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A Review on Ground Water Management

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Abstract

Water is the most widely consumed commodity on the planet. Water on Earth comes in a variety of forms. India has 17% of the world's population but just 4% of the world's water resources, 80% of which are utilized for agriculture. Water consumption in India's cities is about 40%, causing ground water tables to plummet below 2 to 3 meters per year. Ground water depletion has occurred in numerous parts of the world as a result of increased consumption and irrigation of ground water in recent decades. Water is increasingly considered an emergency resource due to the negative effects of climate change, rapid population growth, urbanization, and other issues. As technological developments fail to address the issues, many governments are resorting to administrative remedies. It is commonly accepted to be a worldwide problem. Based on these data, the goal of this study is to examine ground water availability and withdrawals from fresh water resources.

Keywords: Water, Ground Water, Management, Agriculture, Irrigation

Introduction

Water is the most consumable in the world. Water on the planet earth is available in various forms. Worldwide it is approximately estimated that total water of 99.8381% is distributed as 97.2% in oceans, 2% in glaciers, 0.62% ground water, 0.009% fresh water, 0.008% in seas or salt lakes, 0.001% in atmosphere and 0.0001% in rivers (CCAO and ARWEC 2020). India has 17% of world's population and with world water resources only 4%, in this 80% is used for agriculture. The demand for water is almost 40% in urban parts of India, due to which ground water tables are falling below 2 to 3 meters every year. This is causing to top water stressed nation (Dhawan 2017). Groundwater accounting to 0.62% is a key natural resource that is held in beneath geological formations in the earth's crust. During droughts, it provides water to human consumption, farming, industries, and also many watersheds ecosystem. The increased utilisation of groundwater for both human and irrigation in recent decades has resulted in groundwater depletion in many places of the world (Wada et al. 2010; Treidel, Martin-Bordes, and Gurdak 2012). This has put enormous strain on the finite freshwater supply. Fresh water in enough quality and quantity is required for all facets of life and environmental sustainability. Member States broadly recognise the basic rights to sanitation and water. Water resources are important to all types of development (for example, food sufficiency, promotion of health and reducing poverty), to maintain economic growth in agriculture, energy generation and industry and to preserving healthy ecosystems (United Nations 2018). Surface water is not accessible all year in a semi-arid nation like India for many reasons, hence people in such locations must rely on subsurface water supplies for life. Every continent suffers from water shortage, or a lack of sufficient water resources to fulfil demand. Physical scarcity affects approximately 1.2 billion people, or nearly one-fifth of the world's population, with another 500 million people on the verge of becoming so. About 1.6 billion people, or nearly one-fourth of the global population, are affected by economic water scarcity (i.e., where countries lack the necessary infrastructure to take water from rivers and aquifers). The global population is predicted to rise around 7.7 billion in 2018 to 9.4 to 10.2 billion by 2050, with cities housing two-thirds of the population (KPMG 2010). As a result of population expansion, economic growth and shifting consumption habits, worldwide water demand has been growing at a pace of around 1% per year (Chakraborti, Kaur, and Kaur 2019). Globally, agriculture sector is withdrawing 70% of all freshwaters and it may be even higher due to evapotranspiration of crop (World Bank Group Water Global Practice 2022). India is the world's greatest consumer of groundwater, accounting for approximately 60% of irrigated farmland and 85% of drinking water supply (India Water Portal 2022). Irrigated agriculture accounts for 20% of all farming area and 40% of total food production globally. Irrigated agriculture is twice as productive per unit of land than rainfed agriculture, allowing for greater production intensification and crop variety. The rising population lead to demand for food supply and consequently growth of agriculture is estimated as 70% approximately by 2050. Inadequate rules, significant institutional underperformance, and funding constraints often impede agriculture's potential to enhance water management. Critical public and private institutions (including basin authorities, agricultural and water ministries, irrigation agencies, farmer groups and water users) typically lack the supportive environment and capacity to carry out their tasks effectively (World Bank Group Water Global Practice 2022). The increased use of ground water for consumption and irrigation in recent decades has led in ground water depletion in several regions of the world. Water is now considered an emergency resource owing to the detrimental consequences of climate change, fast population expansion, urbanisation, and other factors. As technology advances fail to solve the challenges, several governments are turning to administrative solutions. It is widely acknowledged to be a global issue. Based on this facts, the objective of this study is framed to review the ground water availability and its withdrawals from the fresh water resources.

Literature Review

Groundwater is one of the most important and vital natural resource which is stored in the subsurface geological formations in the critical zone of the earth's crust. The ever-increasing demand of water for meeting human requirements and developments has imposed immense pressure on this limited freshwater resource. In a semi-arid country like India, surface water is not available round the year for meeting different purposes and hence people in such areas have to depend more on ground water resources for their survival. As per Composite Water Management Index (CWMI) report, about 600 million people in India is facing high to extreme water stress due to inadequate availability of fresh water (NITI Aayog 2018).

Atmospheric changes and its effects on water

Numerous factors, including climate change, have an impact on the quality and amount of water resources that are available, and this impact is increasing. It is acknowledged that the natural ecology, water supplies, and other elements are all at risk due to global climate change. the factors influencing the supply of groundwater that contribute to climate change and its fluctuation. The industrial revolution and human activities over many centuries have been shown to have caused a rapid change in climate, according to scientific data (Patil et al. 2020). Due to inequalities in rainfall, climate change, and overuse of groundwater for agricultural purposes, Karnataka has been experiencing serious groundwater issues over the past few years. For the Hiranyakeshi watershed, groundwater resources were measured and assessed using the MODFLOW Flex program. The model simulation findings show a 1.8 m head growth throughout the course of the five-year simulation period. To assess the impact of climate change on groundwater recharge, the model was once more run using Hadley Regional Model 3 (HadRM3) data for the Hiranyakeshi watershed for the years 2021–2050. The average annual temperature is predicted to rise by 2.59°C, precipitation by 81.50%, and groundwater recharge by 24.91% based on the long-term output study (Patil et al. 2020). Ground water patterns are intricately influenced by climate phenomena. The creation and replenishment of ground water are influenced by climatic factors, which include precipitation, evapotranspiration, and snow accumulation. The fundamental problem is that it is unclear how evapotranspiration varies with temperature (Kløve et al. 2014). Climate change projections lead in either slightly greater, no different, or much lower yearly recharge and groundwater levels, with a range of effects on wetlands, water supply potential, and low flows in Eastern Massachusetts. The effects are especially severe in specific drought circumstances. According to the head of a watershed advocacy organisation, the policy response to the potential implications should fight for sensible aquifer management, with a particular emphasis on restricting the growth of aquifer water supply and raising the current quantity of groundwater recharge (Kirshen 2002). Global change includes changes in the properties of interconnected climatic variables in space and time, as well as derived changes in terrestrial processes, such as human activities that impact the environment. Changes in global climate are predicted to affect the hydrological cycle, affecting surface-water levels and groundwater recharge to aquifers, among other effects on natural ecosystems and human activities. Climate change may also alter groundwater outflow, storage, saltwater intrusion, biogeochemical reactions, and chemical fate and transport. Although the most visible consequences of climate change may be changes in surface water levels and quality, there may be effects on groundwater quantity and quality. Even though the Intergovernmental Panel on Climate Change (IPCC) 3rd and 4th Assessment Reports note that there hasn't been much research on the potential effects of climate change, groundwater is still a significant source of water for a large portion of the world's population, especially in rural areas in arid and semi-arid regions (Treidel, Martin-Bordes, and Gurdak 2012). The Pearson's coefficient of determination (r) ranges from 0.35 to 0.66, and these correlations are significant for both cations and anions in ground water quality changes. This study results are essential to establish superior water resources management planning (Mwabumba et al. 2022). The consequences of lateral saltwater intrusion and their implications on the quantity and quality of groundwater were predicted using SEAWAT in Dauphin Island (Albama). According to the modelling results, the saltwater wedge would grow laterally under every future climate change scenario. These findings suggest that the shallow unconfined aquifer may not be able to support any appreciable future population expansion, particularly in the face of unfavourable climate change circumstances. In order to manage Dauphin Island's unconfined groundwater system more effectively, analysis of variations in the volume of freshwater lens gave a deeper knowledge of the linked impacts of climate and human-caused changes on freshwater storage (Chang et al. 2016). Tran Dang An,Maki tsujimura,VoLe Phu,Atsushi Kawachi(2014) “Chemical Characteristics of Ground Water in Mekong Delta Vietnam”-The present situation coupled with increasing ground water from aquifers which later it could be a threat to the sustainable development. In order to manage the ground water further investigations should be

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made like examination of interaction between shallow and deep aquifers and identifying the climatic change and sea level rise in ground water. Dajun Shen(2015, "Ground water management in China"-the main ground water management problems due to lack of ground water quality management systems, poor capacity of hindering the system implementation. They can be overcome by developing aquifer management systems, developing integrated management systems, exploring ways to develop the ground water quality etc. .Izabelaa.Talalaj.Pawel Biedka(2016) "Use of Landfill Water Pollution Index(LWIP)for ground water quality assessment"-The calculated LWIP values indicates negative impact on ground water quality. The average value of LWIP is 7.7.deep deposition of ground water level reduces the landfill impact on the water quality. P S J Minderhoud ,G Erkins ,V H Pham(2018) "Impact of ground water in Vietnam "-here we deploy a delta wide modelling approach comprising of 3 D hydrogeological modal.Exztensometers are used to facilitate management decisions in subsiding deltas. Meng,Yanuo Teng(2018) "Natural factors influencing ground water quality"-ground water exploitation results in dramatic depression cone with higher hydraulic gradient around water source. S Jahan,Riad Arefin(2018) "Ground Water Potential in Drought Prone Area"-To understand the ground water potential,thermatic layers such asGeomorphology,drainage density,rainfall,lithologuare taken into consideration. Pascal Longuevergne(2018) "Quantitative mapping of ground water depletion"-an inversion is performed to focus the ground water related to GRACE signal over different mass distribution maps. The main draw back is GRACE gravity resolution is too low. Ghasemizadeh,Ljiljana Rajic (2019) "Assessment of ground water quality and remediation in karst aquifer"-karst aquifers are the one for capable of storing the large amount of water. A combine set of models are used to simulate ground water flow and contaminate transport either in study state or in transsient state. "Impact of solid municipality waste on ground water quality"-The increase in the calcium is one of the micro elements caused detoriation for ground water quality. The interaction between the leachate and ground water in the area of landfill site proves the efficiency of the drainage system.

Conclusions

- In ground water potential study in Bangladesh by using remote sensing and GIS lithology plays important role following slope, lineament density and geomorphology.
- The problems can be minimized by treating waste water, building drainage systems and preventing waste from industries.

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- The efficiency of identifying of ground water increased enormously by remote sensing and GIS with less time consumption.
- Due to municipal waste, cadmium is one of the micro element which cause deterioration of quality of ground water.

Declarations

- **Competing interests** The authors have no relevant financial or nonfinancial interests to disclose.

Reference

CCAO and ARWEC. 2020. "Water Facts - Worldwide Water Supply." Bureau of Reclamation. 2020. https://www.usbr.gov/mp/arwec/water-facts-ww-water-sup.html.

Chakraborti, Rajat K., Jagjit Kaur, and Harpreet Kaur. 2019. "Water Shortage Challenges and a Way Forward in India." *Journal - American Water Works Association* 111 (5): 42–49. https://doi.org/10.1002/awwa.1289.

Chang, Sun Woo, Katherine Nemec, Latif Kalin, and T. Prabhakar Clement. 2016. "Impacts of Climate Change and Urbanization on Groundwater Resources in a Barrier Island." *Journal of Environmental Engineering* 142 (12): 1–12. https://doi.org/10.1061/(asce)ee.1943-7870.0001123.

Dhawan, Vibha. 2017. "Water and Agriculture in India: Background Paper for the South Asia Expert Panel during the Global Forum for Food and Agriculture - (GFFA) 2017." *OAV - German Asia-Pacific Business Association*, 1–25. https://www.oav.de/fileadmin/user_upload/5_Publikationen/5_Studien/170118_Study_Water_Agriculture_India.pdf.

India Water Portal. 2022. "Agriculture." India Water Portal. 2022. https://www.indiawaterportal.org/topics/agriculture.

Kirshen, Paul H. 2002. "Potential Impacts of Global Warming on Groundwater in Eastern Massachusetts." *Journal of Water Resources Planning and Management* 128 (3): 216–26. https://doi.org/https://doi.org/10.1061/(ASCE)0733-9496(2002)128:3(216).

Kløve, Bjørn, Pertti Ala-Aho, Guillaume Bertrand, Jason J. Gurdak, Hans Kupfersberger, Jens Kværner, Timo Muotka, et al. 2014. "Climate Change Impacts on Groundwater and Dependent Ecosystems." *Journal of Hydrology* 518 (PB): 250–66. https://doi.org/10.1016/j.jhydrol.2013.06.037.

KPMG. 2010. "Water Sector in India : Critical Issues in India: Overview and Focus Areas Fot the Future." https://www.kpmg.de/docs/Water_sector_in_India.pdf.

Mwabumba, Mohamed, Jahangeer Jahangeer, Sahila Beegum, Brijesh K. Yadav, and Mwemezi J. Rwiza. 2022. "Assessment of Groundwater Quality under Changing Climate in Ngorongoro Conservation Area, Tanzania." *Journal of Irrigation and Drainage Engineering* 148 (10). https://doi.org/10.1061/(asce)ir.1943-4774.0001702.

NITI Aayog. 2018. "Composite Water Management Index."

Patil, Nagraj S., N. L. Chetan, M. Nataraja, and Surindra Suthar. 2020. "Climate Change Scenarios and Its Effect on Groundwater Level in the Hiranyakeshi Watershed." *Groundwater for Sustainable Development* 10 (December 2018): 100323. https://doi.org/10.1016/j.gsd.2019.100323.

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 UGC CARE Listed (Group -I) Journal Volume 12, Iss 1, 2023

Treidel, Holger, Jose Luis Martin-Bordes, and Jason J Gurdak. 2012. *Climate Change Effects on Groundwater Resources: A Global Synthesis of Findings and Recommendations*. Edited by Dr. Nick S. Robins. 1st ed. London: CRC Press/Balkema is an imprint of the Taylor & Francis Group, an informa business. www.crcpress.com – www.taylorandfrancis.com – www.balkema.nl.

United Nations. 2018. *Sustainable Development Goal 6 Synthesis Report 2018 on Water and Sanitation*. *United Nations*. New York. https://doi.org/10.18356/e8fc060b-en.

Wada, Yoshihide, Ludovicus P.H. Van Beek, Cheryl M. Van Kempen, Josef W.T.M. Reckman, Slavek Vasak, and Marc F.P. Bierkens. 2010. "Global Depletion of Groundwater Resources." *Geophysical Research Letters* 37 (20): 1–5. https://doi.org/10.1029/2010GL044571.

World Bank Group Water Global Practice. 2022. "Water in Agriculture." Worldbank. 2022. https://www.worldbank.org/en/topic/water-in-agriculture#1.