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Ground Water Depth Fluctuations in Central-Eastern Haryana (1974-2021): A Geographical Analysis

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ABSTRACT:
This is a descriptive paper which deals with the fluctuations of ground water depth in Central-Eastern Haryana from 1974 to 2021 at block level.An Analysis of groundwater depth fluctuation sreveals significant trends influenced by both climatic and anthropogenic factors. This study is focusing on Central-Eastern Haryana which comprises of 34development blocks of five districts namely Karnal, Rohtak, Panipat, Sonipat and Jhajjar. The secondary data has been used for this paper to analysis the fluctuations in ground water depth, stages of water in spatio-temporal manner. The period from 1974 to 2021 in study area has seen significant fluctuations in groundwater depths, primarily driven by climatic variability and human interventions. Continuous monitoring and sustainable water management practices are essential to address these challenges.

KEY WORDS: Water Depletion, Water Resources, Domestic, Agriculture

INTRODUCTION:

With an increasing population sustainable development and efficient management of water is emerging as a complex challenge in India. Increasing population is pressuring urbanization and industrialization combined with the need of raised agricultural demand putting stress on usage of water. Ground water is a perennial source of water. It has an important role in meeting the water requirements of agriculture, industrial and domestic sectors in India. In India about 85 percent of rural domestic water requirement, 50 percent of urban water requirement and more than 50 percent of its irrigation requirement is being met from ground water resources. Ground water is annually replenishing able resource but its availability is non-uniform in space. Technically, the dynamic ground water refers to the quantity of ground water available in the zone of water level fluctuation, which is replenished annually. Increased demand of food grains has increased present requirement of water for irrigation in the state much more than the available surface and sub surface resources. Since there is no river in the state, surface water availability for consumption is extremely limited. The state has varied hydro geological characteristics due to which ground water potentials differ from place to place.

Haryana is currently facing a significant groundwater crisis, with high extraction rate far exceeding sustainable levels. The study of recent data indicates that the state's annual groundwater withdrawal is approximately 137% of its annual extractable resource, placing it among the highest in the country.

STUDY AREA:

The study area is located in the central-eastern part of Haryana State. This area consists of five districts namely Rohtak, Karnal, Panipat, Sonipat and Jhajjar. The study area extends between 28°15' to 30° North Latitude and 76°10 to 77°10 to 77°15' east longitude. The geographical area is 9,467 sq Kms comprising of 34 blocks. The study area is surrounded by Delhi and Uttar Pradesh on its eastern side; Kaithal, Jind, Hissar and Bhiwani on its western side, Kurukeshtra and Yamunanagar on its northern side. The selected area is unique due to its central geographical location in Haryana which represent a whole state picture.

DISCUSSION:

Table-1 shows distribution pattern of ground water table in districts namely Jhajjar, Karnal, Panipat, Rohtak and Sonepat along with their total geographical area.The water table depth is categorized into different ranges, showing the percentage of land falling within each category.

Out of these five, Karnal, Panipat and Sonipat lie in catchment area of river Yamuna and area is plain suitable for agriculture with well-developed irrigation facilities in terms of canals and tube wells. The main occupation of study area is agriculture.

In Karnal, Panipat and Sonipat, main cash crops are rice and wheat which are highly dependent on water and needs water continuously. This demand resulted in extraction of ground water. This is evident from water table data of Karnal and Panipat, in spite of Yamuna catchment region ground water table starts from 5 meters depth. In these two districts in spite of well-developed irrigation facilities in terms of canals, there is high usage of tube well irrigation. This results in depletion of ground water thereby decreasing ground water table. This is also evident from table, significant concentration of ground water table lies beyond depth of 10 meters.

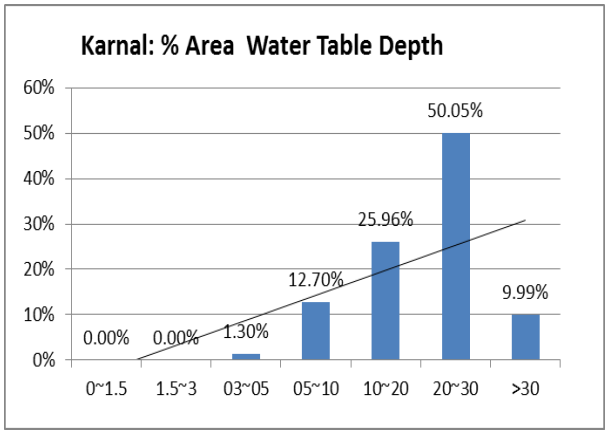
On the other hand Rohtak and Jhajjar lie in dry area, mainly depending on canals and rain water for irrigation. Irrigation facility from tube wells is not well developed in these two districts. In Rohtak and Jhajjar district ground water table distribution ranges from 0~0.15 meters to 20~30 meters.The climate of Rohtak and Jhajjar is sub-tropical monsoon, very cold winter and hot summer except three months of south west monsoon from July to September in which humid air of oceanic origin invade into district and causes rain which is 84% of annual rainfall. Rets of rainfall is distributed in 9 months of year. From above 2 pictures it is evident that in Jhajjar and Rohtak area lying in 1.5-3 meter water table is 56.77% and 54%, which represents a quite significant area with low water table depth indicating good groundwater availability. In Jhajjar very little land (4.69%) has a deep water table (10–20m), and none is deeper than 20m.Overall, Jhajjar has the best groundwater conditions among these districts. Similarly Rohtak has relatively stable groundwater conditions, with most of the area having a shallow water table.Table 2 represents variations in ground water depth from 1974 to 2021 for Karnal, Panipat, Sonipat, Rohtak and Jhajjar.

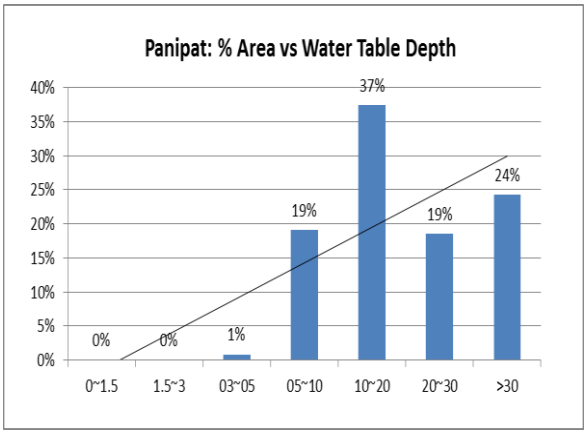
Karnal district has 8 blocks and in all of 8 blocks there is decrease in ground water depth in 2021 in comparison to 1974. There is decrease of more than 19 meters in Nilokheri, Nissing and Assandh. All blocks in Karnal have main profession of agriculture and main crops are rice, wheat and sugarcane, which are heavily dependent on irrigation and main source of irrigation is canals and bore wells.

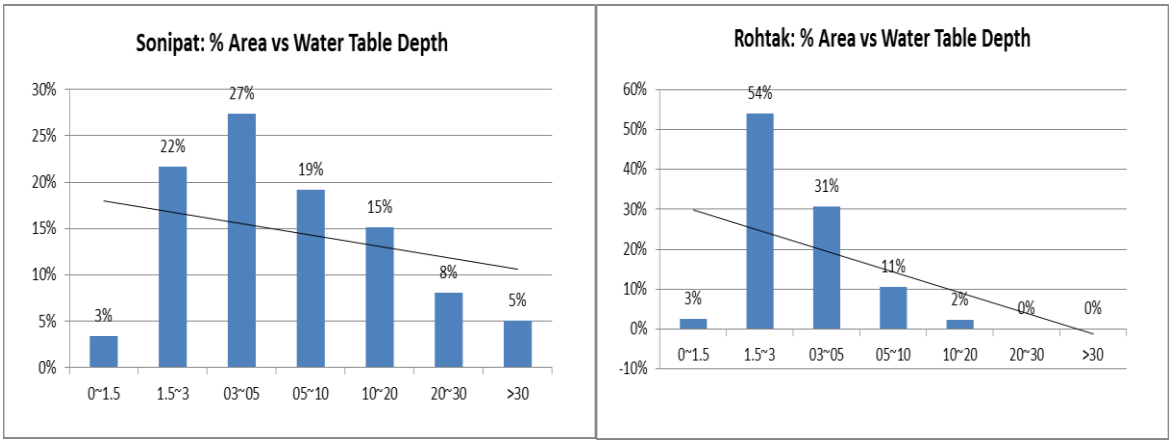
Table: 1 Central-Eastern Haryana: Block Wise Area Depth to Water Level (June,2021)

Sr. No.	District	Total Geo. Area (Acre)	Depth to Water Table (Metres)						
			0~1.5	1.5~3	03~05	05~10	10~20	20~30	>30
1	Jhajjar	470036	14817	266858	139202	27136	22023	0	0
		100%	3.15 %	56.77 %	29.62%	5.77%	4.69%	0.00%	0.00%
2	Karnal	610478.03	0	0	7951.04	77505.12	158460.59	305559.15	61002.13
		100%	0.00 %	0.00%	1.30%	12.70%	25.96%	50.05%	9.99%
3	Panipat	321912.05	0	0	2549.38	61271.46	120460.65	59597.57	78032.99
		100%	0%	0%	1%	19%	37%	19%	24%
4	Rohtak	412436	10638	222778	126556	43315	9149	0	0
		100%	3%	54%	31%	11%	2%	0%	0%
5	Sonipat	528061	18151	114310	144737	101494	79726	42908	26735
		100%	3%	22%	27%	19%	15%	8%	5%
	Total	2342923.1	43606	603946	420995.42	310721.58	389819.24	408064.72	165770.12
	%age	100%	1.86 %	25.78 %	17.97%	13.26%	16.64%	17.42%	7.08%

Source: Report on DynamicGroundWaterResources of Haryana State, March2022







Thus resulting in whole of Karnal block under over exploited category except Indri which is under critical category. In Karnal block average water table depth was 7.38 meters in 1974 and which further fell down to 21.32 meters in 2021 showing excessive withdrawal of ground water for domestic, industrial and agricultural use. Similar situation is prevailing in Panipat and its blocks; there is high depletion of ground water table in Panipat block, water table depth reduced from 10.9 meters to 35.72 meters from 1974 to 2021, being industrial region for textile industry, there is high dependency on bore wells. Rest five blocks Israna, Samalkha, Madlauda, Bopoli and Sanali khurd are agriculture based economies putting a stress on ground water table. All blocks in Panipat district falls in category of overexploited under categorisation of 2021. In Panipat blocks average water table depth was 6.98 meters in 1974, which further fell down to 22.28 meters in 2021 indicating excessive withdrawal of ground water for domestic, industrial and agricultural use.

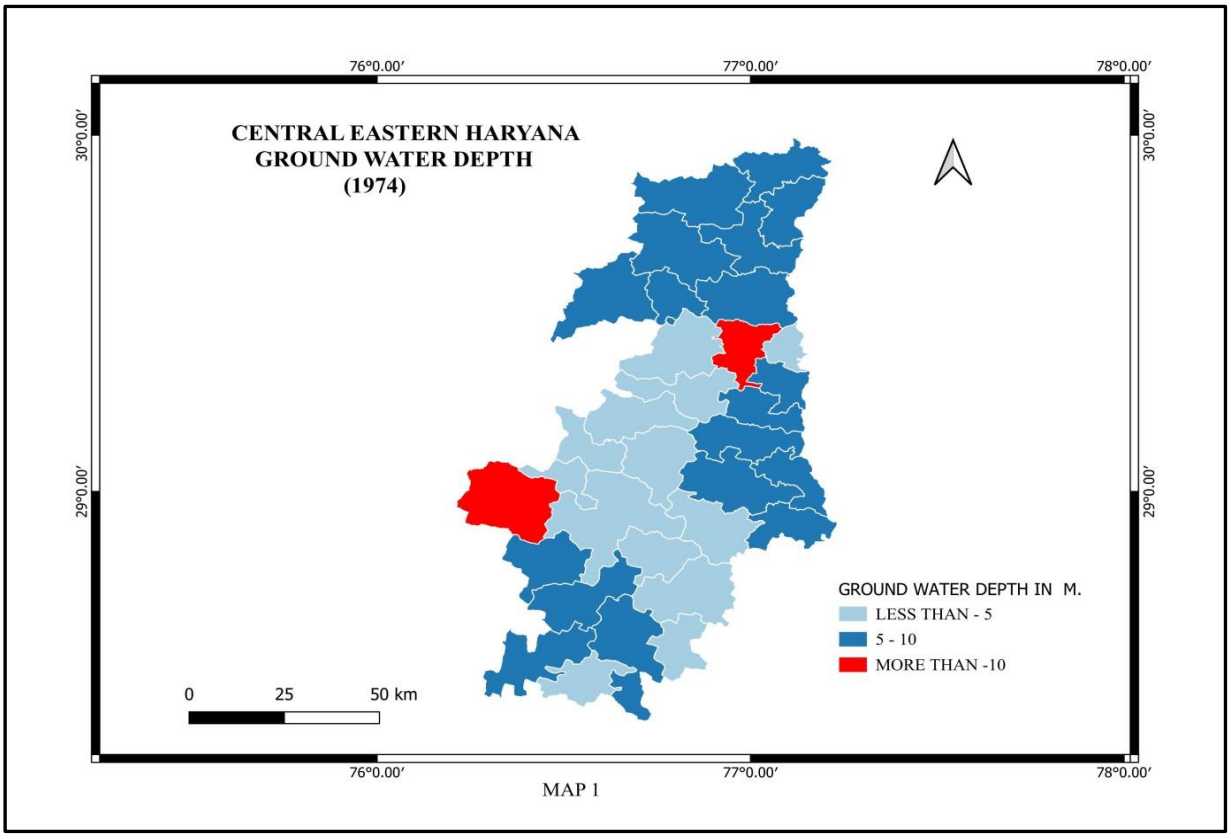
In Rohtak district, all 5 blocks lie under safe category, because water table depth is same except Meham, in which there is rise in water table depth by 8.17 meters from 1974 to 2021. Rohtak, Meham, Kalanaur, Lakhanmajra and Sampla are rural background agricultural regions with less developed irrigation facilities. Main crops sown in the area are Mustard, Cotton, Jowar, Bajra require less water and mainly depend on rainfall. Because of less developed ground water extraction facilities and low industrial development usage of ground water is almost negligible resulting in no impact on ground water table. In Rohtak blocks, average water table depth was 5.84 meters which further improved to 4.12 meters in 2021 indicating better water recharge of overall area. In Jhajjar water table depth was 4.21 meters in 1974 which dropped to 5.13 meters in 2021. Jhajjar has 7 blocks, out of which Machroli is carved out recently; all blocks are in safe category for ground water table. Like Rohtak, Jhajjar is a rural economy mostly depending on agriculture except Bahadurgarh which is an industrial town. Overall in Jhajjar, water table level is more or less stable and improved

Table: 2 Central-Eastern Haryana: Periodic Fluctuations in Ground Water Depth (1974-2021)

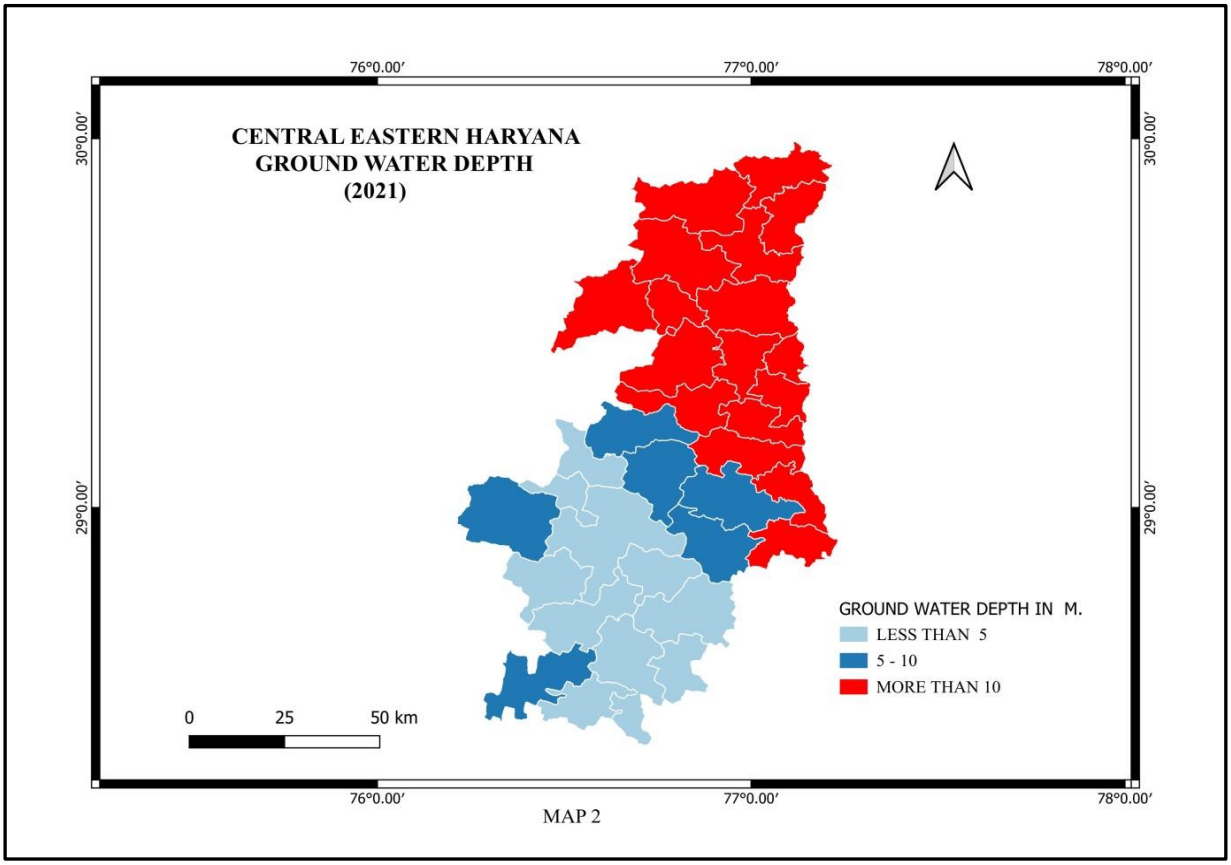
Sr.No	District	Blocks	June 1974	June 2021	1974-2021	Categorization 2022
1	**Karnal**	Karnal	7.41	18.09	-9.77	Over Exploited
2		Kunjpura	6.8	12.51	-5.28	Over Exploited
3		Munak	5.32	21.1	-13.99	Over Exploited
4		Indri	7.28	13.74	-5.38	Critical

5		Nilokheri	8.09	26.54	-19.01	Over Exploited
6		Nissing	7.46	28.37	-19.65	Over Exploited
7		Gharaunda	9.8	23.35	-13.4	Over Exploited
8		Assandh	6.87	26.88	-19.49	Over Exploited
		Average	**7.38**	**21.32**	**-13.25**	-
1	**Panipat**	Panipat	10.19	35.72	-25.31	Over Exploited
2		Israna	3.86	12.18	-8	Over Exploited
3		Samalkha	9.83	28.96	-19.02	Over Exploited
4		Madlauda	4.95	14.51	-8.97	Over Exploited
5		Bopoli	8.72	26.64	-17.91	Over Exploited
6		Sanalikhurd	4.33	15.64	-11.19	Over Exploited
		Average	**6.98**	**22.28**	**-15.07**	-
1	**Sonipat**	Ganaur	6.61	21.59	-13.14	Over Exploited
2		Gohana	3.76	5.41	-0.79	Safe
3		Kathura	3.42	4.05	0.2	Safe
4		Kharkhoda	4.81	6.09	0.02	Safe
5		Mundlana	2.86	6.83	-2.46	Over Exploited
6		Sonipat	6.27	7.61	0.32	Over Exploited
7		Murthal	6.55	27.87	-19.57	Over Exploited
8		Rai	6.43	16.43	-7.86	Over Exploited
		Average	**5.09**	**11.99**	**-5.41**	-
1	**Rohtak**	Rohtak	2.91	3.72	-0.76	Safe
2		Meham	12.31	5.04	8.17	Safe
3		Kalanaur	5.26	3.57	1.96	Safe
4		LakhanMajra	4.96	4.67	0.75	Safe
5		Sampla	3.74	3.62	0.35	Safe
		Average	**5.84**	**4.12**	**2.09**	
1	**Jhajjar**	Jhajjar	5.42	4.32	0.81	Safe
2		Bahadurgarh	3.97	4.17	0.3	Safe
3		Beri	5.1	2.49	2.81	Safe
4		Matanhail	6.99	7.92	0.29	Safe
5		Sahlawas	4.38	4.68	0.5	Safe
6		Badli	3.61	4.68	0.17	Safe
7		Machhroli	-	7.67	-	Safe
		Average	4.21	5.13	0.69	

Source: Report on DynamicGroundWaterResources of Haryana State, March2022



MAP 1

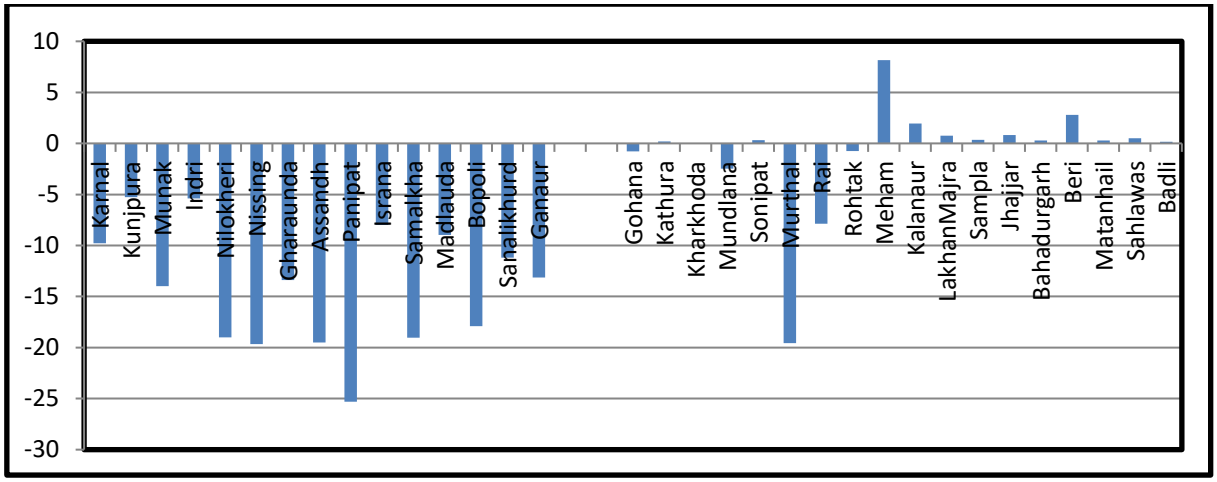


MAP 2

The central eastern Haryana is divided in three fold categories in terms of ground water depth in 1974. The ground water depth ranges between 2.86 metres in Rohtak Blocks to 12.31 metres in Meham block

in 1974 in Rohtak district. Whereas the ground water in 2021 ranges between 2.49 metres in Beri block in Jhajjar district to 35.72 metres in Panipat block in Panipat district. In 2021 the picture of map changed totally in comparison to map of 1974. The map of 1974 shows that thirteen blocks are lying in the category of less than 5 metres zone of ground water depth but 2021 map shows that the situation of this category has been changed and total eleven blocks are lying in category of ground water depth less than 5 metres. In 1971 map (Map-1) the second category of 5-10 meters total nineteen blocks are located in that category but in 2021 (Map-2) shows drastic change only six blocks are remaining in this category as others are shifted in category of more than 10 meters. In 1974 (Map-1) represent that only two blocks namely Panipat (10.19) & Meham (12.31)are lying in more than 10 meters of ground water depth. The scenario and perspective has been totally changed because in 2021 (Map-2) seventeen blocks shifted in this category instead of two blocks in 1974. This is an important issue for not only the people also for the government. While in 1974 data shows that we found water at depth of 12.31 metres but in 2021 data this shifted to 35.72 meters below the earth surface. These fluctuations are attributed to various factors such as variable rainfall patternand extensive groundwater extraction for irrigation purposes. The interplay between natural recharge processes and human activities has led to notable changes in groundwater levels over the decades.

Central-Eastern Haryana: Periodic Fluctuations in Ground Water Depth (1974-2021)



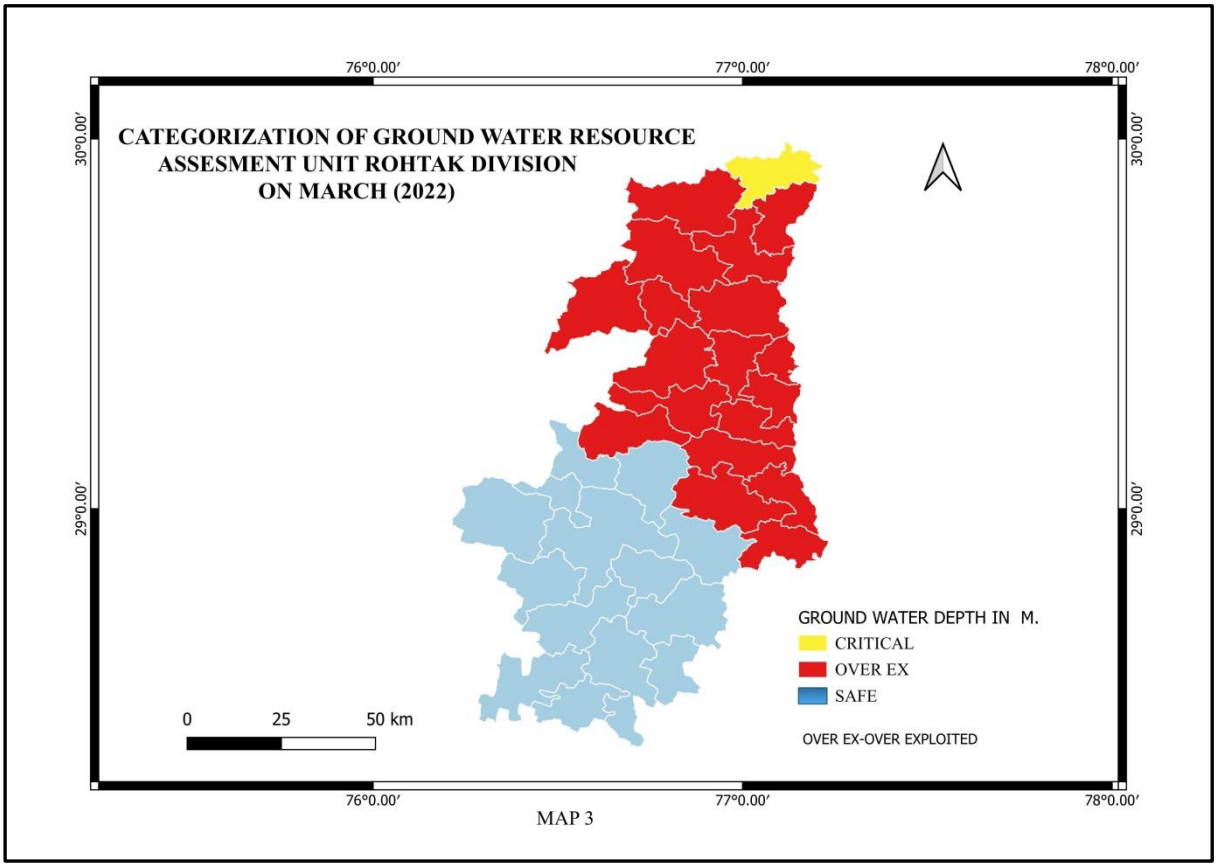
This fluctuation not only affects the daily life of the people but also affect the agricultural, domestic, industrial and commercial future of this particularly this area. More planning, policies and action plan from government side to be needed and also support of people are play a considerable role to improve the situation.

Table:3 CategorizationoftheBlocks/AssessmentUnits

Sr. no	Categorization	Haryana	% Blocks	Rohtak Division	% Blocks
1	No. of Over-Exploited Blocks	88	61.53	18	52.94
2	No. of Critical Blocks	10	6.99	01	2.94
3	No. of Semi-Critical Blocks	09	6.29	-	-

4	No. of Safe Blocks	36	25.17	15	44.11
	Total Blocks	143	100	34	100

Source: Report on DynamicGroundWaterResources of Haryana State, March2022



The analysis of the figures of the groundwater resources of study area indicates that there exists enough scope for development of existing resource in 15 blocks which are considered safe from ground water development point of view. 18 blocks have attained stage of development more than 100% and long-term water level trends during pre and post monsoon period in the block showing declining trend, they are categorized as over exploited (map-3).The analysis of present ground water resource assessment indicates that there is marginal increase in net availability of ground water resources as compared to previous assessment.Out of total 34 Blocks taken for study18 Blocks (52.94%) are over-exploited, 1 Block (2.94%) is critical and 15 Blocks (44.11%) are in safe category. Northern part of the study area such as District Karnal, Panipat, Sonipat are located in category of very critical situation. Southern part like District Rohtak and Jhajjar shows safe zone. The primary contributor to this over extraction is the cultivation of water-intensive crops, particularly paddy (rice) and wheat. The traditional agricultural practices in the region have led to unsustainable water usage, enhancing the depletion of groundwater reserves.

Conclusion:

The situation of groundwater table in Central-Eastern Haryana, which includes districts like Karnal, Panipat, Sonipat, Rohtak and Jhajjar is a matter of grave concern. Over the decades, these areas have experienced significant reliance on groundwater resources due to a combination of factors like irrigation

of water intensive crops, resulting in depletion of ground water. In the absence of a perennial river flowing through state, dependence on groundwater for farming has led to unsustainable extraction rates, which outpace natural recharge rates which depend majorly on rain water. Several blocks of Central and Eastern Haryana have been classified as over-exploited, with groundwater extraction rate exceeding than the replenishment capacity. Due to this water table is falling faster than its natural recharge capacity. Further ground water situation is worsened by changes in precipitation patterns, with erratic rainfall and longer dry spells. This issue is exacerbated by reduced recharge due to low rainfall and increased evaporation rates during hotter periods. The state government has started implementing measures such as promoting crop diversification, regulating water usage, and introducing water-efficient irrigation systems. Central-Eastern Haryana is facing a critical groundwater depletion problem that is threatening both agriculture and domestic water security. To address this challenge, a multi-pronged approach is required: stricter regulation of groundwater usage, investment in water conservation technologies, enhancing recharge mechanisms (like rainwater harvesting), and promoting sustainable farming practices.

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