be misleading. Additionally, numerical methods can be sensitive to parameter estimates, which, if inaccurately specified, can further exacerbate inaccuracies in outputs. Data quality and availability also present challenges. Financial models require high-quality, accurate data to produce reliable results. However, in practice, data may be incomplete, noisy, or suffer from biases, undermining the integrity of the numerical analyses. Furthermore, practitioners often face difficulties in validating the results of numerical methods against real market scenarios, making it hard to ascertain their reliability.

• Strategies for Overcoming Barriers

To effectively address these challenges, several strategies and best practices can be implemented. First, investing in advanced computational resources and technologies can significantly enhance the efficiency of numerical methods. Utilizing high-performance computing systems or cloud-based solutions allows for quicker simulations and processing, making it feasible to apply complex models in real-time scenarios. Improving the accuracy of numerical methods involves rigorous model validation and testing.[7]

Practitioners should conduct back-testing against historical data to assess the reliability of their models and adjust assumptions as necessary. This iterative process can help identify potential discrepancies and refine the numerical methods employed. Data quality can be improved by establishing robust data governance frameworks that ensure the accuracy and reliability of inputs. [4] Collaborating with data providers to access high-quality datasets can mitigate issues related to data biases or gaps. Additionally, leveraging machine learning techniques can assist in cleaning and enhancing data quality, ultimately leading to more reliable numerical analyses. Finally, continuous

education and training in advanced numerical techniques can empower financial professionals to better understand and apply these methods. Encouraging a culture of collaboration among teams can facilitate knowledge sharing, leading to innovative solutions that address common challenges in numerical finance. [11] By implementing these strategies, financial practitioners can navigate the complexities of numerical approximation techniques, ultimately enhancing their effectiveness and the quality of financial modeling.

6. Conclusion

In conclusion, numerical approximation techniques are indispensable in enhancing the effectiveness of stochastic models within the finance sector. These methods not only provide essential insights into risk assessment and derivative pricing but also enable the optimization of investment strategies in an increasingly complex financial landscape. As financial markets evolve and new instruments emerge, the importance of these techniques will likely intensify. This shift is driven by the growing need for precise modeling in the face of uncertainty, highlighting the urgency of developing more sophisticated numerical methods.[18]

Future research should prioritize refining existing approximation techniques and exploring hybrid models that synergize the strengths of various numerical methods. For example, combining Monte Carlo simulations with finite difference methods could yield more accurate results in certain contexts. Additionally, as computational power continues to expand, there is a significant opportunity to integrate machine learning algorithms with traditional numerical methods, enhancing their predictive capabilities and efficiency. Interdisciplinary collaboration will be critical in addressing the challenges faced in implementing these techniques. By fostering partnerships among mathematicians, financial analysts, and data scientists, the finance community can better tackle the complexities associated with modern financial markets. [17]

This collaborative approach can lead to innovative solutions that not only improve the accuracy of numerical approximations but also make them more accessible to practitioners in the field. Moreover, as regulatory environments and market conditions shift, ongoing research should aim to adapt numerical techniques to these changes. Developing robust frameworks that can quickly adjust to dynamic market conditions will be essential for maintaining the relevance and applicability of these methods. By focusing on these areas, the finance community can significantly enhance the robustness and adaptability of financial modeling practices. In summary, the future of numerical approximation in finance is promising, with ample opportunities for innovation and growth. By prioritizing research and collaboration, we can unlock the full potential of these techniques, ultimately leading to more informed decision-making and improved outcomes in financial markets. The commitment to

advancing numerical methods will not only benefit financial practitioners but also contribute to the overall stability and efficiency of the financial system.[18]

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