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Rejuvenation Of Water Bodies For Groundwater Recharge And Sustainable Agriculture

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ABSTRACT
Groundwater depletion presents a multifaceted challenge with profound implications for the environment, society, and economy, on a global scale and specifically in India- the largest extractor of groundwater (UN Water, 2022). Groundwater constitutes a vital and finite resource, serving as a primary source of drinking water for over 2 billion people globally (Kundzewicz & Döll, 2009), and supporting nearly 70% of agricultural water needs (UN Water, 2022). As groundwater depletion accelerates, it contributes to alarming consequences such as sea-level rise (Aeschbach-Hertig & Gleeson, 2012), land subsidence, and even perturbations in Earth's rotation axis (Castelvecchi, 2023). India, heavily reliant on groundwater for drinking and agriculture, faces a severe crisis, impacting the availability of water for domestic and irrigation purposes, and leading to migrations from water-scarce regions (Rodella et al., 2023).
The interconnection between surface water and groundwater underscores the need to treat water as a single and integrated resource. The traditional separation of surface and groundwater has been proven inadequate in managing water systems (Gupta & Sharma, 2023). Surface-water features, such as rivers, lakes, and reservoirs, significantly interact with groundwater, impacting water quantity and quality in both systems. Effective land and water management requires a comprehensive understanding of these linkages to manage resources sustainably (Hossein Ahmadi, 2023).
Waterbody rejuvenation, specifically through desilting practices, has emerged as a decentralized, replicable, time-bound, and effective solution for groundwater recharge. Scientific evidence and case studies demonstrate the positive impact of desilting practices on water storage capacity, groundwater levels, and agricultural productivity (Balamatti and Chandra, 2018; Gumma et al., 2003; Jal Charcha, 2022d). Desilting restores the water storage capacity of ponds, lakes, and reservoirs, facilitating groundwater recharge, and mitigating stress on groundwater systems. Moreover, the fertile silt removed during desilting can be used to enhance soil fertility and agricultural productivity, rendering rejuvenation a cost-effective and sustainable approach (Kulkarni and Soni, 2021).

Keywords: *Groundwater, surface water, rejuvenation, desilting, waterbody, recharge, agricultural productivity*

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I. Introduction:

The increasing depletion of groundwater resources is a global concern, with far-reaching implications that span environmental, social, and economic domains. As we stand on the precipice of a water crisis, it is imperative to understand the intricate relationship between surface water and groundwater and to treat water as a single, interconnected resource. This perspective, which transcends traditional compartmentalization, forms the foundation for effective groundwater management and rejuvenation of waterbodies as a solution to replenish stressed groundwater systems.

Groundwater, constituting approximately 30% of the world's freshwater reserves, is a hidden treasure that caters to the drinking water needs of over 2 billion people globally (Kundzewicz & Döll, 2009). Furthermore, it sustains nearly 70% of the world's agricultural water requirements (UN Water, 2022). Yet, the acceleration of groundwater depletion, particularly since the mid-20th century, poses a host of challenges. Groundwater depletion is not merely an isolated hydrological phenomenon; it reverberates through various facets of human existence.

Sea-level rise, an outcome of excessive groundwater pumping, adds to the dire consequences of climate change (Aeschbach-Hertig & Gleeson, 2012). Alarming alterations in Earth's axis, due to the excessive extraction of groundwater, bear testimony to the profound geophysical implications of groundwater depletion (Castelvecchi, 2023). India, in particular, grapples with the severity of this crisis, where more than 85% of rural drinking water is sourced from groundwater, and agricultural and domestic water supplies face relentless challenges (Rodella et al., 2023).

The challenge of groundwater depletion requires a paradigm shift in the way we perceive and manage water. It is no longer tenable to treat surface water and groundwater as distinct entities. Instead, a comprehensive understanding of the intricate interactions between the two is essential. Surface waterbodies, such as rivers, lakes, and reservoirs, exert profound influences on groundwater quantity and quality. Effective land and water management necessitates recognizing this integral connection and striving for a holistic approach.

This paper explores one of the innovative solutions to effectively address the challenges of groundwater depletion by rejuvenating waterbodies through desilting. The discussion focusses on how restoration of water storage capacity in ponds, lakes, and reservoirs can substantially increase groundwater levels and alleviate stress on this vital resource. This decentralized, replicable, time-bound, and effective solution is a beacon of hope in the global fight against groundwater depletion. It provides a sustainable way forward for preserving groundwater resources and supporting agricultural practices, demonstrating the potential for widespread and lasting change. The following sections, provide scientific evidence and case studies that underscore the effectiveness of desilting waterbodies, laying the foundation for a comprehensive understanding of this innovative approach.

II. Statistics On The Global Distribution And Reliance On Groundwater

Groundwater, a hidden and finite resource, plays a critical role in meeting the world's water demands. It constitutes approximately 30% of the world's freshwater reserves (IGRAC, 2021) and is a primary source of drinking water for over 2 billion people (Kundzewicz & Döll, 2009). Additionally, groundwater supports the irrigation of nearly 70% of the world's food crops (UN Water, 2022). The global distribution of groundwater resources is diverse, with various countries relying significantly on this source.

In the United States, for example, groundwater accounts for approximately 26% of the nation's total freshwater withdrawals, serving as a vital resource for agricultural, industrial, and municipal needs (USGS, 2022). India, the largest extractor of groundwater, witnesses' groundwater providing drinking water to more than 85% of rural areas and supporting agriculture in both rainy and dry seasons (Rodella et al., 2023; UN Water, 2022).

In China, nearly 70% of the rural population relies on groundwater for drinking and agricultural use, with groundwater contributing to over 80% of total water consumption (UN Water, 2022). The Middle East and North Africa region also demonstrates a significant reliance on groundwater, with some countries obtaining more than 90% of their water supply from groundwater sources (World Bank, 2017).

This groundwater stored around the globe in different aquifers has accumulated over thousands of years and we are at the risk tipping point with 21 out of 37 of the world's major aquifers depleting faster than it can be naturally replenished (UNU EHS,2023). Groundwater depletion is most severe in parts of India (Aeschbach-Hertig and Gleeson, 2012). The UN reports states that the Indo-Gangetic basin in India has already crossed the tipping point and predicts critically low groundwater availability by 2025.

III. Impacts Of Groundwater Depletion

Groundwater depletion carries multifaceted consequences, including impact on the environment, society, economy, and food security.

Environmental

Sea-Level Rise: Excessive groundwater pumping contributes to the rising sea levels as water is extracted from aquifers and eventually flows into the oceans (Aeschbach-Hertig & Gleeson, 2012). This environmental effect has far-reaching implications on coastal regions and ecosystems.

Land Subsidence: Groundwater depletion can lead to land subsidence, causing the sinking of the Earth's surface, which damages infrastructure, particularly in areas with clay-rich soils (Rodella et al., 2023).

Changes in Earth's Axis: Excessive pumping of groundwater can result in a tilt in the Earth's rotation axis, with implications for climate patterns and geophysical systems (Castelvecchi, 2023).

Social

Displacement and Migration: Depletion of groundwater in groundwater-dependent activities, such as agriculture, leads to male labour migration to urban areas, disrupting traditional rural livelihoods (Fishman et al., 2013; Rodella et al., 2023). Increased well depths are correlated with a higher likelihood of households having migrant family members in some regions (Fishman et al., 2013).

Community Conflicts: The competition for dwindling groundwater resources can lead to conflicts among communities, particularly in regions where water scarcity is acute (Doring, 2020; Robins and Fergusson, 2014).

Economic

Reduced Crop Yields: Groundwater depletion can diminish crop yields, affecting farming livelihoods and economic stability (Rodella et al., 2023).

Increased Costs for Farmers: Farmers may incur higher costs related to well-digging equipment and electricity expenses for groundwater extraction, impacting their financial well-being (Pandey et al., 2022).

Government Subsidies: In some cases, government incentives, such as electricity subsidies for irrigation, contribute to groundwater depletion (Devineni et al., 2022).

Food Security

Reduced Water Availability for Irrigation: As groundwater levels decline, the availability of water for irrigation reduces, particularly for water-intensive crops like rice and wheat (Jain et al., 2021). This poses a significant threat to food security and the ability to feed growing populations.

Altered Cropping Patterns: Changes in water availability can lead to shifts in cropping patterns, affecting the variety and quantity of crops that can be cultivated (Gumma et al., 2003).

IV. Factors Contributing To Groundwater Depletion

The accelerating depletion of groundwater resources is driven by a confluence of interconnected factors, each exacerbating the challenge:

***Agricultural Intensification*:** Agriculture accounts for approximately 70% of global groundwater withdrawals (UN Water, 2022). The cultivation of water-intensive crops, such as rice and wheat, in regions with unfavourable climatic and soil conditions intensifies groundwater extraction (Devineni et al., 2022).

***Government Policies*:** Government incentives, such as electricity subsidies for irrigation, have stimulated proliferation of wells, intensifying crop production and extending cropping seasons in countries like India (Devineni et al., 2022).

***Privately Owned Groundwater Rights*:** Traditional practice of privately owned groundwater rights in many countries leads to over-extraction and depletion as it fails to account for the collective impact of individual groundwater use (Burchi and Nanni, 2003).

International Trade of "Virtual Water": Approximately 11% of depleted groundwater is embedded in international crop trade, with countries like Pakistan, the USA, and India exporting the majority (Dalin et al., 2017). This practice contributes to export of depleted groundwater, resulting in further stress on local aquifers.

These factors collectively aggravate groundwater depletion, making groundwater management a challenge.

V. Challenges in Groundwater Management

Groundwater management faces a myriad of challenges that must be addressed to ensure the sustainable use of this vital resource. One significant challenge is the prevalent reactive approach to groundwater management. Often, actions are taken in response to problems, rather than proactively preventing them, leading to unsustainable groundwater use and inadequate responses to changing environmental conditions (Margat and Van der Gun, 2013). Furthermore, limited understanding of groundwater dynamics among the public presents a substantial challenge, as groundwater is hidden underground, making it challenging for individuals to comprehend how these reservoirs function (Margat and Van der Gun, 2013).

Inadequate data and monitoring systems also hinder effective groundwater management. Lack of comprehensive data regarding the quantity and quality of groundwater resources can lead to overextraction due to uncertainty about the available supply (Vasco et al., 2019). Enhanced monitoring and data collection are vital to gain comprehensive understanding of groundwater availability and trends. Moreover, absence or inadequacy of regulatory frameworks for groundwater management in some regions can result in uncontrolled and excessive groundwater extraction, further exacerbating depletion (Burchi and Nanni, 2003). Traditional practice of privately owned groundwater rights is also a serious challenge in managing groundwater. Complex legal and ownership issues can complicate groundwater management, particularly in areas with shared aquifers or transboundary groundwater resources.

Water management policies often overlook the interconnections between surface water and groundwater, even though changes in surface waterbodies can affect groundwater quantity and quality, and vice versa, highlighting the need for a holistic approach to water management.

Furthermore, the pressing issue of climate change marked with shifting patterns of precipitation and increased demand for groundwater during prolonged droughts, exacerbates groundwater challenges. Economic and political factors, including subsidies for groundwater extraction or land-use policies that promote water-intensive crops, can influence groundwater management practices (Devineni et al., 2022). To overcome these challenges, it is imperative to implement effective, proactive, and science-based strategies to ensure responsible and sustainable use of groundwater.

VI. Role Of Waterbodies In Groundwater Recharge

Waterbodies, such as ponds, lakes, and reservoirs, are integral components of the hydrological cycle, serving as critical contributors to groundwater recharge (Meybeck et al., 2019). All water, regardless of whether it is above or below ground, constitutes a component of the hydrologic system, driven by solar energy, which initiates the process through evaporation from land, lakes, and oceans, followed by precipitation (Meybeck et al., 2019). Once this water reaches the terrestrial environment, a portion of it infiltrates below the surface, with its fate determined by various factors such as depth and subsurface conditions (Sophocleous, 2002). Water may remain as groundwater for varying durations, ranging from months to decades or even centuries (Sophocleous, 2002). Extraction of water from streams can lead to depletion of groundwater resources, while extraction of groundwater can adversely affect water levels in streams, lakes, or wetlands (Sophocleous, 2002).

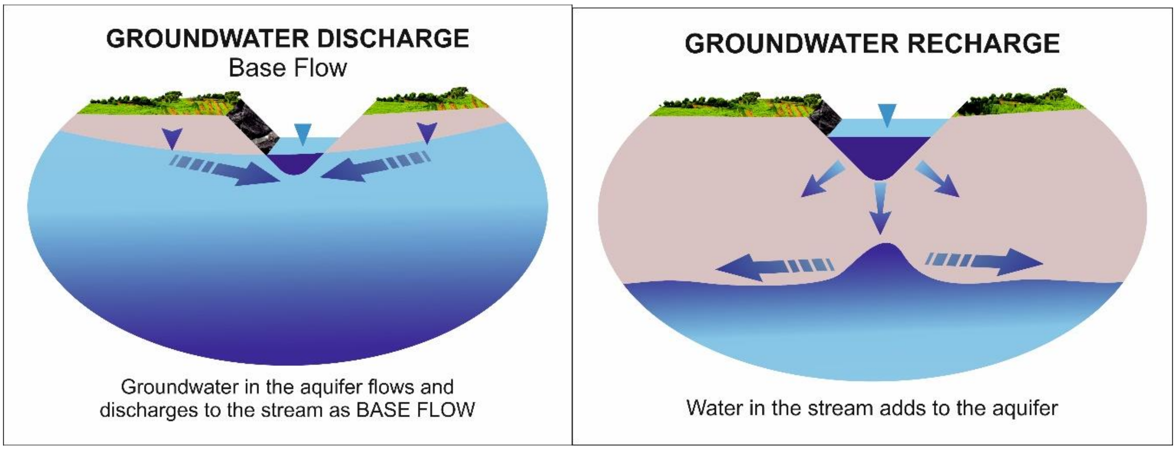

Figure: Symbiotic relationship between surface water and ground water system

The Government of India in 1982 established the Groundwater Estimation Committee (GEC), comprising members from both state and central organizations specialized in hydrogeological studies and groundwater development to submit a set of recommendations known as GEC 1984. These recommendations introduced a systematic methodology for evaluating the dynamic groundwater resources of the country and advocated for the formation of state-level working groups responsible for implementing this methodology.

Table 1: Recharge norms recommended by GEC for planning effective management of groundwater resources.

No.	Structure type	Recharge norms according to GEC
1)	Storage tanks and ponds	1.4 mm/day for the period in which the tank has water, based on the average area of water spread. If data on the average area of water spread is not available, 60% of the maximum water spread area may be used instead of average area of the water spread.
2)	Percolation tanks	50% of gross storage, considering the number of fillings, with half of this recharge occurring in the monsoon season, and the balance in the non-monsoon season.
3)	Check dams and nala bunds	50% of gross storage (assuming annual de-silting maintenance exists) with half of this recharge occurring in the monsoon season, and the balance in the non-monsoon season

However, these vital surface water ecosystems encounter a significant challenge in the form of silt and sediment accumulation. As part of the hydrological cycle, when water flows over the ground and generates runoff, it carries sediments and silt from the catchment area which eventually gets deposited in the waterbodies. This inevitably leads to a reduction in water storage capacity of the waterbody (Kharche et al., 2018). Initially, this deposition interferes with water flow patterns, diminishing their capacity to effectively facilitate groundwater recharge. Eventually, this triggers water stagnation and culminates in partial/complete drying of waterbodies (Kharche et al., 2018; Mohammed et al., 2009). According to the First Census Report on Waterbodies published by Ministry of Jal Shakti, Government of India in 2023, 16.3% of waterbodies are not in use on account of being dried-up. Indiscriminate withdrawal of groundwater coupled with vanishing waterbodies which act as recharge zones is a major reason for falling groundwater levels (Singh et. al., 2013). Therefore, addressing the issue of silt and sediment accumulation is of paramount importance to preserve and optimize the role of waterbodies in replenishing groundwater as well as to sustain the broader hydrological cycle (Kharche et al., 2018; Meybeck et al., 2019).

VII. Rejuvenation Of Water Bodies (Rwb)

Rejuvenation of waterbodies (RWB) stands as an imperative step to restore and enhance their role in groundwater replenishment (Kharche et al., 2018). This concept, rooted in the removal of silt and clay sediments from waterbodies, serves as an efficacious means to reinstate their water storage capacity and enhance groundwater recharge (Kulkarni and Soni, 2021).

In Indian villages, a common practice involves the strategic placement of drinking water supply wells and bore wells in close proximity to waterbodies. However, as time elapses, the natural sedimentation processes lead to the accumulation of silt deposits within these waterbodies. This sediment deposition gives rise to the formation of a hydraulic confinement between the water body and the underlying aquifer. This confinement adversely affects the groundwater recharge process, subsequently leading to challenges in ensuring a consistent availability of drinking water in these localities. To mitigate this issue, desilting operations are systematically undertaken, with the primary objective of removing the silt confinement and promoting the recharge of groundwater. Removal of sediments from waterbodies was an established indigenous natural management practice by the community to maintain their waterbodies which has been discontinued lately, mainly due to administrative and political changes prompting rapid exploitation of groundwater (Bhanavase et. al). To ensure revival of the waterbodies, desilting emerges as a vital strategy to ensure uninterrupted access to drinking water in these regions (Kulkarni and Soni, 2021).

Desilting is removal of accumulated sediments from the waterbodies, and it does not alter the physical characteristics of the waterbodies maintaining their integrity. It is different from dredging which involves shaping, widening, and enlarging the waterbodies. Moreover, dredging can be done when deep water levels are available and desilting using machines is done on dried waterbodies thereby not harming the benthic biodiversity of the waterbody.

The significance of desilting extends beyond the mere removal of sediment. It serves a dual purpose that encompasses the augmentation of water storage capacity within these waterbodies, thereby enabling them to retain larger volumes of water as well as maintain the function of waterbodies as natural reservoirs for groundwater replenishment (Karanam et al., 2008). The improved water percolation and groundwater recharge contribute to additional water availability in bore wells and open wells within the surrounding areas (Balamatti and Chandra, 2018). This enhanced storage capacity assumes paramount importance in maintaining a reliable water supply, especially during periods of water scarcity (Kulkarni and Soni, 2021).

Importantly, desilting offers a cost-effective, time-efficient, and decentralized solution when compared to the alternative of constructing new waterbodies with similar storage capacity. This approach underscores its sustainability and efficiency, rendering it a compelling choice for addressing both water scarcity and groundwater recharge issues within a wide array of hydrogeological contexts (Kulkarni and Soni, 2021; Subramani et. al., 2013).

Moreover, during the desilting process, the fertile silt that is excavated from these waterbodies can be efficiently repurposed by spreading it onto farmlands. This practice considerably enriches the soil's fertility, increases water retention capacity of the soil, and elevates agricultural productivity in the region (Kulkarni and Soni, 2021; Balamatti and Chandra, 2018). Fertile silt reduces deficiency of nutrients like zinc, boron, sulphur, and organic carbon nutrients resulting in improved soil fertility (Mohammed et. al., 2009).

VIII. Scientific Findings And Research Studies

The efficacy of waterbody rejuvenation, particularly through desilting practices, is strongly substantiated by scientific evidence and compelling case studies. These findings emphasize the pivotal role of waterbody rejuvenation in enhancing water storage, groundwater levels, and agricultural practices.

Below are a few case studies that offer solid evidence of the effectiveness of desilting as a rejuvenation strategy:

(a) In Suttur, Mysuru district, desilting of tanks had a significant effect on enhancing their water storage capacity. This resulted in an impressive increase of approximately 40,000 cubic meters of water, which is equivalent to a staggering 4 crore liters of water (Balamatti and Chandra, 2018). The consequences of this effort extended water availability until the peak monsoon month of August and remarkably improved water percolation, subsequently leading to increased water availability in the wells within the command area.

(b) In Maharashtra and Karnataka, desilting has yielded similarly encouraging outcomes. Research conducted by Kulkarni and Soni in 2021 showcased that these rejuvenation efforts resulted in the creation of substantial additional storage capacity within existing water structures. These findings highlight the potential of such interventions in augmenting water storage and availability in regions facing water scarcity (Kulkarni and Soni, 2021). A different study in Kolar district of Karnataka, reveals that desilting of waterbodies helps in improving the groundwater table (Ramachandra, 2008).

(c) In Telangana, studies have shown that the restoration and desilting of tanks had a multifaceted impact. Not only did it significantly expand surface water storage, but it also had positive repercussions on the groundwater table. These initiatives induced changes in cropping patterns and eventually led to an expansion of the irrigated area. This comprehensive approach to water body rejuvenation demonstrates how it can contribute to sustainable agricultural practices and overall water resource management (Gumma et al., 2003).

(d) Rejuvenation efforts in Odisha, Uttar Pradesh, and Haryana have presented notable improvements in groundwater levels and increased the availability of water for various purposes, including drinking, domestic use, irrigation, and livestock. The positive outcomes of these efforts underscore the importance of comprehensive water resource management strategies and the potential to address multiple water-related challenges simultaneously (Jal Charcha, 2022d, 2022a, 2022b, 2022c).

(e) In Maharashtra, a study conducted on application of silt from waterbodies to crop lands confirmed increase in water content, organic carbon, potassium, and phosphorus levels significantly. The results showed clear impact on yield, moisture use efficiency and net returns accrued as compared to lands without application of waterbody silt (Bhanavase et.al., 2011)

(f) In Andhra Pradesh, a study by ICRISAT on farm silt application led to INR 2500 per hectare savings in use of pesticides and the farmer recovered the transportation cost of silt to the farms through the increased net profit gained from the crops. The outcomes of the study indicate desilting as an economically viable activity for creating water storage and from farmers perspective for transportation cost of silt (Mohammed et. al., 2009).

(g) A study in Rajasthan confirmed improved productivity of wells due to groundwater recharge is the most valuable benefit farmers associate with the waterbodies (Shah and Raju, 2002). Desilting improved groundwater levels, thereby increasing cropping intensity and total cropped area in Thiruvallur district of Tamil Nadu (Deivalatha et. al., 2014). The study confirmed increase in productivity indicator of yield from 4800 and 4425 to 5400 in both the seasons respectively and increase in benefit cost ratio from 0.64 to 1.04 in first season and from 1.13 to 1.31 in second season.

IX. Importance Of Rejuvenation Of Waterbodies In India

The practice of desilting and rejuvenation of waterbodies in India is not restricted to research studies alone. Drawing experience from the traditional practice of desilting and rejuvenation of waterbodies, drought prone states in India mainly dependent on agrarian economies, have run flagship programs having focused interventions of desilting, groundwater recharge and application of silt to farms. An impact assessment study conducted on the Galmukt Dharan Galyukt Shivar (GSDS) program in Maharashtra indicates increase in water holding capacity and enhanced organic carbon in the soil after silt application, increase in area under cultivation during both kharif and rabi season, reduction in per acre cost of fertilizers, increase in annual income of farmers from Rs. 37000 to Rs. 92000, reduction in migration and increase in fodder for livestock (TNC & WOTR, 2018). Due to Jalyukt Shivar Program, 8 out of 12 villages were able to plant a second winter crop and 9 out of 10 villages became tanker-free. After implementation of Mission Kakatiya in Telangana, groundwater levels increased in 22 of the 31 districts whereas silt application led to an increase in crop yield and reduced the cost of cultivation. The Mukhyamantri Jal Swavlamban Abhiyan in Rajasthan increased groundwater levels by an average 1.42 in 16 out of 21 non-desert districts. Similarly, the Saurashtra Recharge Movement and Sujalam Suphalam Yojana in Gujarat improved well-productivity, enhanced cropping intensity, doubled the irrigated area and increased crop output value (Verma & Shah, 2019).

The success of the intervention is also evident from the measures taken by the central government for rejuvenation of dried waterbodies. Desilting and rejuvenation have been included in Repair, Renovation and Restoration of Water Bodies component of Pradhan Mantri Krishi Sinchayee Yojana-Har Khet Ko Pani, Jal Shakti Abhiyan, Mission Amrit Sarovar, Mahatma Gandhi National Rural Employment Guarantee Scheme and Atal Mission for Rejuvenation and Urban Transformation (AMRUT) Scheme under Ministry of Housing & Urban Affairs to supplement the efforts of State government. Niti Aayog has a dedicated program on rejuvenation of water bodies in Aspirational districts of India which includes application of silt to farmlands. The flagship Jal Jeevan Mission program which aims to provide water supply at household level on regular basis including its quantity and quality aspects also focuses on rejuvenation of waterbodies as part of its source strengthening component mainly due to the proximity of drinking water sources to the waterbodies.

These central and state level programs are efficiently supported by regional NGOs working in the space of water, capacity building and community mobilization. Driving collective action has been the prime role of these NGOs by creating a ‘community movement’ for rejuvenation of dried waterbodies with voluntary contribution of community members and carting of silt from waterbodies to farmland by farmers themselves. Rejuvenation of waterbodies, specifically through desilting practices, has emerged as a decentralized, replicable, time-bound, and effective solution for groundwater recharge. Having said this, India is left with a humongous task of rejuvenating its waterbodies to revive and replenish its groundwater systems with an opportunity to improve the agricultural soil productivity and turn this into a win-win situation for farmers and communities.

X. CONCLUSION

Groundwater depletion is a complex and multifaceted challenge that has significant implications for the environment, society, and the economy. Groundwater serves as a vital resource for drinking water and agricultural needs, playing a crucial role in supporting the livelihoods of billions of people worldwide. However, the accelerating depletion of groundwater resources has led to alarming consequences such as sea-level rise, land subsidence, and disruptions in Earth’s rotation axis.

The impacts of groundwater depletion extend beyond environmental concerns and encompass social, economic, and food security aspects. Displacement and migration, conflicts over water resources, reduced crop yields, increased costs for farmers, and diminished water availability for irrigation are among the challenges faced by societies grappling with groundwater depletion. These challenges highlight the urgency of implementing comprehensive solutions to sustain groundwater resources and mitigate the impacts of their depletion.

However, addressing groundwater depletion requires a paradigm shift in the way we perceive and manage water resources. It demands comprehensive policies and strategies that consider the underlying factors contributing to groundwater depletion, such as agricultural intensification, government policies, privately owned groundwater rights, and international trade of" virtual water". These factors collectively pose significant challenges to groundwater management and require concerted efforts from governments, communities, and individuals to implement sustainable solutions.

The interconnection between surface water and groundwater emphasizes the need to adopt a holistic and integrated approach to water management. Recognizing the inseparable link between these two systems is essential for sustainable resource management. Traditional compartmentalization of surface water and groundwater has proven inadequate in addressing the challenges posed by groundwater depletion. Effective land and water management require a comprehensive understanding of the intricate interactions between surface waterbodies and groundwater systems.

Waterbody rejuvenation, particularly through desilting practices, has emerged as a promising and effective solution for groundwater recharge. Scientific evidence and case studies have demonstrated the positive impact of desilting on water storage capacity, groundwater levels, and agricultural productivity. By restoring the storage capacity of ponds, lakes, and reservoirs, desilting facilitates groundwater recharge, mitigating the stress on groundwater systems. Additionally, the fertile silt removed during desilting can be utilized to enhance soil fertility and agricultural productivity, making desilting a cost-effective and sustainable approach. Moreover, field data collection and pilot-based research studies on few locations can strongly complement the findings of this paper.

Scientific studies also justify the replicability and scalability of rejuvenation of waterbodies program. It needs greater support from the government to make this into a continuous process instead of a one-time intervention. The government needs to set realistic goals to motivate and mobilize implementing agencies and communities to undertake rejuvenation as a drought-proofing water conservation and climate adaptation measure. Awareness and belief in strength of the rejuvenation programs to manage the water woes of the community should be given prime importance. The government needs to support local institutions in taking ownership for rejuvenation of waterbodies and revive the dying wisdom of management of these waterbodies.

In conclusion, the restoration of groundwater resources and the sustainable management of water systems require a comprehensive understanding of the complex interplay between surface water and groundwater. Water body rejuvenation, such as desilting practices, offers a promising approach to replenishing stressed groundwater systems, enhancing agricultural productivity, and ensuring the availability of water resources for future generations. By adopting an integrated and holistic approach to water management, we can address the challenges of groundwater depletion and work towards a more sustainable and resilient future.

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