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"GROUND WATER RESOURCES IN THE PURBA MEDINIPUR DISTRICT: AN INTEGRATED APPROACH AND GEOLOGICAL INFORMATION SYSTEM (GIS)"

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Abstract

Frameworks for overseeing water are turning out to be more significant in the making of maintainable metropolitan administrations. This article presents the production of a geographic data framework that is utilized for water the executives while considering the needs of shrewd urban communities. Notwithstanding four savvy instruments that have been produced for the city of West Bengal, this framework has been completely evolved utilizing free open source programming to make a fundamental framework in light of a successful and explicit proposed information model: water network approvals, visual follow reproduction, verifiable information route, and brilliant stockpile cuts. The water the executives firm will actually want to adjust its strategies to give clients further developed client encounters and utilization plans in view of prescient apparatuses thanks to this innovation. The advantages for water the board organization directors are underscored and covered.

Keywords: Water management; FOSS; open source; data base; GIS; data mode

1. Introduction

An essential asset for life is water. In India, accomplishing supportable turn of events and compelling administration of this restricted asset has demonstrated troublesome. Contending needs for water are made by rising agrarian efficiency, extending urbanization, developing urbanization, and speeding up industry. Ground water has progressively turned into the

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underpinning of India's farming and security of drinking water. Practically 62% of water system, 85% of provincial water supply, and half of metropolitan water supply are helped by ground water. Despite the fact that groundwater can be renewed intermittently, its accessibility shifts relying upon where you are and when you really want it. Precipitation is the fundamental supporter of the yearly renewal of ground water in the zone of water level vacillation. Thusly, a sensible quantitative gauge of ground water accessibility in this zone in light of commonly sound logical ideas is important for the supportable double-dealing of ground water assets. The 2012 Public Water Strategy put areas of strength for on leading customary, logical evaluations of ground water supplies. Anticipating water assets should think about patterns in water accessibility brought about by different causes, including environmental change. To expand how much usable water assets, it suggests the immediate utilization of precipitation, desalination, and staying away from unplanned evapotranspiration. The Public Water Strategy 2012 likewise expresses that protected water for drinking and sterilization ought to be considered as preplanned needs followed by high need distribution for other homegrown requirements (counting necessities of creatures), accomplishing food security, supporting food farming and least eco-framework needs. In the wake of tending to the previously mentioned needs, accessible water ought to be conveyed in a manner that energizes protection and compelling use.

The First Irrigation Commission first estimated the nation's water resources in 1901, estimating the nation's surface water resources to be 144 million hectare metres. In view of experimental recipes, Dr. A. N. Khosla determined the normal yearly overflow of all Indian stream frameworks, containing both surface and ground water assets, to be 167 M.ham in 1949. From that point forward, a few Working Gatherings, Councils, and Teams laid out by the Public authority of India have occasionally endeavored to gauge the nation's ground water assets in view of existing information and in light of formative requests. The Public Commission of Horticulture assessed the country's all out ground water assets to be 67 M.ham, how much utilizable ground water to be 35 M.ham, and how much ground water that could be utilized for water system to be 26 M.ham in 1976.

1.1. Ground Water Evaluation and the executives Drives

The ends from the assessment of the ground water assets are utilized as an asset by organizers and partners to settle on the best administration rehearses for the practical improvement of the ground water assets. The Public authority of India has carried out various advances, for the most part founded on the aftereffects of the asset evaluation, to renew or increment ground water assets.

The conservation of ground water is a key component of the watershed development programmes being carried out by some state governments. As part of the MGNREGA, initiatives

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to conserve water are being implemented. The "JalKrantiAbhiyan" effort, started by the Ministry of Jal Shakti, aims to bring all water management and conservation initiatives in the nation under one comprehensive umbrella. The AtalBhujalYojana, which will be put into action starting in April 2020, aims to improve ground water management in areas of seven States that have been recognized as being water-stressed, with a focus on demand management and community involvement.

1.2. Re-Appraisal of Ground Water Assets, 2020

To ascertain the current state of ground water resources in the nation, the evaluation of ground water resources is conducted. Also, it aids in evaluating how current ground water management techniques affect available groundwater resources. A Focal Level Master Gathering (CLEG) was laid out in 2020 by the Division of Water Assets, Stream Improvement and Ganga Restoration, and Service of Jal Shakti to supervise the reconsideration of ground water assets the country over in 2020.

The assessments for a few States (Chhattisgarh, Jharkhand, and Kerala) have not yet received state level committee approval. The Public Level Report named "Dynamic Ground Water Assets of India-2020" has been made in light of the assessments provided by the particular State Level Boards and joint evaluation made in the previously mentioned States. West Bengal's assessment for 2020 was unable to be finished; hence CLEG suggested that the outcomes of the 2013 assessment be taken into consideration for 2020. In the national compilation report, ground water resources in various States are summarized and analyzed.

2. Literature review

To distinguish the most likely areas for groundwater research in a dry bowl in Jordan, Jawad and Yahya arranged and dissected computerized layers of lithology, land construction, waste, and geology utilizing geographic data frameworks (GIS) devices and remote detecting information. To decide the extent of wells in every time of thickness and the quantity of lineaments and seepage, guides of existing wells and recently produced maps were crossed. The most likely locations for groundwater research were then mapped using various GIS intersection and spatial query algorithms. The study demonstrated that groundwater exploration sites may be efficiently mapped using remote sensing and GIS. The information from groundwater wells would help to fine-tune the final positions of the most likely sites, though.

The capacity of a PC framework to incorporate, store, dissect, and show geographic data was examined by Prattana and Royol. Before currently, GIS was just utilized for map making and different information the executives errands, including ecological effect appraisal and the board of normal assets. Internet enables more simultaneous user sharing of geographic information.

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Accessing, processing, and disseminating geographic or non-geographic information is made easier by the Internet GIS system. For a better knowledge of the user for the total national watershed, they built an internet GIS application for managing water resources.

By planning the metropolitan drinking organization, setting the capacity water tank, and picking the wellspring of water for the water supply framework while considering ground surface characteristics, Khadri, Pande, and partners associated GIS and RS offices. They talked about how to use GIS, GPS, and RS technology for network planning, mapping, and visualisation. To determine the distribution supply networks, they gathered data from multiple sources and combined it with GIS. Results were shown in GIS maps, tables, and visualisations after a spatial database was constructed and built. It has been demonstrated that GIS is a capable and useful tool for managing networks. Using techniques from remote sensing, GPS, and GIS, they described the water network distribution and delivery system in and around Chalisgaon city. Analyzed was the pattern of urban growth relative to changes in land use and demographics.

Larsen, Mark, and colleagues provided illustrations of how GIS may work well with hydraulics modeling and integrate with asset management systems to create a productive workbench for developing, updating, and graphically displaying precise water supply and sewage models. In comparison to other lengthy and laborious processes like creating hydraulic models, the capacity of GIS to interact with vast volumes of data provides a visual and intuitive understanding method.

A GIS-based spatial choice emotionally supportive network for foreseeing contamination entrance into water circulation frameworks was introduced by Vairavamoorthy and Yan et al. To mirror the methodology and hazard of pollution, three models were made. The tainting zone of contamination sources and the adjustment of focus during movement through soil are anticipated by a leakage model. As indicated by the probability of poison penetration, a line condition evaluation model positions the state of water pipes. The calculation and foreign substance zone are consolidated in an entrance model to decide the region of the water appropriation pipe that might be possibly dirtied. They combined three models with ArcView GIS to aid in risk-reduction decision-making. Thematic maps in GIS were used to show the possibility for pollutant ingress and the potential for pollution in the vicinity of water pipes. The GIS maps were used to pinpoint the high-risk zones. Consequently, a geographical decision support system built on GIS enabled the greatest possible risk reduction.

An integrated, remote sensing-based methodology was developed by Yan, Sultan, and others to enhance assessment of renewable water resources. They utilized remote detecting procedures to accumulate geological and fleeting information, and afterward joined information to work out precipitation, soil dampness, repository limit and stages, and streams in tremendous waterway

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channels, which are significant components in hydrologic processes. They made a hydrologic model with a GIS capacity to peruse and involve different satellite sensor information for model info and model adjustment. Their model emulates hydrologic processes, the utilization of water for energy age, and agrarian tasks. The parched to semiarid areas of Egypt have been exposed to this incorporated portrayal strategy. They produced estimations for potential water resources using their model, which can be applied as a tool for future management improvement.

Yu Weng and Huiting Liu discussed the use of GIS technology to effectively transmit information with people in the field. The primary function of GIS in the age of big data is the sharing and storage of spatial data. Distributed computing, which will be basically as normal as water and power, changed over all IT assets into administrations and incorporated the HADOOP and GIS Innovation models.

For the supportable improvement of land and water assets, Dasika P. Rao made a coordinated technique in view of remote detecting and geographic data frameworks (GIS). Involving GIS as an instrument, information on soils, water assets, and land use/cover were assembled from various sources and joined with the social, social, and monetary requests of the populace. The joining supported the production of an activity plan including exact watershed intercession procedures. Land deterioration was slowed down, ground water levels rose, and wastelands were given a greener appearance as a result of the implementation of action plans in specific particular watersheds. It was determined that consideration of impact, risk, and analysis of numerous objectives is crucial for sustainable development.

To help the administration of water assets and in-stream water quality, Fletcher and Sun et al. made an assortment of instruments and methodology that consolidate the force of GIS with a bunch of water quality models. They focused on the Watershed Portrayal and Displaying Framework (WCMS), an assortment of GIS devices that tended to watershed issues in West Virginia, for example, stream assessment, depiction of watersheds for a picked pour point, distinguishing proof of possibly impacted streams from a contamination source, positioning of watersheds for remediation, and utilization of water quality information to gauge poison loadings and fixations connected with corrosive mine waste. To progressively assess the impacts of a poison or treatment on downstream water quality, the Water Quality Displaying Framework (WQMS) was created. As an extra to WCMS, WQMS utilizes a stream network model made with Java instruments. Guidelines, modern administrators, ecological organizers, and networks can involve the WCMS and WQMS as apparatuses to more readily comprehend stream conditions and the combined impacts of contamination and treatment on water quality.

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3. Methodology

3.1. Ground Water Assets Assessment Technique

As per the standards in the GEC 2015 approach, the ground water asset starting around 2020 has been assessed utilizing the significant suppositions relying upon the information accessibility. These are the primary attributes of the GEC 2015 system:

The methodology suggests evaluating groundwater resources by aquifer, including replenish able groundwater resources, also known as dynamic groundwater resources, as well as in-storage resources, also known as static resources. In alluvial areas down to the depth of bed rock or 300 m, whichever is less, the in-storage ground water resources must be evaluated whenever the aquifer geometry for the unconfined aquifer has not been firmly established? Hard rock aquifers would have a maximum assessment depth of 100 m. assuming it is known that groundwater is being extricated from obliged springs, assessing both the dynamic and away resources is vital. Assuming that it is demonstrated unquestionably that ground water isn't being removed from this restricted spring, just the spring's away assets should be determined. The flow practice of utilizing watershed in hard rock regions and blocks/mandals/firkas in delicate stone regions might be held until an OK scale for spring math has been found.

It is likewise critical to take note of that the class additionally considers the connection between the yearly renewal and groundwater improvement since it is prescribed to restrict groundwater advancement however much as could reasonably be expected to assets that can be recharged yearly. In contrast to an area with significant groundwater potential, which may be developed and may eventually become over-exploited, an area with no groundwater potential may not be considered for development and may remain safe. So, if the groundwater potential is great and there is room for augmentation, attempts to add water can be fruitful.

3.2. Rainfall Recharge

Since this technique considers the reaction of ground water levels to ground water info and result parts, it is prompted that ground water re-energize be assessed on ground water level variance and explicit yield approach. However, to do this, you want to take delegate water level estimations that are adequately scattered throughout a long sufficient opportunity. The assessment unit should contain at least three observation wells that are evenly spaced apart, or one observation well for every 100 square kilometers. Together with related rainfall data, water level data should be accessible for a minimum of 5 years (ideally 10 years).

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3.3. Total Yearly Ground Water Re-energize

The general yearly ground water re-energize/gatherings for the sub unit are determined as the amount of the re-energize/aggregations during rainstorm and non-storm seasons. Comparative estimations should be made for every one of the assessment unit's accessible subunits**.**

3.4. Annual Extractable Ground Water Resource (EGR)

The Complete Yearly Normal Release is deducted from the All out Yearly Ground Water Re-energize to compute the Yearly Extractable Ground Water Asset (EGR). To compute the yearly extractable ground water assets, the commitment of the ground water to the organic progression of the stream ought to be determined and deducted from the yearly ground water re-energize (EGR). The Focal Water Commission and other pertinent stream bowl organizations will assist with deciding the waterways' natural streams. The accompanying suspicion ought to be utilized assuming the base stream commitment to the environmental progression of waterways can't be determined.

Utilizing the post-storm water level one month after the finish of the blustery season, the water level vacillation approach represents a sizable measure of base stream. Especially in locales with hard rock, the base stream in the leftover non-storm time frame is presumably going to be negligible. The momentum practice (GEC 1997) of assigning unaccounted normal streams to 5% or 10% of yearly re-energize might be kept in evaluation units where waterway stage information and exact information for quantitative appraisal of the regular release are not accessible. The yearly re-energize will be 5% assuming the water level vacillation strategy is utilized to work out the precipitation re-energize and 10% on the off chance that the precipitation invasion factor technique is utilized to ascertain the re-energize. The leftover sum will address yearly extractable groundwater assets (EGR).

3.5. Ground Water Assessment in Urban Areas

Urban and rural locations both have ground water resources that must be assessed. The following few things need to be taken into account due to the accessibility of draught data, a somewhat different infiltration process, and recharging from other sources.

- In spite of the fact that data on flow ground water deliberation systems is open, their exactness is to some degree sketchy, and individuals couldn’t actually include the quantity of wells in metropolitan regions. Hence, it is encouraged to ascertain the channel from groundwater assets utilizing the contrast between the genuine interest and the inventory given by surface water sources.

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- Except if and until explicit safeguards are taken in the development of streets and asphalts, metropolitan regions can sometimes look like substantial wildernesses, and precipitation penetration isn't comparable to that of provincial regions. Subsequently, it is proposed to embrace 30% of the water penetration factor recommended for metropolitan regions as a brief arrangement until field examinations here have been finished and are accessible as recorded field studies.
- Urban regions have a lot of pipelines because of water supply plans, and certain areas suffer significant seepages from these channels or pipes. In order to estimate the recharge, this component must also be included with the other resources. Individual water supply agencies may be contacted to obtain their percentage losses, with 50% of that amount being used to refresh the ground water system.

4. Result And Discussion

4.1. Ground Water Assessment in Water Level Depletion Zones

Even during the monsoon season, there might be certain regions where the level of ground water is falling. Any one of the following could be the cause:

a) Ground water extraction and regular ground water release during the storm season (outpouring from the district and base stream) outperform the re-energize, showing a serious consumption in the ground water system.
b) Due to inadequate observation wells, water level data may contain errors. If it is determined that the water level data is inaccurate, a recharge assessment using the rainfall infiltration factor approach may be done. The ground water level fluctuation approach may be used for recharge estimate if, on the other hand, water level data are deemed to be accurate. The anticipated recharge will be smaller than the gross ground water extraction during the monsoon season because S in equations 3 and 4 is negative. It should be emphasized that this recharge is the gross recharge less the monsoon season's natural discharges. Such an analysis in water depletion zones will lead directly to the conclusion that the region is overexploited and needs micro level research.

4.2. Norms for Trench Re-energize

Rather than different guidelines, the Re-energize Component for computing the re-energize attributable to channels is given in two units: ham/million m2 of wetted region/day and cumecs per million m2. The board of trustees recommends involving the norm in ham/million m2 of wetted land to ascertain the re-energize because of trenches since any remaining standards are communicated in ham

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The upsides of the re-energize standards proposed by GEC 1997 shift significantly. The other re-energize standards are multiple times the Waterway leakage standard. The advisory group chooses to stay with similar guidelines without any field exploration to further develop them. Prior to finishing the underlying assessment utilizing this philosophy, the board profoundly exhorts that each state organization do no less than one field concentrate on in each region. Likewise with different standards, the council additionally offers a suggested esteem, as well as least and greatest qualities. At the point when specific discoveries from contextual analyses in certain states are accessible, specially appointed guidelines ought to be subbed with those created from these discoveries.

4.3.Evaporation and Transpiration

If the aquifer's water levels are inside the capillary zone, evaporation can be calculated for the assessment unit. It is advised to calculate evaporation using field research. For places with water levels under 1.0 mbgl, vanishing can be determined utilizing the dissipation rates recorded for adjacent regions in the event that field research isn't achievable. Dissipation misfortunes from the spring ought to be thought to be nothing assuming that the profundity from the water level is more than 1.0mbgl.

On the off chance that water levels in the spring are inside the greatest root zone of the neighborhood vegetation, happening through vegetation not entirely set in stone. It is advised to calculate transpiration using field research. Even though it varies from location to location based on the kind of soil and plants, the following estimation might be used in the absence of field investigations. Using the published transpiration rates for other regions, one may calculate transpiration if the water level is less than 3.5m bgl. Transpiration should be regarded as zero if it is larger than 3.5m bgl.

Field instruments, such as lysimeters, can be used to calculate evapotranspiration in order to determine actual evapotranspiration. Typically, lysimeter experiments are conducted by agricultural colleges and IMD, and the evapotranspiration data is archived. For the evaluation of genuine evapotranspiration, approaches in light of remote detecting, like SEBAL (Surface Energy Equilibrium Calculation for Land), can be applied. Evaluation workplaces can gauge evapotranspiration utilizing existing lysimeter information or different strategies. Evapotranspiration misfortunes can be experimentally derived utilizing PET information given by IMD without a trace of such information.

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Table 1.1: Ground water Resources assessment 2004 to 2020

S. No.	Ground Water Resources Assessment	2004	2009	2011	2013	2017	2020
1	Annual Ground Water Recharge	433 bcm	431 bcm	433 bcm	447 bcm	432 bcm	436 bcm
2	Annual Extractable Ground Water Resource	399 bcm	396 bcm	398 bcm	411 bcm	393 bcm	398 bcm
3	Annual Ground Water Extraction for Irrigation, Domestic & Industrial uses	231 bcm	243 bcm	245 bcm	253 bcm	249 bcm	245 bcm
4	Stage of Ground Water Extraction	58 %	61 %	62 %	62 %	63 %	62 %

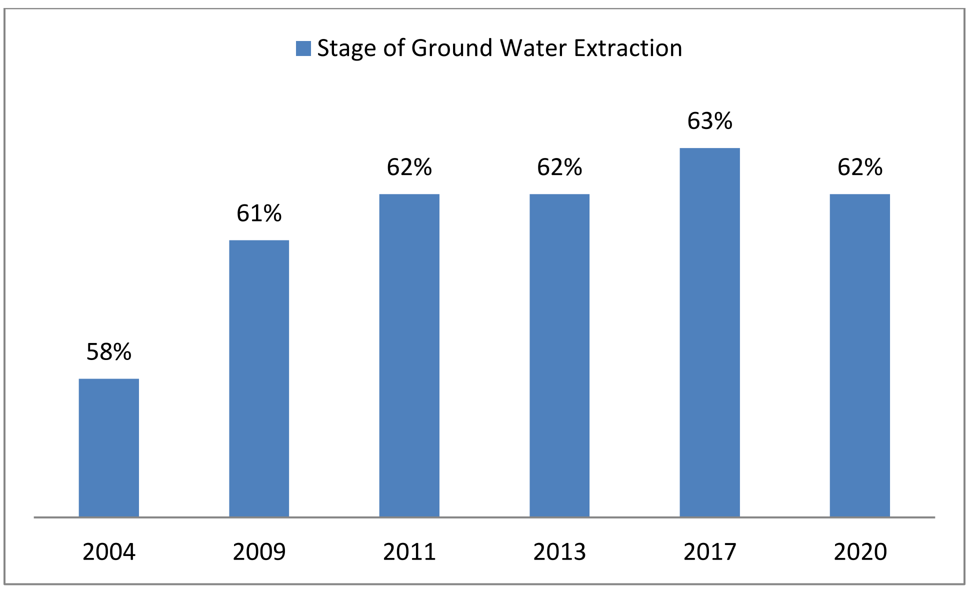

Figure 1: Ground water Resources assessment

4.4. Ground Water Appraisal and The board Drives

The ends from the assessment of the ground water assets are utilized as an asset by organizers and partners to settle on the best administration rehearses for the maintainable improvement of the ground water assets. The Public authority of India has executed various advances, generally

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founded on the consequences of the asset evaluation, to recharge or increment ground water assets.

The Focal Ground Water Authority was laid out by the Public authority of India to manage ground water advancement in the country. The Focal Ground Water Board likewise set up a reasonable arrangement named "End-all strategy for Fake Re-energize to Ground water in India" that requires the development of almost 11 million Downpour Water Collecting and Counterfeit Re-energize designs to expand the country's ground water assets. To assist them with carrying out legitimate regulations for the guideline of ground water improvement, which incorporates the arrangement for water gathering, Service of Jal Shakti has likewise conveyed a Model Bill to all States/UTs. To guarantee the supportability of the assets, CGWB has carried out the Public Spring Planning and The executives Program, which means to plan significant springs, portray them, and make spring the board plans with an emphasis on overexploited, basic, and semi-basic evaluation units. The conservation of ground water is a key component of the watershed development programme being implemented by some state governments. As part of the MGNREGA, initiatives to conserve water are being implemented.

Table 1.2: Categorization of assessment units from 2004 to 2020

S. No.	Categorization of Blocks/ Mandals/ Talukas	2004	2009	2011	2013	2017	2020
1	Total Assessed units	5384	5842	6673	6824	6883	6377
2	Safe	4384	4277	4584	4827	4310	4482
3	Semi-critical	538	527	684	631	938	1274
4	Critical	237	169	219	237	320	228
5	Over-Exploited	839	812	1381	1083	1138	1137
6	Saline	30	71	90	95	100	97

4.5. Categorization of Evaluation Unit In view of Amount

As indicated by the Phase of Ground Water Extraction, the grouping in view of ground water amount is as per the following:

Stage of Ground Water Extraction	Category
≤ 70%	Safe
> 70% and ≤95%	Semi-critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

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The Panel prompts that every evaluation unit ought to convey a quality risk identifier notwithstanding the amount based classification (safe, semi-basic, basic, and over-took advantage of), as it is unimaginable to expect to order the evaluation units as far as the degree of value peril in view of the accessible water quality checking component and data set on ground water quality. In mappable units, the evaluation sub unit might be named with a particular quality danger if any of the three quality perils — arsenic, fluoride, and saltiness — are tracked down there.

Only the four rainy months of June through September get more than 75% of the yearly rainfall, which causes significant temporal changes. In spite of the fact that there are huge territorial changes, the yearly typical precipitation is 119 cm. While the Northern Pieces of Kashmir and Western Rajasthan get less precipitation than 40 cm every year, the Districts on the Western Ghats and the Sub-Himalayan regions in the North East and Meghalaya Slopes get significant precipitation of over 250 cm yearly. Using rainfall data from a network of 3800 stations spread over India for 50 years (1961–2010), rainfall normals have been calculated. India's rainfall has two noteworthy characteristics: in the north, it decreases westward; in Peninsular India, it reduces eastward before increasing in the coastal region.

5. Conclusion

2020 estimates place the nation's annual ground water recharge at 436 billion cubic metres (bcm). Rainfall and other sources, such as canal seepage, recharge from water bodies, return flow from irrigation, and water conservation buildings, among others, are used to replenish ground water supplies. Precipitation, which represents generally 64% of the complete yearly ground water re-energize, is the essential wellspring of yearly ground water re-energize.

Subsequent to representing normal release, the absolute yearly extractable groundwater asset of the country has been assessed to be 388 bcm. The country's yearly ground water extraction (2020) is 245 bcm, with water system being the significant shopper. The extent of ground water extraction contrasted with the yearly extractable ground water re-energize, or the Phase of ground water extraction, has been determined at 62% for the whole country.

In light of the idiosyncrasies of the landscape and the accessibility of information, the GEC-2015 methodology has been intended for the ordinary Indian settings. The CGWB and IIT-HYDERABAD made the India-groundwater asset assessment framework (INGRES) as a product/electronic application to dissect ground water assets utilizing the GEC 2015 Methodology. Realistic hypotheses based on experience in many States have helped to overcome data availability constraints. The State/Central authorities must make a conscientious effort to collect the necessary realistic data in order to map the country's evolving groundwater scenario.

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The following conclusions are drawn from a study of the assessment's findings as to how to proceed with the evaluation of groundwater resources.

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Author's Declaration

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