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DECREASING LEVEL OF GROUND WATER: A CASH STUDY OF WEST INDIA

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ABSTRACT

The earth's groundwater supply is one of its most valuable natural resources. Not only did it make it possible for practically every kind of living form to emerge, but it also contributed to the development of human civilization. The use of groundwater without discrimination and in certain cases to an excessive degree has prompted many to doubt the resource's long-term viability. How much of the groundwater resource may be extracted without jeopardising the concept of sustainable development to an unacceptable degree? To determine whether or not the use of groundwater can be considered sustainable, an interdisciplinary approach must be used, with hydrology, ecology, geomorphology, and climatology each playing a significant part in the analysis. It is important to make a distinction between shallow groundwater flow systems and deep groundwater flow systems. The former interact with surface water, whilst the latter do not. The pace of groundwater turnover can range anywhere from years to millennia, depending on the location of the aquifer, the kind of aquifer, the depth of the aquifer, the features of the aquifer, and its connection. In general, groundwater does not recycle as quickly as surface water.

Keywords: *Groundwater, Geomorphology, Hydrology, Ecology, Aquifer*

INTRODUCTION

There are approximately two billion people in the globe that are dependent on groundwater at the present time. Fortunately, groundwater is a renewable resource that is always being replenished as a result of annual precipitation. However, this process of recharging is not totally dependent on rainfall; rather, it is based on a variety of other natural elements that vary from place to region and across time as well as space. As a result, the process of groundwater recharge is never an unchanging component. Overexploitation occurs when the annual average amount of draught exceeds the annual average quantity of recharge for many years in a row. Because of the manner and the scale in which the use of groundwater has accelerated, human beings have become so dependent on the assured source that there is no sign of the over increasing demand for groundwater stabilising. This is because there is no sign of the over increasing demand for groundwater stabilising. At the turn of the 20th century, the demand for groundwater in the industrial sector skyrocketed at a rate that was far quicker than the rate at which it increased in the agricultural and home sectors. Fresh water that is useful comes from groundwater more than any other source on the planet. Only through tapping into the ground's aquifers is it possible to satisfy the water requirements of households, farms, and factories in many areas of the world, particularly in regions where surface water sources are in short supply. According to the United States Geological Survey, the water that is held in the earth is analogous to money. Fresh water that is useful comes from groundwater more than any other source on the planet.

Groundwater is the most important source of potable, fresh water in many regions of the world, especially those places where surface water is scarce. Only through tapping into the ground's aquifers is it possible to satisfy the water requirements of households, farms, and factories in many areas of the world, particularly in regions where surface water sources are in short supply. According to the United States Geological Survey (USGS), the water that is stored in the ground is analogous to money that is held in a bank account. There will ultimately be issues with the account's supply if the money is taken at a pace that is higher than the rate at which fresh money is deposited. Similar issues might arise if, over the course of time, water is extracted from the ground at a pace that is greater than the rate at which it is replaced. The Central Ground Water Board (CGWB) has informed the Ministry of Water Resources that approximately 56% of the wells that are analysed to keep a tab on ground water level showed a decline in their level in 2013 when compared to the average of the preceding 10 years (2003-12) period. This information was provided by the CGWB to the Ministry of Water Resources. Pumping of groundwater over extended periods of time is the primary contributor to groundwater depletion. The following is a list of some of the negative impacts that groundwater depletion may have:

- **Lowering of the Water Table**

An excessive amount of pumping might cause the groundwater table to drop, which will prevent wells from reaching groundwater in the future.

- **Increased Costs**

As the water table drops, the water needs to be pumped further in order to reach the surface, which requires a greater amount of energy. In some circumstances, the utilisation of a well of this kind may be financially prohibitive.

- **Reduced Surface Water Supply**

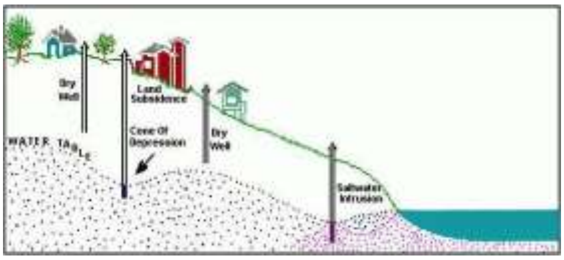
Both surface water and groundwater are linked to one another. When there is an excessive demand for groundwater, the lakes, streams, and rivers that are linked to it may also see a reduction in their water supply.

- **Land Subsidence**

The process of land subsidence happens whenever there is a loss of support underneath the earth. When this happens, the collapse, compacting, and dropping of the soil are almost often the result of human activity, specifically the excessive use of groundwater.

- **Water Quality Concerns**

An excessive amount of pumping in coastal regions can cause saltwater to travel inland and upward, which can contaminate the freshwater supply with saltwater. Coastal areas are located on the coast.



The amount of groundwater available in India is decreasing at an alarming rate, to the point that certain states are seeing water levels that are dangerously low.

Groundwater is utilised for a wide variety of reasons, including irrigation, industry, and human consumption. The government's inadequate distribution infrastructure is another factor that contributes to the already precarious state of the water supply. Leaks account for the loss of forty percent of the water supply in metropolitan areas such as Pune and Delhi.

There are three primary factors that have contributed to India's current water crisis:

1. There is not enough water available for each person since the population is rapidly growing. In spite of the fact that it has been projected that India should have between 700 and 1200 billion cubic metres of potable water, the country only possesses 1000 cubic metres of water per person.

2. The water in the majority of rivers has been contaminated, rendering it unsafe for use in any capacity, including drinking. The inadequate and sluggish investment in urban water-treatment infrastructure is the root cause of the poor quality of the water. The lack of available technical and human resources at state pollution control boards is the primary cause for the non-implementation of regulations governing industrial wastewater.

3. The overexploitation of groundwater resources by farmers is one of the primary contributors to this problem. This is the case due to the fact that anybody has the legal right to pump water from their own property and that groundwater is freely accessible.

As a result of climate change, monsoon conditions have been poor, which has made the groundwater situation even worse. Groundwater mainly relies on rain for replenishment. Due to the lack of rainfall, the farmers are forced to dig deeper in order to reach groundwater and irrigate the area. The end outcome is that the tables are pushed even farther down.

Saltwater pollution of the water supply is the direct result of unchecked urbanisation that has moved inland and higher and contributed significantly to the problem. Additionally, both the government and the population have depleted the water reserves.

The depletion of groundwater has created such a significant risk that cities are now need to search for alternative water sources, either due to the fact that groundwater has become contaminated or because it may soon cease to exist. Despite the fact that India is one of the nations with the most abundant water supplies, both the government and the people have depleted the country's water reserves. Another problem that has to be addressed is the quality of the groundwater, particularly in areas where people drink it. The contamination of the groundwater can be attributed to a variety of sources, such as sewage, runoff from landfills, the use of pesticides and fertilisers, and so on.

GROUNDWATER STUDIES REPORT OFOTHER STATES IN INDIA

States like Punjab and Haryana, which are located in India's north-western area, are responsible for a significant portion of the country's agricultural production as well as farm revenues. This region is commonly referred to as the granary of the country. The levels of groundwater are decreasing in both of these places, which is making farming in both of these areas increasingly unsustainable. In the south-eastern areas of the country, the situation is just as hazardous as it is everywhere. According to the graphic that follows, both of these regions are responsible for the majority of the groundwater-stressed blocks in India.

With the beginning of the so-called Green Revolution, which was dependent on the extensive use of inputs such as water and fertilisers to promote farm productivity, there was a rise in the degree to which irrigation was dependent on groundwater. Instead of irrigating unirrigated areas with surface water, officials have started offering financial incentives to pump groundwater instead.

Groundwater usage

After the Green Revolution, there was a massive increase in the use of groundwater for irrigation.

Source	Surface	Groundwater
1950	57.1	28.7
1960	60.6	29.6
1970	54.5	38.2
1980	47.7	45.7
1990	42.5	51.4
2000	33.2	61.6
2009	29.4	61.2
2013	28.5	58.3

The provision of financing and financial assistance in the form of subsidies was used to make private groundwater irrigation more feasible. On the other hand, the huge subsidy that is granted for the delivery of power has been the primary focus of government policy. The low cost of electricity led to an increase in water use, which in turn caused a precipitous drop in water tables. In recent years, there has been a mad rush to develop cash crops, which has only made the issue worse.

lowering of the water table (all-India)

Type of structure	**Deep tube wells**	**Shallow tube wells**	**Dug wells**
1986-87	1.3	30.4	68.3
1993-94	2	34.2	63.8
2000-01	2.9	45.2	52.0
2006-07	7.3	46.1	46.6
2010-13	9.1	48.2	47.5

Depth to water table	Below 10m	10-20m	20-40m	40-60m	60m and above
1993-94	61.9	24.8	7	2	4
2000-01	55.8	25.6	8	3	7
2012-13	53.1	26.5	8	2	9

Groundwater in India is growing increasingly difficult to obtain as time goes on. The proportion of groundwater wells located within 10 metres of the surface has decreased by six percentage points in recent years. Beyond this level, farmers are forced to begin employing machinery designed for use in deeper water, which further complicates their already difficult lives. According to the data, the percentage of groundwater wells varies depending on their depth below the surface.

The lowering of water tables necessitated the use of costly deep-water equipment, which increased the amount of debt that farmers carried, which in turn made the issue even worse.

Depth to water table	Below 10 metre	10-20 metre	20-40metre	40-60 metre	60 metre and above
North	66.1	22.4	6.3	1.3	3.8

South	28.6	20.3	13	8.2	30
East	73	21.3	4	0.7	1
West and Central	38.3	37.6	12.2	4.2	7.6

Water table for the region

The water table in the south, west, and central parts of India is much lower than in other parts of the country.

A terrifying thirty percent of the South's groundwater table is located less than sixty metres below the surface. According to the data, a fraction of groundwater wells are located at varying depths below the surface.

Participation in the deep-water equipment:

The reaction of farmers to the declining groundwater table

The proportion of dug wells, which are limited in their ability to access water at deeper depths, has decreased by more than 20 percentage points in the past two decades.

Eastern India is struggling with a distinct issue. Irrigation continues to struggle owing to a shortage of available energy despite the fact that there are ample groundwater supplies. This is the only region where there has been a decrease in the amount of irrigated land, which is mostly attributable to a shortage of energy for water extraction. The states of Jharkhand, Bihar, and West India have been affected the hardest by this disaster.

Regional inequities in irrigation Regional disparities in irrigation in India

The data displays a percentage share of the total net irrigation applied to the total net area that was planted with crops. The North has an advantage that is disproportionate to that of other areas. The East is the only region that has experienced a decrease in its proportion of irrigated land.

Region	North	South	East	Central and Western	All-India
1985-86	71.15	27.24	28.88	14.48	29.44
1995-96	78.03	33.46	37.84	23.83	37.54
2000-01	87.56	34.53	32.31	23.26	38.91
2005-06	90.06	36.1	35.42	34.4	46.84

2008-11	91.2	38.4	36.2	37.2	48.5

Utilization of water by crops The need of water for crops

Plants that require a lot of water to flourish, such as sugarcane and rice, are almost exclusively cultivated in regions of the nation that are naturally lacking in water (From FAO)

Crop	Water need
Cotton	700-1300
Maize	500-800
Onion	350-550
Potato	500-700
Rice (Paddy)	450-700
Sugarcane	1500-2500
Wheat	450-650

GROUNDWATER POTENTIAL IN WEST INDIA

The term "Asamudra Himachalam" refers to a state that runs from mountainous terrain all the way to the coast, and West India is the only one of India's states that fit this description. The potential for groundwater in West India is quite promising. Because to her geographical position, copious rainfall, and advantageous geological setting, she has amassed a great deal of wealth throughout the years. Despite having just around 2.7% of India's total geographical area, this state contains roughly 6% of the country's total replenishable groundwater resources. In West India, particularly in the agricultural sector, groundwater is the resource that is utilised to the greatest extent. The demand for groundwater has soared in recent years as a result of the widespread adoption of water-intensive, high-yielding varieties. The number of STWs has increased by 64 percent over the past 16 years, according to the results of the quinquennial census of small irrigation infrastructure.

Table Showing Number of Groundwater Structures from 1986to 2001:

Name of Structure	1986-87	1994-95	2000-2001
Dug Well	63387	55983	39377
Shallow Tube well	368316	504638	603667

Deep Tube well	3122	4039	5139

CASE STUDIES

HYDROGEOLOGICAL CONDITIONS OF WEST INDIA

According to its geological characteristics, West India may be broken up into two large divisions.

Formation that is either fully or partially consolidated may be found in the most northern and western parts of West India, whereas the remainder of West India is made up of formation that is neither fully or partially consolidated. Formations that are consolidated or semi-consolidated:

The western and northern regions of the state are also covered by these formations. These are made up of crystalline Archean rocks and rocks from the Gondwana group, including Rajmahal traps, and they encompass a portion of Purulia, Bankura, PaschimMedinipur, Birbhum, and Burdwan. A portion of the Darjeeling and Jalpaiguri District is occupied by Archaean metamorphics, Siwalik, and Gondwana. These hard and semi-consolidated rocks are capped by a layer of weathered residuum and laterite in the western half of the district, as well as in some parts of the Darjeeling district.

DEPLETION OF GROUNDWATER IN SOMEAREAS OF WEST INDIA

In spite of the fact that West India has a large amount of available groundwater, the region's resources have been exploited to such an extreme degree that the 1980s were the first decade to see signs of groundwater depletion in certain blocks of Murshidabad, Burdwan, Medinipur, and Hoogly. In these areas, the pre-monsoon water level fell below the centrifugal pumping limit, and hand tube wells ran dry as a result. Despite the fact that the introduction of submersible motor powered pumps, which are able to pull water from an even greater depth, was a boon to farmers, this development led to an even greater reduction in the level of groundwater. The State Water Investigation Directorate of the Government of West India conducted an analysis of depth to water level data and found that during the period 1995–2004, some blocks in the districts of Murshidabad, Burdwan, PurbaMedinipur, and Hooghly experienced a significant average annual fall in premonsoon depth to water level. This fall ranged from 16 to 70 centimetres on average. It was observed that there was a large drop in several areas of the districts of Hooghly, Burdwan, and Murshidabad both before and after the monsoon season.

Case1- No change

Case2- Post monsoon no change but pre monsoon falling trend

Case3 -both pre & post monsoon show falling trend

Case4- Pre monsoon rising trend, post monsoon falling

GROUNDWATER ACT

The West Indian Groundwater Resources (Management, Control, and Regulation) Act 2005 was passed on September 15, 2005, and its provisions began to take effect the following day. The provision of this legislation requires the acquisition of a necessary permission prior to the construction of groundwater extraction facilities. Each day, more land is falling under the influence of arsenic and fluoride. It has not been possible to stop the unrestrained proliferation of tube wells in the state due to the inability of the authorities to properly apply the Groundwater Act and the lack of understanding on the part of those who use the wells. The stages of groundwater development using 2004 as the base year, which reflect a paltry 42% stages of groundwater development in the state in comparison to the average of 58% throughout the country, need to be improved. It is unlikely that the act for controlling the extraction of groundwater will be sufficient in and of itself for the overall management of groundwater resources unless the general public is made aware of the potentially negative outcomes that may result from the unplanned and arbitrary use of groundwater.

When it comes to the other measures, a coordinated approach is taken to the conservation, augmentation, and conjunctive use of groundwater. This may be effectively accomplished by the collection of rain water and the artificial recharging of aquifers, which make it feasible to fulfil the following goals:

1. Restore supply in aquifer, depleted due to overexploitation.
2. Improve chemical quality
3. Prevent salinity ingress.

Operated by engine or motor powered pump . This legislation also requires the registration of any and all structures of this kind that were in existence before the act went into effect.

Other states in India, including Himachal Pradesh, Kerala, Goa, and Tamil Nadu, in addition to West India, have already enacted laws that are suited for the control and management of groundwater.

In 2002, the state of Andhra Pradesh passed a law governing water, land, and trees. In 1993, the state of Maharashtra passed the groundwater (regulation for drinking water sources) Act with the intention of controlling public drinking water to a certain extent. The governments of the remaining states either have groundwater bills in the process of being drafted or draught bills that are currently being considered by those governments.

CONCLUSION

A water crisis is almost certainly the greatest possible calamity that any civilisation might be forced to endure. Because a portion of this generation does not have adequate foresight, the current problem will be a tragedy for the subsequent generation that must face it. The supplies of groundwater, although being renewable, are restricted and susceptible to contamination. There is a possibility that the water crisis is not simply one of quantity; the deterioration of water quality may also bring a new facet to the issue. It should come as no surprise that West India, which is often regarded as having enormous groundwater potential, is not an exception. During the Boro cropping season in rural West India, the drinking water sector is already feeling the crunch, which is leading to a condition of artificial drought virtually every year. This situation has been made much worse by the unpredictability of monsoons, the erosion of green covers, the siltation of rivers, and unregulated development.

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