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ASSESSING GROUNDWATER DEPLETION IN HARYANA: AN URGENT CALL FOR SUSTAINABLE MANAGEMENT

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ABSTRACT:

Groundwater, as a critical natural resource, has evolved into the primary water source in rural India, playing a pivotal role in poverty alleviation and economic growth. However, its unsustainable exploitation driven by escalating water demands has led to a concerning decline in water tables nationwide, posing a substantial threat to sustainable development. This study zeroes in on the pressing issue of declining groundwater levels in Haryana, where groundwater serves as a linchpin for agriculture, industry, and domestic needs. The research underscores the gravity of depletion and its adverse socio-economic consequences, fueled by intensive agricultural practices, escalating industrial demands, and rapid urbanization within the state. This study acknowledges that groundwater depletion is one of humanity's most significant challenges, impacting both food and environmental security. Over the years, overexploitation of groundwater has become the norm, primarily to meet the increasing water demand, resulting in a decline in water tables across the country and posing a substantial threat to sustainable development. In the present study, we make a concerted effort to address the critical issue of declining groundwater levels in Haryana. The state stands at the precipice of a severe water crisis, primarily due to groundwater over-extraction, with the proliferation of tubewells for irrigation accounting for more than 90 percent of the groundwater extraction. What initially appeared as a boon during the Green Revolution has given rise to a myriad of socio-economic and environmental challenges. It is essential to recognize that overexploitation of groundwater is a complex and multifaceted problem that requires comprehensive attention and innovative solutions to secure a sustainable water future.

Keywords: Groundwater depletion, Water Crisis, Green Revolution, Irrigation, Water Security.

INTRODUCTION:

The evolution of groundwater as a pivotal natural resource in rural India has had profound implications for poverty reduction and economic development. It has played a central role in meeting the increasing water demands of the region. However, this transformation has not come without its challenges. The unsustainable extraction of groundwater, driven by the ever-rising water requirements, has

raised a red flag. This alarming trend has resulted in a concerning drop in water tables, affecting the entire nation and posing a significant hurdle to the pursuit of sustainable development. Inderjeet's study in 1997 delved into the spatio-temporal dynamics of groundwater balance in eastern Haryana, uncovering a concerning trend. Jha (2000) analyzed the implications of intensive agriculture on soil and water resources in Kurukshetra district and found deterioration in the macro-nutrient status of soil over the years. The study suggested that with the increase in the area under paddy, the chances of decline in groundwater table have increased. Research by Wada et al. in 2010 shed light on the global scope of groundwater depletion, underscoring its colossal impact on a planetary scale.

This study is dedicated to the pressing issue of diminishing groundwater levels, with a specific focus on the state of Haryana, where groundwater is indispensable for the sustenance of agriculture, industry, and domestic needs. The research endeavors to cast a spotlight on the gravity of this depletion and the consequential socio-economic repercussions. This depletion is exacerbated by intensive agricultural practices, the ever-increasing demands of industry, and the swift pace of urbanization within the state.

The depletion of groundwater has emerged as one of humanity's paramount challenges, bearing profound implications for both food and environmental security. Over time, the excessive exploitation of groundwater has become the norm, primarily in response to the escalating demand for water resources. This has resulted in the deterioration of water tables across the length and breadth of the nation, posing a substantial threat to the ideals of sustainable development. In this current study, our focus is directed towards tackling the pressing concern of declining groundwater levels, particularly in Haryana. The state is on the verge of a severe water crisis, primarily due to excessive groundwater extraction. The widespread proliferation of tubewells for irrigation, once viewed as a blessing during the Green Revolution, now serves as evidence of numerous socio-economic and environmental challenges.

STUDY AREA:

Haryana, a state located in the northwest of India, grapples with persistent water resource challenges owing to its unique geographical and climatic characteristics. Spanning a relatively modest land area of 44,212 square kilometers, the region is primarily arid or semi-arid, making drought conditions a recurring issue,

particularly in districts like Mahendragarh, Bhiwani, Rewari, Sirsa, and Hisar. The southwestern half of the state is intertwined with the desert belt extending into Rajasthan, rendering it chronically vulnerable to droughts, crop failures due to inadequate soil moisture, and extreme temperature fluctuations. In terms of surface water resources, Haryana faces limitations as the main perennial rivers of the composite Punjab—Satluj, Beas, and Ravi—do not traverse the state. Instead, Haryana's share of these rivers' waters is allocated and utilized through the Bhakra Canal in the western region. Furthermore, the state relies on the Yamuna River for surface water supply, a source that is insufficient and must be shared with neighboring Uttar Pradesh.

Amid these constraints, groundwater emerges as Haryana's predominant freshwater source. The potential for a consistent supply lies in natural replenishment processes, provided there is a delicate balance between extraction and replenishment. However, the feasibility of groundwater development, achieved primarily through shallow and deep tubewells, is limited to 92% of the state's territory. In other areas, unsuitability arises from high salinity or inadequate granular zones. To surmount these challenges and ensure sustainable water management, Haryana must embark on comprehensive groundwater investigations, customizing approaches to accommodate the diverse hydrogeological characteristics of the region. Furthermore, as urbanization burgeons and reliance on groundwater for agriculture escalates, the imperative of effective planning and equitable resource governance becomes increasingly evident, safeguarding the state's water security and long-term sustainability.

OBJECTIVES OF THE STUDY:

1. Evaluate the current status of groundwater resources in Haryana.
2. Quantify the rate and magnitude of groundwater depletion in the state.

DATA SOURCE AND METHODOLOGY:

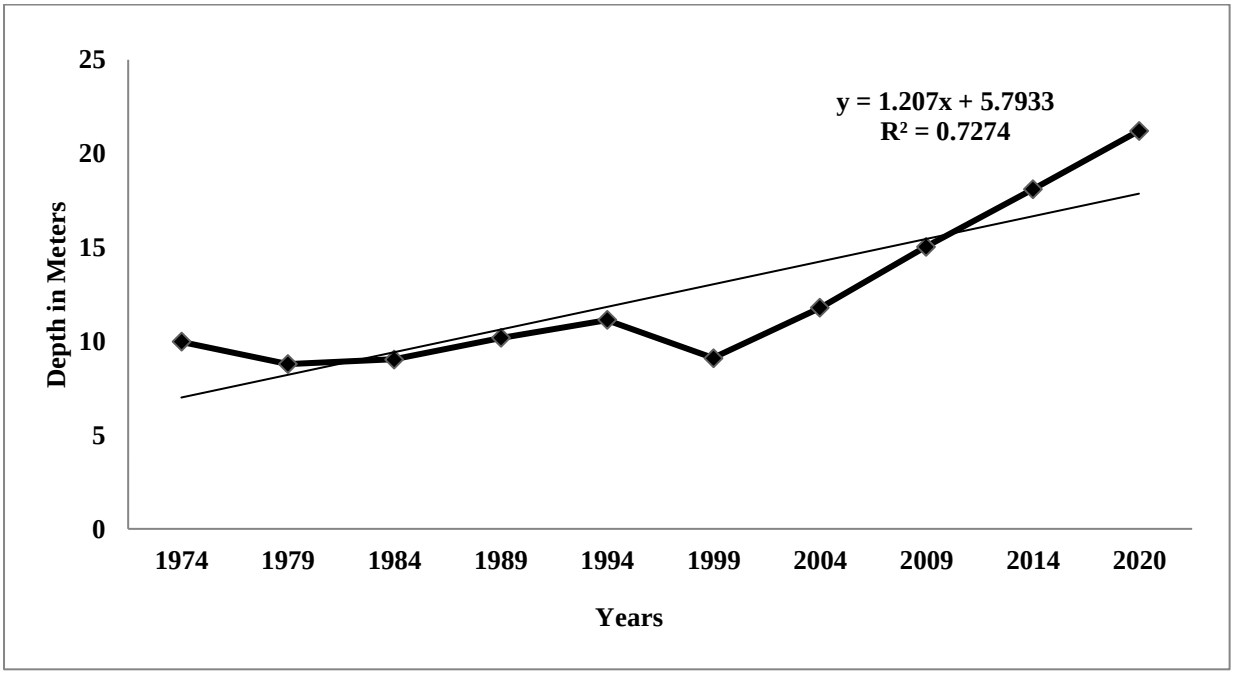
The current research is reliant on secondary data sourced from both publicly available and undisclosed references. The dataset includes time series information pertaining to different facets of groundwater, including depth and groundwater distribution across various categories, at both the state and district levels within the state. These datasets were acquired from the Groundwater Cell and the Central Ground Water Board, covering the time span from 1974 to 2020. To facilitate analysis and

interpretation, the collected data has undergone processing using percentage-based techniques, and the results are presented in the form of tables and diagrams. This methodology allows for a comprehensive examination of trends and patterns in groundwater characteristics over the specified timeframe, contributing valuable insights to the understanding and management of groundwater resources in the region.

Water table trends refer to the historical or observed changes in the level of the water table over a specific period of time. The water table is the subsurface boundary that separates the saturated zone from the unsaturated zone. These trends are typically studied to understand how the depth or elevation of the water table is changing in a particular region or aquifer. Figure 1 illustrates the water table trends in Haryana spanning from the year 1994 to 2020.

RESULT AND DISCUSSION:

Figure 1: Water Table Trends in Haryana, 1974-2020



The water table depth in Haryana, India, exhibited a dynamic pattern of fluctuations from 1974 to 2020. In 1974, the water table depth stood at 9.98 meters, and by 1979, it experienced a slight rise, reaching 8.78 meters. However, this upward trend was short-lived as the water table resumed its decline, reaching 9.03 meters by 1984. In 1989, there was another modest rise, with the depth increasing to 10.17 meters.

Table 1: District wise Average Depth to Water Table (m) in Haryana, 1974-2020

District	1974	2022	Water Table Fluctuation June	Change of Groundwater
Mahendragarh	16.11	47.65	31.54	Fall
Kurukshetra	10.21	40.79	30.58	
Kaithal	6.28	31.70	25.42	
Gurgaon	6.64	29.72	23.08	
Fatehabad	10.48	31.00	20.52	
Rewari	11.75	29.92	18.17	
Panipat	4.56	21.40	16.84	
Karnal	5.72	21.20	15.48	
Faridabad	6.43	19.98	13.55	
Panchkula	7.58	17.90	10.32	
Charkhi Dadri	19.62	29.65	10.03	
Sonepat	4.68	12.25	7.57	
Palwal	5.37	12.75	7.38	
Bhiwani	21.24	28.29	7.05	
Yamuna Nagar	6.26	13.14	6.88	
Mewat	5.5	12.22	6.72	
Ambala	5.79	12.19	6.4	
Sirsa	17.88	23.37	5.49	
Jind	11.97	15.41	3.44	
Jhajjar	6.32	4.74	-1.58	Rise
Rohtak	6.64	3.55	-3.09	
Hisar	15.47	7.74	-7.73	
Haryana	9.35	21.21	11.86	Fall

Source: Groundwater cell Haryana

The most significant increase occurred between 1989 and 1994 when the water table depth surged to 11.13 meters. Nevertheless, by 1999, the water table experienced a slight decrease, settling at 9.1 meters. Subsequently, the overall trend was marked by a decline, with the water table depth reaching 11.78 meters in 2004. A substantial increase ensued from 2004 to 2009, peaking at 15.04 meters. However, the decline persisted from 2009 to 2014, with the depth reaching 18.1 meters. Ultimately, by 2020, the water table depth had further diminished to 21.21 meters.

Table 1 demonstrates substantial fluctuations in pre monsoon groundwater levels across Haryana's districts. In 1974, Bhiwani recorded the deepest water table at 21.24 meters, closely followed by Charkhi Dadri at 19.62 meters. Over the years, groundwater levels have exhibited dynamic changes, with some districts experiencing notable increases while others faced declines. By 2020, Mahendragarh saw a significant

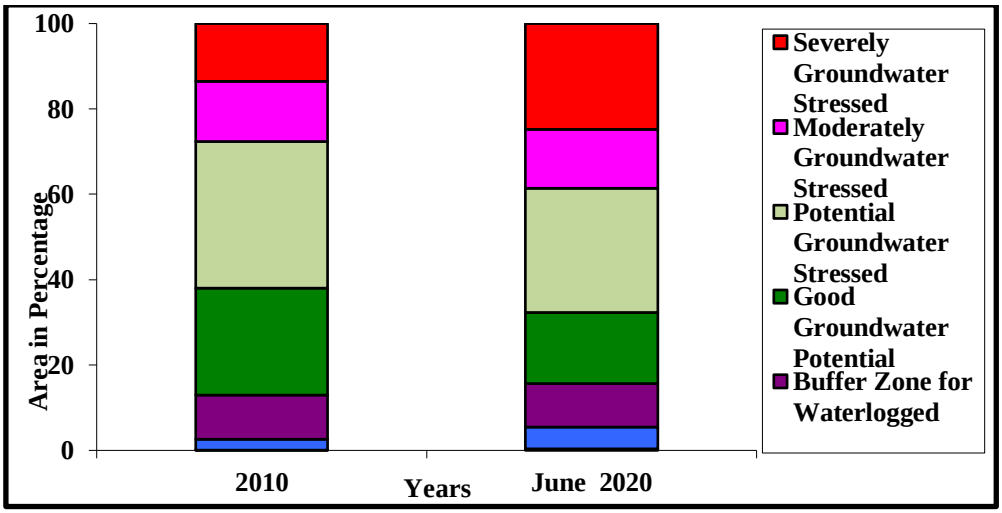
decrease, with the water table at 47.65 meters, representing a drop of 31.54 meters since 1974. Conversely, Kurukshetra observed a remarkable rise of 30.58 meters, reaching 40.79 meters in 2020. These variations underscore the intricate dynamics of groundwater resources in Haryana, underscoring the imperative need for sustainable management to ensure a reliable and consistent water supply that caters to the region's diverse requirements. Notably, the state's average water table witnessed a decrease of approximately 11.86 meters from 1974 to 2020, underscoring the urgency of prudent groundwater resource management.

CATEGORIZATION OF GROUNDWATER LEVEL DEPTHS:

The categorization of groundwater level depths into specific categories serves as a vital tool for assessing and understanding the groundwater situation in diverse regions. These categories, based on the depth to the water table in meters, provide valuable insights into the accessibility and health of groundwater resources. Figure 2 illustrates the changes in groundwater level categories between the years 2010 and June 2020, expressed in meters. To better understand these changes in terms of percentage, we calculated the percentage change for each category.

In severely waterlogged areas, the groundwater level surged by approximately 314.29% from 0.07 meters in 2010 to 0.29 meters in 2020. Potential waterlogged areas also saw a noteworthy increase of around 104.72%, with the groundwater level rising from 2.54 meters to 5.18 meters during the same period. Contrastingly, areas categorized as having good groundwater potential exhibited a substantial decline, plummeting by roughly 33.35% from 25.06 meters in 2010 to 16.69 meters in 2020. The groundwater level in potential groundwater stressed areas decreased by approximately 15.35%, declining from 34.34 meters to 29.09 meters.

Figure 2: Groundwater Level Categorizes in Haryana



In the buffer zone for waterlogged areas, there was a modest decrease of about 1.84%, with the groundwater level declining from 10.34 meters to 10.15 meters. Similarly, moderately groundwater stressed areas experienced a slight dip of approximately 2.76%, as the groundwater level shifted from 14.13 meters to 13.74 meters. Remarkably, severely groundwater stressed areas witnessed a substantial rise of around 83.81%, with the groundwater level ascending from 13.52 meters in 2010 to 24.86 meters in 2020. These percentage changes underscore the dynamic nature of groundwater levels across different categories, reflecting the complex interplay of factors influencing water resources over the decade.

CONCLUSION:

The state of Haryana in northwestern India faces a complex and challenging water resource scenario due to its arid to semi-arid climate and geographical characteristics. With limited access to perennial rivers, Haryana relies heavily on groundwater as its primary freshwater source. However, overdevelopment, especially for water-intensive crops like sugarcane and paddy, has led to a continuous decline in the water table. The analysis of water table trends spanning from 1974 to 2020 reveals a dynamic pattern of fluctuations, with distinct periods of both rise and decline. Over this extended period, the average water table depth showed a significant decrease of approximately 11.86 meters. This substantial decline highlights the urgent need for responsible and sustainable groundwater resource management strategies to address the challenges posed by diminishing water tables. Moreover, the categorization of groundwater levels into specific groups has proven to be an invaluable tool for evaluating the groundwater situation. Examining changes in these categories between 2010 and 2020 provides a more detailed understanding of groundwater dynamics. Some regions experienced notable increases in groundwater levels, while others witnessed declines. These changes emphasize the intricate interplay of various factors influencing water resources. It is clear that effective and sustainable water management practices are imperative to ensure the availability and equitable distribution of this vital resource for the well-being of current and future generations.

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