
“GROUNDWATER-DEPTH SITUATION IN HISAR DISTRICT:

A SPATIO-TEMPORAL ANALYSIS: 2001-2010”

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Abstract

Water plays a major role in the ‘Uniqueness’ of Earth. Though groundwater constitutes less than 1.69 percent of the total water on Earth, it is vital in fulfilling human requirements. As Haryana doesn’t have perennial rivers, the dependence upon groundwater has increased here. Taking this factor into account, a study of groundwater situation in Hisar district of Haryana has been carried out. Hisar District is situated in the west-central part of Haryana covering an area of 4172.4 square kilometers having nine Community Blocks. For the present study the Historical water level data of Hydrographic Stations in Hisar has been collected from District Groundwater Cell, Hisar. The Pre-Monsoon and Post-Monsoon data for the year 2001 as well as 2010 has been analyzed. The study reveals that the depth of groundwater level is increasing with time which indicates overdependence upon groundwater and thus over-drafting of this scanty resource in this district. The water level has fallen in most parts of the district with Narnaund block witnessing the fastest rate of water table depletion. On the one side a good number of villages in Hansi-I and Hansi-II blocks are water-logged, while most of the villages in Hisar-II and Adampur Blocks have deepest water levels in the District. There is an urgent need to adopt measures like scientific irrigation methods, alternation in cropping pattern and rainwater harvesting in the district to improve the situation.

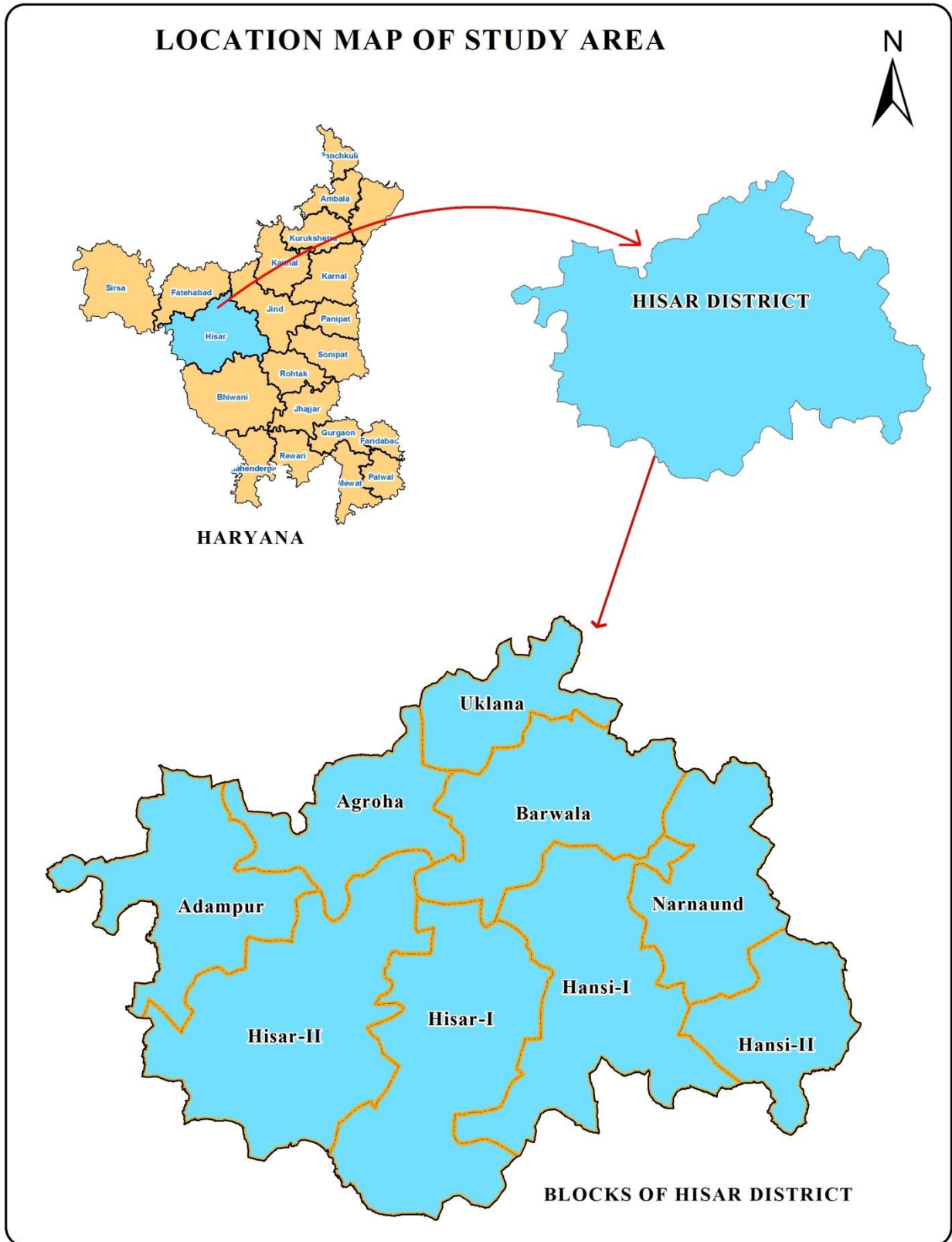
Key Words- *Groundwater, Pre-monsoon, Post-monsoon, Community Blocks, Water-table Depletion.*

Introduction

Hisar district, a part of the Indo-Gangetic alluvial plain is situated between $28^{\circ}53'45''$ and $29^{\circ}49'15''$ north latitudes and $75^{\circ}13'15''$ and $76^{\circ}18'15''$ east longitudes. It occupies an area of 4172.4 square kilometres and comprises nine development blocks (Map 1). It is bordered on the east by Rohtak district, on the west by Fatehabad district & Rajasthan state, on the south by Bhiwani district and on the north by Jind district. The average rainfall in the district is 276.2 mm. Hisar district comprises of three major physiographic units i.e. Aeolian plain, Older alluvial plain and Chautang flood plain. The surveyed terrain forms

regionally a water-divide between Ghaggar and old Drishdawati. (Drishdawati (Chautang) river tract is extinct and its vast filled channel course is occupied by the Hansi branch of the Western Yamuna canal. During the monsoons, many seasonal streams flood the adjoining portions of the lateral shifting Ghaggar flood-plain. The depth of the alluvium varies from 100 meters to more than 400 meters (Haryana district Gazetteer, Hisar). The soils of the districts are conventionally referred to as alluvial and aeolian soils and fall into three orders - viz. Entisols, Inceptisols and Aridisols. The scanty forest cover of the district falls under category of desert thorn.

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Map 1

Methodology

The methodology includes the preparation and reformatting of available water depth data pertaining to two time periods i.e. 2001 and 2010 received from District Groundwater Cell, Hisar with their GPS locations. Different multi temporal thematic maps of groundwater depth have been reformatted using interpolation technique done in GIS mode. A classification system has been developed to classify water depth data. Interpolation method has been used to classify water depth using Arc GIS Desktop 9.3 software. A document containing codification system for interpretation and interpolation explaining the detailed methodology and layers characteristics has been prepared and used in the study.

Image Interpretations

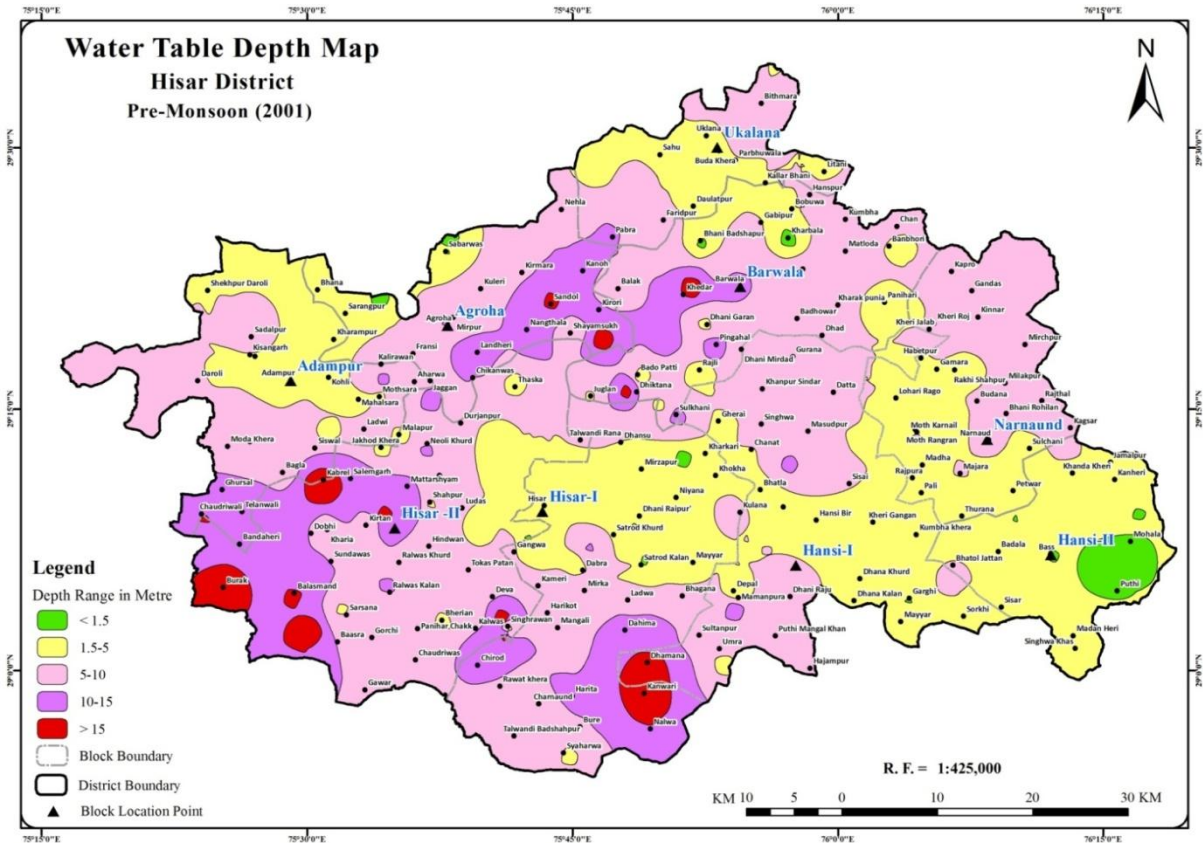
Based on the data characteristics such as minimum and maximum values of data Interpretation “keys” have been developed for ground water depth and quality mapping. A separate layer of the village

location along with their names and major roads has also prepared using Toposheet. These maps have been put in GIS format to create the database. The datum and projection system of the satellite data has been taken as WGS 84 and UTM respectively. Arc GIS Desktop 9.3 and Microsoft office 2007 have been used for generation of vector layer and geo referencing respectively.

Findings

During pre-monsoon season in 2001, the groundwater depth ranged from 0.13 metres (Puthi village) to 23.60 metres (Kabrel village). While 85.76 square kilometres area (2.06 percent) had the depth below 15 metres, 51.79 square kilometers area (1.24 percent) especially in Hansi-II block as shown clearly in Map 2 was prone to water logging. Maximum area i.e. 2041.64 square kilometres (48.93 percent) in the district had the groundwater between 5-10 metres of depth. Only 15.41 percent area in the Hisar had groundwater below the depth of 10 metres

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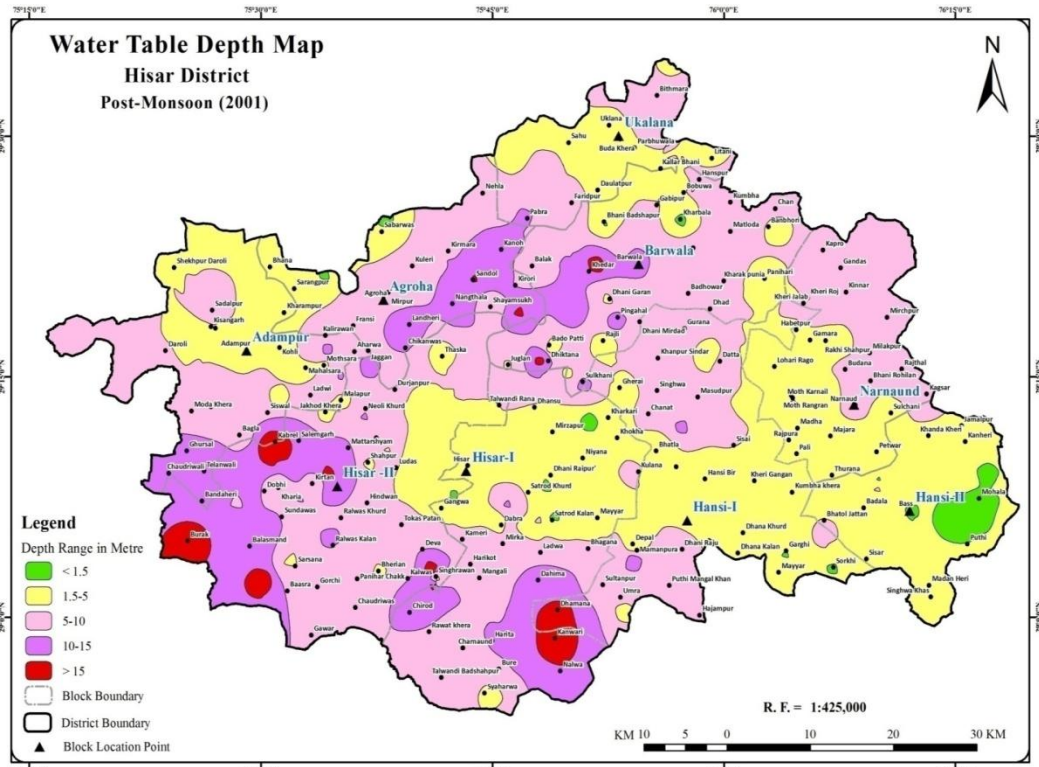


Map 2

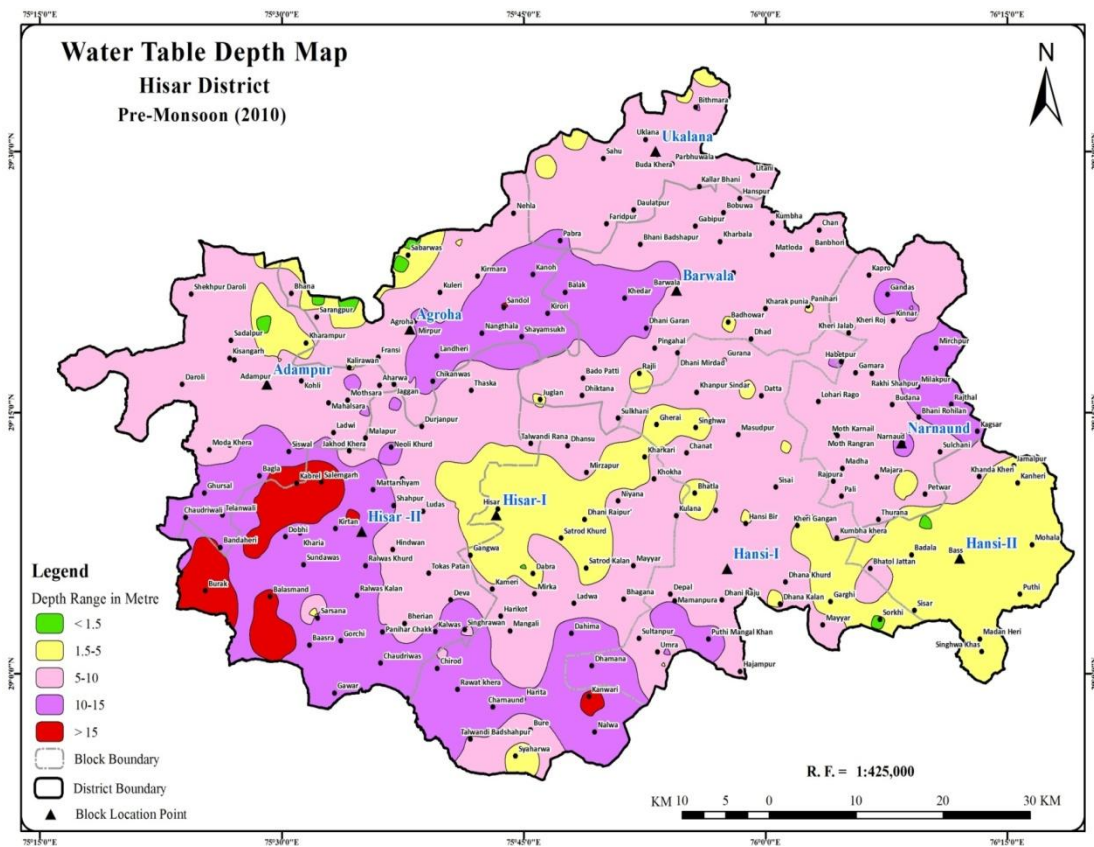
The post-monsoon data of 2001 (Map 3) reveals that the water level in the district ranged from 0.10 metres (Puthi village) to 24.05 metres (Kabrel village). The water level in the whole district has increased due to percolation of rain-water during the rainy season. The area between depths of 1.5-5 metres has gained the maximum

increase (34.43 percent to 37.32 percent). During pre-monsoon 85.76 square kilometres area was having depth below 15 metres which decreased to 70.95 square kilometers in post-monsoon. Maximum area (46.58 percent) in Hisar had depth between 5-10 metres.

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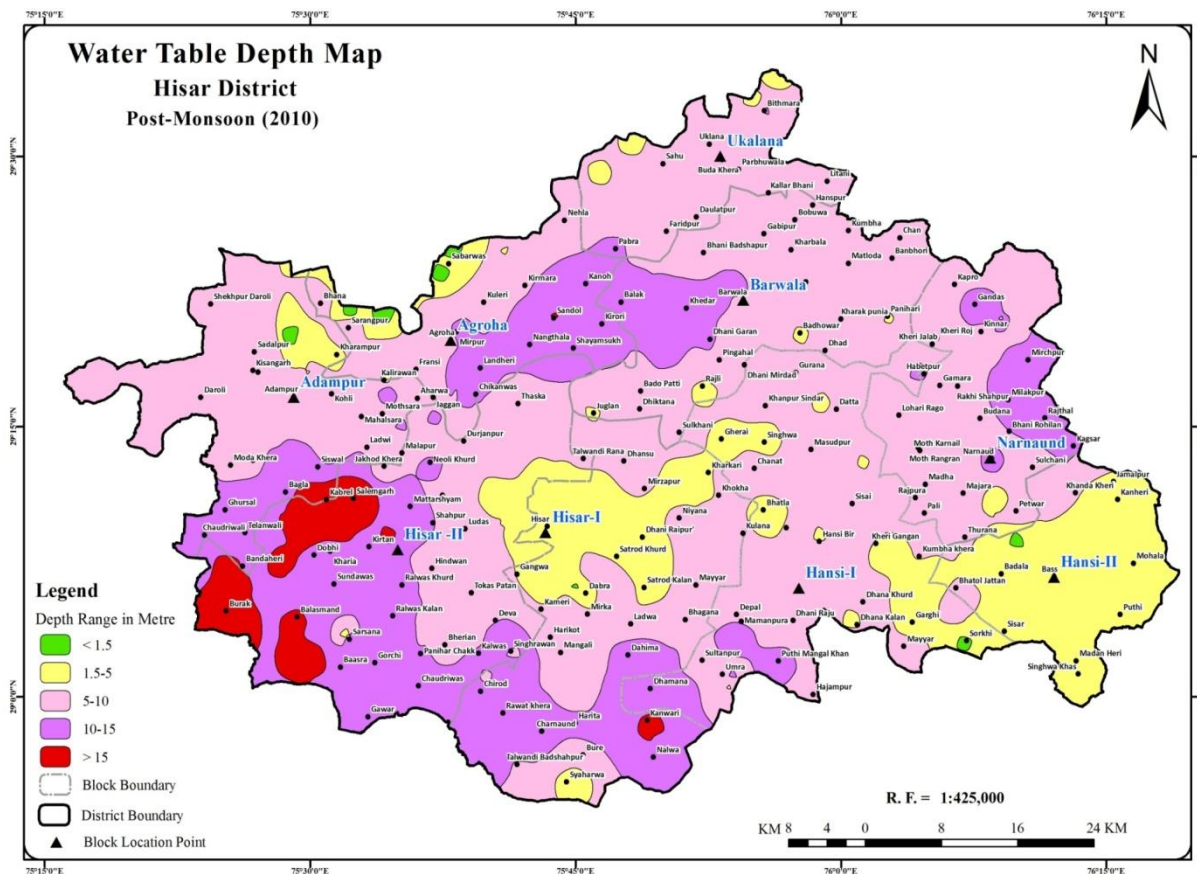
Map 3



Map 4

The area under 1.5 metres of groundwater depth has decreased in 2010 as compared to 2001 and most of the area has further increased under the category 5-10 metres of depth (60.22 percent). It is to be noted that the area below 15 metres of groundwater depth which hardly crossed 2 percent mark, has now increased to 3.13

percent. Whereas 35.67 percent area (1438.19 square kilometres) had above 5 metres of depth in 2001, now only below 13.68 percent (569.98 square kilometres) is having depth of water below it. The overall study reveals that the groundwater has fallen at a very fast speed in Hisar during this decade (Map 4).



Map 5

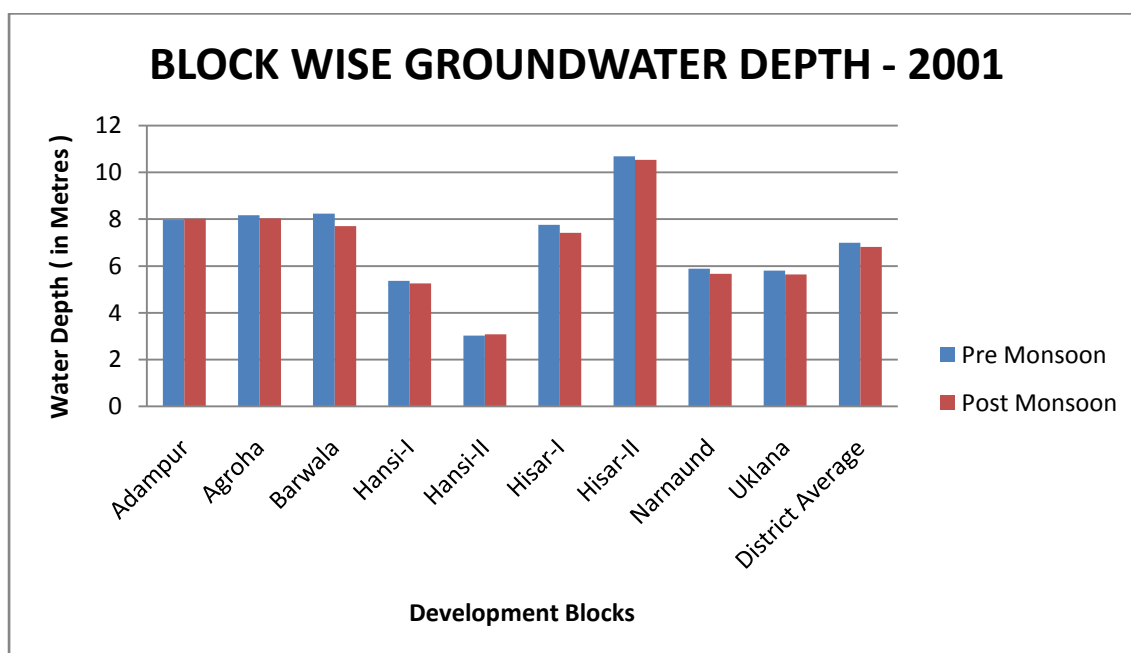
During post-monsoon season in 2010 also Badopal, Chinder, Dharnia, Kajalheri, Kharakheri and Kharkari villages witnessed water-logging due to water level reaching the ground level, Kabrel remained the deepest place with water level falling further to 26.26 metres (Map 5). Rain water percolation caused a slight increase in water level in all blocks generally past the

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monsoon season. Unlike a slump in water level in all other categories, slight rise is seen in the area under 1.5-5 metres of depth.

Temporal Analysis

In 2001, during Pre Monsoon, the average depth of the district was 6.99 metres. Hansi-I, Hansi-II, Narnaund and Uklana blocks had better situation than the district average while rest of the blocks had more depth of water than the district average, block Hisar-II had the maximum depth pointing towards excessive dependence upon groundwater for irrigation. Compared to Pre Monsoon in 2001, it has been observed that during the Post Monsoon season, Adampur and Hansi-II witnessed a fall of 0.63 percent and 0.99 percent respectively. The condition of other blocks was better as they witnessed slight rise in their water levels ranging from 1.4 percent increase (Hisar-II) to 4.38 percent increase (Hisar-I). It occurred due to percolation of rain water in the rainy season. Kabrel village witnessed the maximum depth of water form 23 metres in Pre-Monsoon to a further fall to 24.05 metres in Post-Monsoon. Burak, Basra and Nalwa villages also had depth in excess of 18 metres with levels altering from 18.22, 18.91 and 18.15 metres to 18.15, 18.21 and 18.37 metres respectively (Figure 1 and Table 1).



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Figure 1
Table 1: Block wise Groundwater Depth – 2001

Name of Block	Groundwater Depth		Absolute Change (in metres)	Proportional Change (in percentage)
	Pre Monsoon	Post Monsoon		
Adampur	7.97	8.02	.05	0.63
Agroha	8.17	8.03	-.14	-1.71
Barwala	8.24	7.7	-.54	-6.5
Hansi-I	5.36	5.25	-.11	-2
Hansi-II	3.03	3.08	.03	0.99
Hisar-I	7.76	7.42	-.34	-4.38
Hisar-II	10.69	10.54	-.15	-1.4
Narnaund	5.88	5.66	-.22	-3.74
Uklana	5.8	5.64	-.16	-2.76
District Average	6.99	6.81	-.18	-2.6

While the district average in Pre Monsoon was 8.19 metres in 2010, blocks Adampur, Agroha, Hisar-II and Narnaund had more depth of water level than district average. It is to be noted that while the depth of water in rest of the blocks was lesser than the district average, the difference is meager except in Hansi-II. Like 2001 block Hisar-II bears maximum depth of groundwater, adding further fall in depth by 6percent during the decade. In Post Monsoon, the level of blocks Hansi-I and Hansi-II has raised by 6.26percent and 28.3percent respectively compared to Pre Monsoon. It happened due to comparatively more rainfall in these blocks. In fact, many villages in these two blocks are witnessing the problem of water

logging. Narnaund and Uklana witnessed a fall in water level by .65percent and .67 percent respectively in 2010. It is due to the shifting of cotton fields to paddy in these two blocks. As in 2001, Kabrel village had the maximum depth in Hisar district during 2010 as well. Interestingly the water level slumped further to 26.14 and 26.26 metres in pre-monsoon and post-monsoon season respectively during 2010 compared to 23 metres and 24.05 metres in the corresponding seasons during 2001 here. Burak and Basra villages tend to be other two villages with maximum depth after Kabrel, but the level saw a rise of about 1 metre here compared to 2001 (Figure 2 and Table 2).

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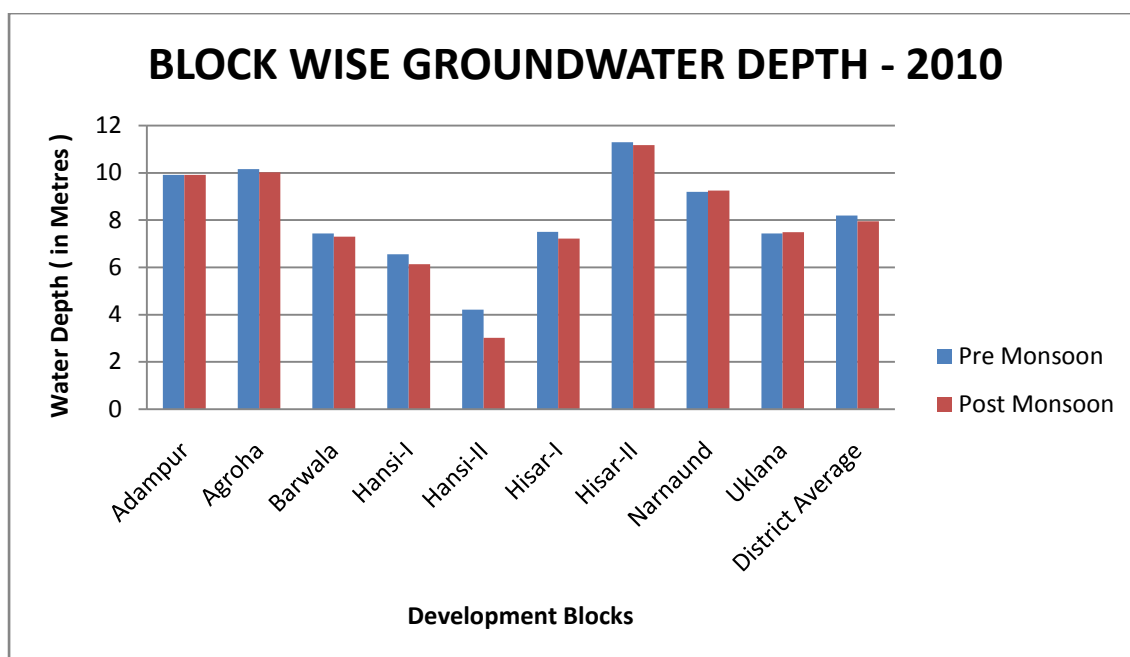


Figure 2

Table 2: Block wise Groundwater Depth – 2010

Name of Block	Groundwater Depth		Absolute Change (in metres)	Proportional Change (in percentage)
	Pre Monsoon	Post Monsoon		
Adampur	9.92	9.91	-.01	-.10
Agroha	10.16	10.02	-.14	-.01
Barwala	7.44	7.3	-.14	-1.9
Hansi-I	6.55	6.14	-.41	-6.26
Hansi-II	4.21	3.02	-1.19	-28.3
Hisar-I	7.51	7.22	-.29	-3.9
Hisar-II	11.29	11.18	-.11	-.98
Narnaund	9.19	9.25	.06	.65
Uklana	7.44	7.49	.05	.67
District Average	8.19	7.95	-.24	-2.9

The comparison of the pre-monsoon season of 2001 and 2010 reveals that except Barwala and Hisar-I blocks all other blocks have undergone a fall in water level ranging from 5.61 percent in Hisar-II to 56.3 percent in Narnaund block. This is a matter of great concern for Narnaund

block and clearly indicates towards a sudden over drafting of groundwater during this decade due to farmers shifting towards paddy farming. While Kabrel village remains the deepest place with 23 metres and 26.14 metres respectively during beginning and end of the decade,

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Burak saw some betterment from 18.15 metres to 17.5 metres. The situation in Barwala and Hisar-I has improved during the decade witnessing slight rise in water levels. It is to be noted that during the decade, average depth of groundwater in

Hisar district has fallen by 1.2 metres (17.2 percent). This is a negative sign for the coming times and poses serious threat of shortage of water in the near future. The situation is very critical in Narnaund block (Figure 3 and Table 3).

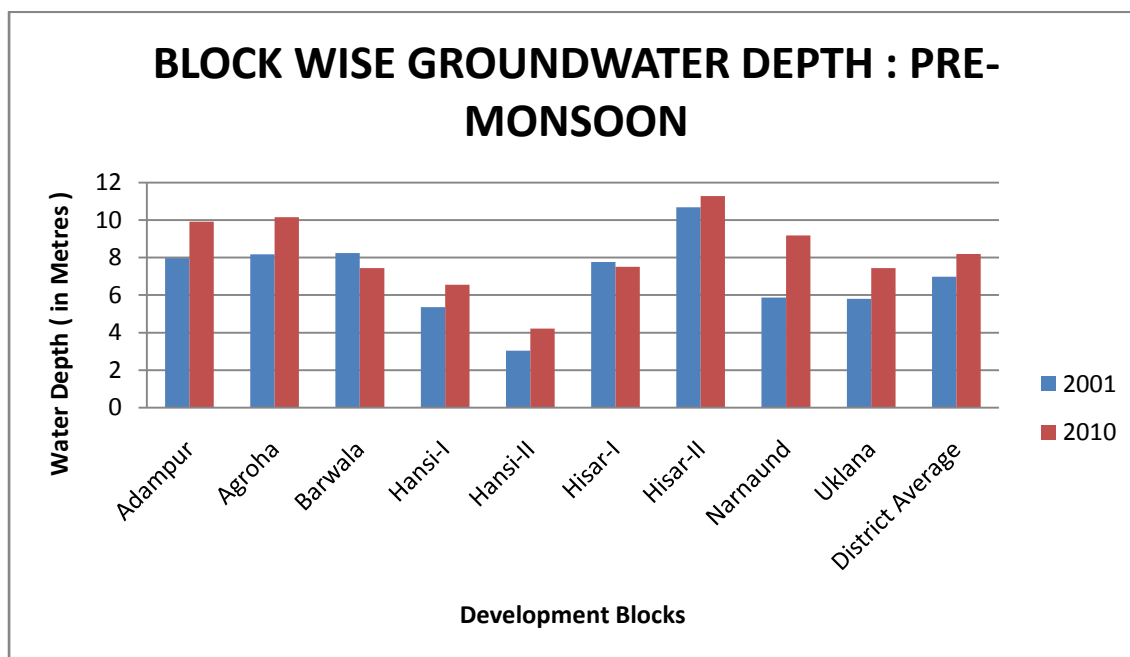


Figure 3

Table 3: Block wise Groundwater Depth: Pre-Monsoon

Name of Block	Groundwater Depth		Absolute Change (in metres)	Proportional Change (in percentage)
	2001	2010		
Adampur	7.97	9.92	1.95	24.5
Agroha	8.17	10.16	1.99	24.4
Barwala	8.24	7.44	-.8	-9.7
Hansi-I	5.36	6.55	1.19	22.2
Hansi-II	3.03	4.21	1.18	38.94
Hisar-I	7.76	7.51	-.25	-3.22
Hisar-II	10.69	11.29	.6	5.61
Narnaund	5.88	9.19	3.31	56.3
Uklana	5.8	7.44	1.64	28.27
District Average	6.99	8.19	1.2	17.2

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A study of Table 4 shows that the average depth of groundwater has fallen by 1.14 metres (16.74 percent) in the district during the decade. While Hansi-II block is facing the problem of water-logging, Narnaund has witnessed a fall of 63.42 percent in water level. Uklana has also undergone higher rate of fall in water level (32.8 percent). Interestingly the

comparison of post-monsoon seasons of 2001 and 2010 reveals that Barwala, Hansi-II and Hisar-I blocks have seen improvement in water level (Figure 4). In fact being closed drainage basin, some parts of these blocks are facing the problem of water logging due to seepage of canal irrigation water

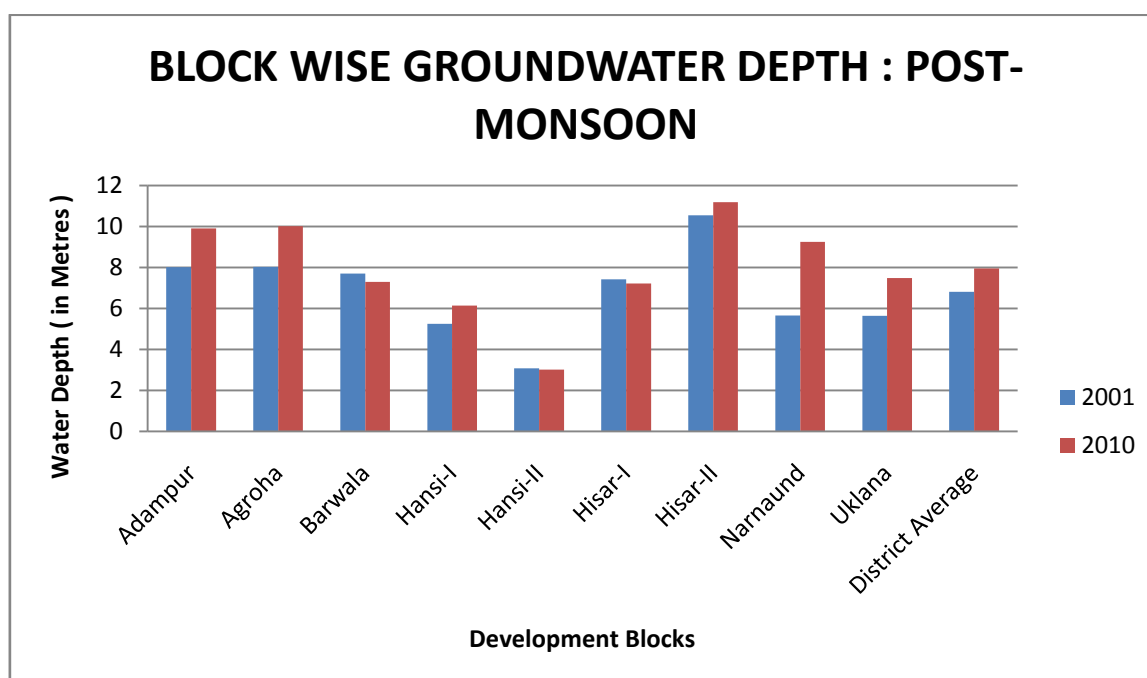


Figure 4

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Table 4: Block wise Groundwater Depth: Post Monsoon

Name of Block	Groundwater Depth		Absolute Change (in metres)	Proportional Change (in percentage)
	2001	2010		
Adampur	8.02	9.91	1.89	23.6
Agroha	8.03	10.02	1.99	24.8
Barwala	7.7	7.3	-0.4	-5.2
Hansi-I	5.25	6.14	.89	16.9
Hansi-II	3.08	3.02	-.06	-1.9
Hisar-I	7.42	7.22	-.02	-2.7
Hisar-II	10.54	11.18	0.64	6.07
Narnaund	5.66	9.25	3.59	63.42
Uklana	5.64	7.49	1.85	32.8
District Average	6.81	7.95	1.14	16.74

Conclusions

The present study reveals that the depth of groundwater level is increasing with time which indicates overdependence upon groundwater and thus over-drafting of this scanty resource in this district. The water level has fallen in most parts of the district with Narnaund block witnessing the fastest rate of water table depletion. On the one side a good number of villages in Hansi-I and Hansi-II blocks are water-logged, while most of the villages in Hisar-II and Adampur Blocks have deepest water levels in the District.

Remedial Measures

In the area where water table has rising trend, especially in Hansi-I, Hansi-II, and Hisar-I blocks it has reached to the critical depth after monsoon, vertical and horizontal drainage system should be

adopted to control its further adverse effects. In the area where water table has a declining trend artificial accelerated recharge method should be adopted to control the water table declining trend in future. Change of cropping pattern system should be adopted according to the potential of groundwater. Submersible pumps should be used in the installation of tubewells where ground water potential and Geo-hydrological conditions permit. Rainwater harvesting is the need of hour. Proper spacing (according to NABARD norms) between two pumping wells or shallow tube wells should be adopted in the water table decline area to check on water table declining trend. Groundwater act should be implemented in the state to prevent over exploration of groundwater by shallow tubewell in the district.

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