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Status of ground water development in Western Haryana, India

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Abstract
In the last few decades, groundwater has emerged as an important resource for agriculture and food security in India, with Haryana being considerably dependent on its underground reserves. Irrigated area has increased and in Western Haryana, the groundwater extraction has gone upto 132.17%. However, this groundwater development is at different stages for different blocks of the region. Only in 11 blocks the groundwater levels are "safe", while in as many as 24 blocks the water availability is classified as being "over-exploited", implying there will be acute water distress. The present study is an attempt to analyze the block-wise stages of groundwater development in Western Haryana, which also reveals localized disparities with spatial differences in groundwater availability.

Keywords: Groundwater development stages, western Haryana, planning, management

Introduction
Haryana is one of the most developed agricultural states of India. It is also one of the leading state in the country with reference to groundwater based irrigation development and water supply. Available data and projections reveal a rapid increase in the area irrigated by groundwater, along with a significant rise in the number of wells and energized pump sets. The different hydrogeological characteristics of the state results in regional variations of groundwater potential. In the period of 1965-68, canals constituted the leading source of irrigation and covered around 78 percent of the irrigated area. However, their contribution to irrigation has gradually declined since the advent of tubewell irrigation (Sharma, 2020). Tube wells in the state have risen from a mere 0.2 million in 1966 to 0.73 million in 2013, i.e., nearly thirty times. Even though groundwater irrigation has expanded rapidly all over the state in the intervening years, it has also brought about adverse effects on the state's groundwater resources (Singh & Amrita, 2017) [7]. Western Haryana is also highly dependent on groundwater resources. The stage of groundwater extraction in western Haryana is 132.17 percent (CGWB, 2023). This stage of groundwater extraction clearly indicates that there has been overexploitation of this precious resource and there is an urgent need for its management and conservation.

This study focuses on the groundwater development in the 42 blocks of Western Haryana. Understanding of the present scenario of groundwater resources is very important. Increasing requirements for agricultural, industrial, and domestic uses necessitate planned development of groundwater. Water being indispensable to all life forms and highly decreased in availability, the economical and equitable use of this resource for sustenance of ecological balance is required. In order to address, the issues of water scarcity, increased demand, and reduced ground levels, effective development and management of water resources is the need of the hour (Nagaraja, 2018) [5].

Study area
Astronomically, the western part of Haryana lies between 27°49′ 08\" North to 29°58′50" North latitudes and from 74°28′ 18" East to 76°27′7" East longitudes. The area is generally dry, semi-arid in terms of climatic conditions, and the Aravalli hills extend into the southern portion that stretches up to Bhiwani. In this study area, modern farming technologies have been adopted on large scale and almost all the district mainly consists of homogeneous agricultural landscapes.

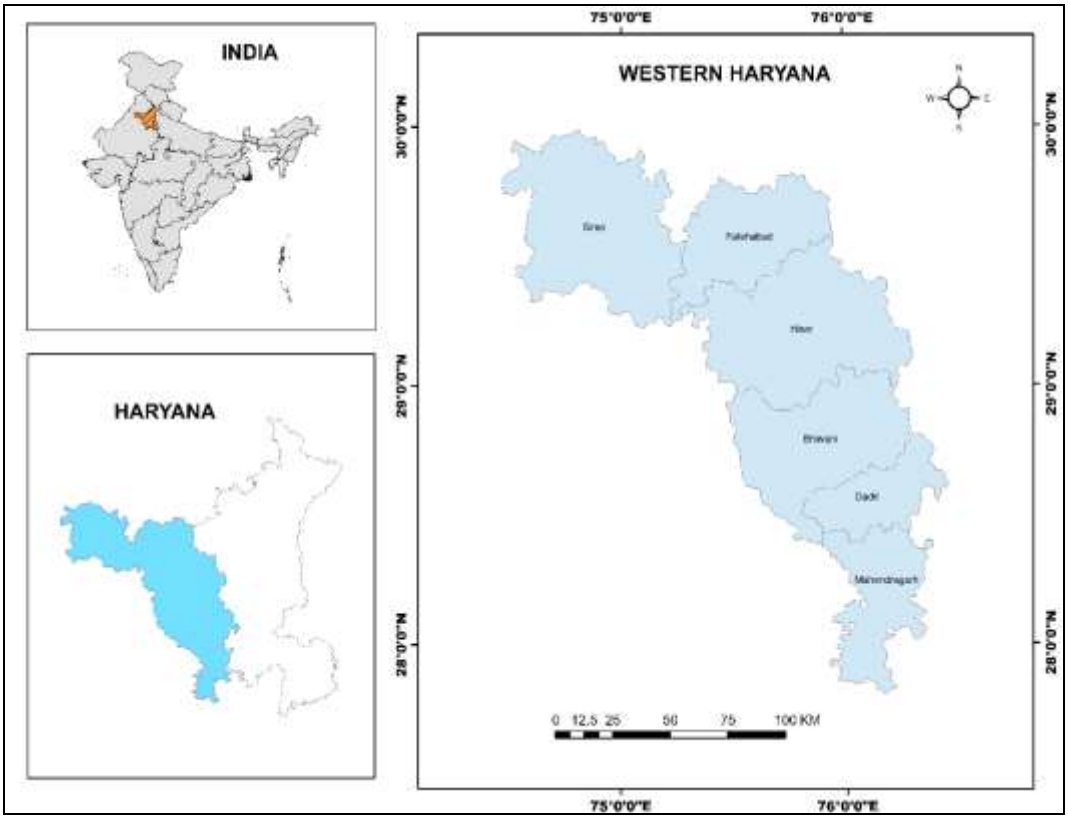
This zone comprises of six districts: Sirsa, Fatehabad, Hisar, Bhiwani, Charkhi-Dadri, and Mahendragarh and these are further divided into 42 blocks. The altitude across this section of Haryana ranges from 220 to 235 meters above mean sea level (MSL). It forms a part of the alluvial Ghaggar-Yamuna plain, whereas the southern as well as the western portion gradually merges with Thar Desert.

Data and methodology

The present study deals with the western parts of the Haryana. Blocks are considered as study unit and the data considered for this study is secondary in nature. The data of years 2020 and 2022 is used for studying the stages of groundwater development. The data and information is collected from the Central Ground Water Board, Chandigarh. The base map has been prepared with the help of ArcGIS software.

Objectives

1. To know about the overall stage of groundwater development in the blocks of Western Haryana.
2. To explore the number of over-exploited blocks and the need for groundwater conservation.



Source: Prepared by Authors

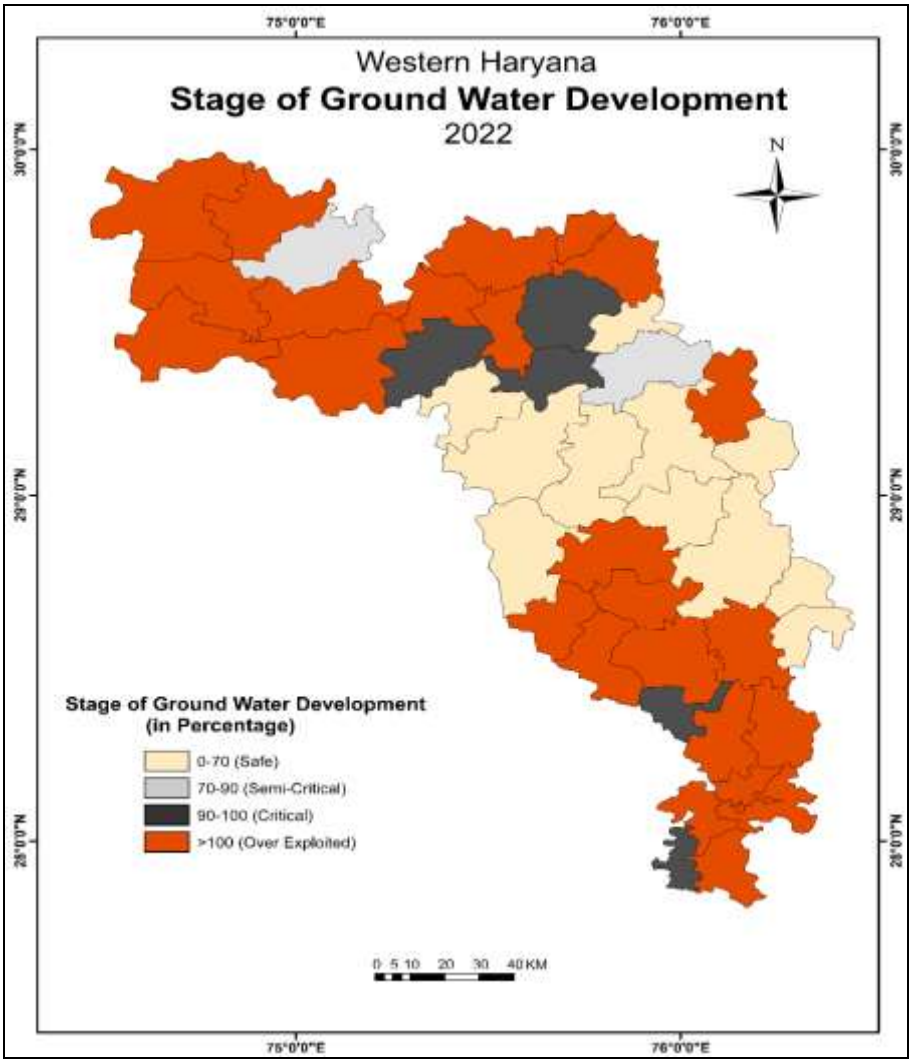
Fig l: Location map of the study area

Stage of groundwater development

Groundwater has been an important component of the hydrological cycle and an important source of drinking water, irrigation for agriculture, and industrial use for regions around the globe. However, the ever-increasing need for water together with human activities have led to the depletion and degradation of groundwater in most regions. To appraise the state of groundwater, classifications have evolved into various categories based on specific criteria regarding the quantity or volume and also the quality of groundwater. Understanding the classification of groundwater is important in the effective management of water resources, especially in areas perceived to have its over-extraction and contamination and also in regions being subject to scarcity.

Quantitative parameters such as groundwater levels, recharge rates, and extraction rates along with qualitative parameters of salinity and level of contamination are considered for the categorization of groundwater as over-exploited, critical, semi-critical, or safe. Over-exploited areas are those in which the extraction rate of groundwater is higher than the recharge rate; the continuous resultant lowering of water levels characterizes this category. Critical or semi-critical areas show high stress on the groundwater resources, and unless managed, will run the risk of depleting the ground water. However, safe areas have sustainable levels and rates of groundwater extraction, ensuring a balance between the usage and recharge.

Various studies have highlighted that the categorization of groundwater is necessary to to enable informed decision-making in water management policies and practices. The Central Ground Water Board (CGWB), India categorized its regions of concern on possible water stress and acted by focusing interventions in such fields. Such categorizations are prevailing across the world and help the authority identify locations requiring prompt attention for the sustainable management of groundwater (CGWB, 2019).



Source: Central Ground Water Board, 2023

Fig 2: Stages of Groundwater Development

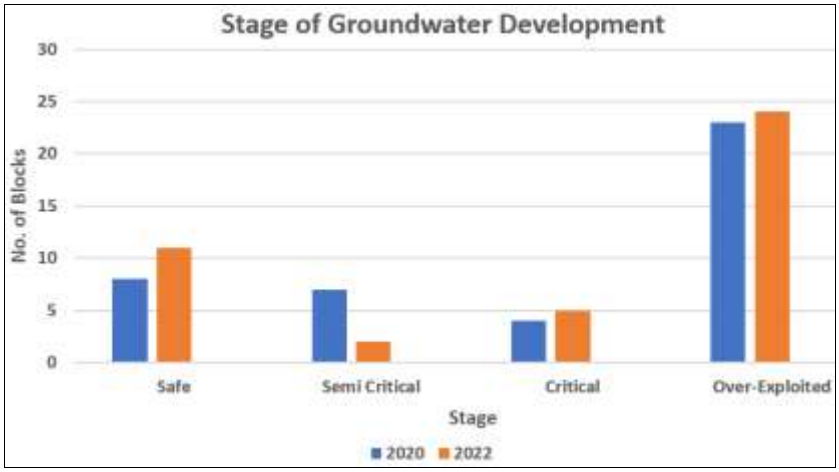
Such classifications connote much, as these will determine agricultural activities, socio-economic status, and the sustainability of the environment. Over-exploited and critical areas typically suffer at the agricultural level due to falling water tables, decreased crop yields, and farmer distress. Moreover, the degradation of groundwater in saline areas poses various health concerns and restricts the usability of water for varied purposes, affecting the wellbeing of the community (Adimalla & Qian, 2020) [1].
These categories are shown in Map 2 and Table 1 and are discussed in detail below:

SAFE
Only eleven blocks in Western Haryana are classified as "safe." There isn't a safe block in the districts of Mahendragarh, Fatehabad, and Sirsa. The 'Safe' classification for blocks like Adampur, Bass, Hansi, Hisar-I, Hisar-II, Uklana, Bawani Khera, Bhiwani, Siwani, Baund, and Charkhi Dadri indicates that these blocks have better groundwater supply than other blocks. The percentage values in this category vary between 0-70. This assessment is essential for developing plans for managing water resources, with a particular focus on areas that require immediate attention and conservation measures due to acute water stress.

Semi-Critical
In Western Haryana, this is the third prominent category in the groundwater development stage. With percentage levels between 70 and 90 percent, only two blocks-Barwala in the district of Hisar and Baragudha in the district of Sirsa-fit into the "Semi-Critical" category, indicating a moderate degree of water stress.

Critical
Five blocks-Bhattu Kalan and Bhuna in the Fatehabad district, Agroha in the Hisar district, Nizampur and Satnali in the Mahendragarh district-are deemed "critical" due to the fact that their percentage values fall between 90 and 100, indicating that the water level is approaching an alarmingly low level.

Over exploited
Blocks in western Haryana that are overexploited make up about 57% of the total. In the districts of Sirsa, Fatehabad, Bhiwani, and Mahendragarh, this category is predominant. 'Over-Exploited' blocks include Bahal, Kairu, Loharu, Tosham, Badhra, Jhojhu, Bhattu Kalan, Fatehabad, Jakhal, Ratia, Tohana, Barwala, Mahendragarh, Rania, Sirsa, etc. because their percentage values suggest that the amount of water extracted is alarmingly high-above 100. There's a big chance that there won't be adequate water supply in these blocks in the near future.



Source: CGWB, 2023

Fig 3: Stage of Groundwater Development in 2020 and 2022

Figure 3 shows that many blocks witnessed a change in the groundwater development stage category between 2020 and 2022. Some improved and went into safer categories, while some worsened and went into more critical and over-exploited categories. Others have stood their ground with stability regarding the use of groundwater in those blocks.

Table 1: Block- wise comparison of Stage of Ground Water Development and Category with previous Assessment

S.N.	District	Block	SOGWD In 2020	Categorization	SOGWD In 2022	Categorization	Change
1	Sirsa	Baragudha	76.31	Semi Critical	78.47	Semi Critical	No Change
2	Sirsa	Dabwali	123.20	Over Exploited	138.79	Over Exploited	No Change
3	Sirsa	Ellenabad	244.47	Over Exploited	226.44	Over Exploited	No Change
4	Sirsa	Nathusari Chopta	106.57	Over Exploited	119.79	Over Exploited	No Change
5	Sirsa	Odhan	204.85	Over Exploited	194.24	Over Exploited	No Change
6	Sirsa	Rania	147.52	Over Exploited	147.84	Over Exploited	No Change
7	Sirsa	Sirsa	213.50	Over Exploited	210.65	Over Exploited	No Change
8	Fatehabad	Bhattu Kalan	112.23	Over Exploited	99.44	Critical	Improved
9	Fatehabad	Bhuna	96.89	Critical	98.57	Critical	No Change
10	Fatehabad	Fatehabad	185.11	Over Exploited	203.90	Over Exploited	No Change
11	Fatehabad	Jakhal	220.07	Over Exploited	219.74	Over Exploited	No Change
12	Fatehabad	Nagpur	249.07	Over Exploited	227.53	Over Exploited	No Change
13	Fatehabad	Ratia	215.51	Over Exploited	248.74	Over Exploited	No Change
14	Fatehabad	Tohana	133.06	Over Exploited	132.29	Over Exploited	No Change
15	Hisar	Adampur	91.82	Critical	49.49	Safe	Improved
16	Hisar	Agroha	95.30	Critical	94.08	Critical	No Change
17	Hisar	Barwala	119.64	Over Exploited	82.31	Semi Critical	Improved
18	Hisar	Bass	64.54	Safe	53.45	Safe	No Change
19	Hisar	Hansi	80.69	Semi Critical	68.78	Safe	Improved
20	Hisar	Hisar-I	76.21	Semi Critical	64.19	Safe	Improved
21	Hisar	Hisar-II	78.28	Semi Critical	65.87	Safe	Improved
22	Hisar	Narnaund	160.85	Over Exploited	215.42	Over Exploited	No Change
23	Hisar	Uklana	20.29	Safe	29.56	Safe	No Change
24	Bhiwani	Bawani Khera	74.48	Semi Critical	66.50	Safe	Improved
25	Bhiwani	Behal	143.81	Over Exploited	149.70	Over Exploited	No Change
26	Bhiwani	Bhiwani	90.00	Semi Critical	68.51	Safe	Improved
27	Bhiwani	Kairu	187.41	Over Exploited	155.87	Over Exploited	No Change
28	Bhiwani	Loharu	143.71	Over Exploited	161.94	Over Exploited	No Change
29	Bhiwani	Siwani	48.28	Safe	40.87	Safe	No Change
30	Bhiwani	Tosham	149.15	Over Exploited	159.82	Over Exploited	No Change
31	Charki Dadri	Badhra	244.19	Over Exploited	234.04	Over Exploited	No Change
32	Charki Dadri	Baund	31.27	Safe	27.09	Safe	No Change
33	Charki Dadri	Charkhi Dadri	64.88	Safe	62.04	Safe	No Change
34	Charki Dadri	Jhojhu	157.65	Over Exploited	152.33	Over Exploited	No Change
35	Mahendragarh	Ateli Nangal	91.29	Critical	121.07	Over Exploited	Deteriorated
36	Mahendragarh	Kanina	173.75	Over Exploited	196.56	Over Exploited	No Change
37	Mahendragarh	Mahendragarh	114.18	Over Exploited	127.80	Over Exploited	No Change
38	Mahendragarh	Nangal Chaudhry	61.61	Safe	153.08	Over Exploited	Deteriorated
39	Mahendragarh	Narnaul	45.23	Safe	112.00	Over Exploited	Deteriorated
40	Mahendragarh	Nizampur	28.67	Safe	97.32	Critical	Deteriorated
41	Mahendragarh	Satnali	75.11	Semi Critical	96.61	Critical	Deteriorated
42	Mahendragarh	Sihma	126.15	Over Exploited	152.89	Over Exploited	No Change

Source: CGWB, 2023

Conclusion

In conclusion, the classification of groundwater into several categories constitutes one of the excellent steps toward sustainable management of the water resource. Targeted measures taken by policymakers and stakeholders with well-defined areas facing over-exploitation or depletion towards the conservation and replenishment of groundwater resources are meant to understand the criteria and implications in each category, which will lead to a strategy that manages stress of water while ensuring safe and sustainable supply of groundwater in the future. This data is crucial for water resource management and conservation strategies to address the water stress in different regions of Haryana. There are 11 safe blocks, indicating a safer level of groundwater availability and on the other extreme are the 24 over exploited blocks which show a bleak future and water crisis.

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