
**“GROUNDWATER-pH SITUATION IN HISAR DISTRICT:
A SPATIO-TEMPORAL ANALYSIS: 2005-2010”**

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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. But the quality of groundwater available everywhere is not as good to be considered as potable. The quality of water is measured on a number of parameters. The “pH range” is one of the most vital factors to determine the quality of water. Taking pH range 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 Development Blocks. The pre-Monsoon and post-Monsoon water quality data for the years 2005 and 2010 has been analyzed. In 2005 the pH value was slightly less than that of normal range (6.5-8.5) across the development blocks with the district average 5.63 (pre-Monsoon) and 5.78 (post-Monsoon). Surprisingly the pH value increases very sharp with the district average 8.08 (pre-Monsoon) 7.94 (post-Monsoon) though within normal range.

Key Words- Groundwater, pH range, Parameters, pre-Monsoon, post-Monsoon

Introduction

‘We must use groundwater like a bank. Live off the interest-what is recharged-and not the capital’

- A DOWN TO EARTH ANNUAL State of India's environment 2014 pp13.

Water is an essential element of the planet. There is no life without water. It is required for domestic, agricultural and industrial uses. It is found on the earth in two forms i.e. Surface Water and Groundwater. In India, a large part of drinking water supply

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is fulfilled by groundwater and thereby increasing its vital importance. In a significant part of the country, groundwater is the only source of drinking water. This is why; a large population is exposed to risk of consuming contaminated water. There are spatial and temporal variations in the quality of groundwater and its quality is the reflection of wide variety of chemical and biological constituents present in it. These constituents include turbidity, pH, hardness, iron, chloride, residual chlorine, total dissolved solids, calcium, magnesium, radioactivity, sodium, potassium, phosphate, pesticides, etc.

In recent years, the increasing threat to groundwater quality due to human activities has become a matter of grave concern. Most of the groundwater quality problems are caused by contamination and by over-exploitation. The rapid pace of agricultural development, industrialization and urbanization has resulted in the over-exploitation and contamination of groundwater resource in parts of the country, resulting in various adverse environmental impacts and threatening its long term sustainability.

Generally, groundwater in the country is potable and suitable for various usages.

However, localized occurrence of groundwater having chemical constituents in excess of the limits prescribed for drinking water use has been observed in almost all the states. The commonly observed contaminants such as Arsenic, Fluoride and Iron are geo-genic whereas contaminants such as nitrates, phosphates, heavy metal, etc. owe their origin to various human activities including domestic sewerage, agricultural practices and industrial effluents.

The pH value of water is a measure of its reactive characteristics as it is caused due to dissociation of water molecules and of acids and bases dissolved in water. A low value of pH, particularly below 4, indicates the corrosive nature of water. Thus, it is a measurement of acidity or alkalinity of water. Water with a pH value below 7.0 is considered as acidic and above 7.0 as basic. Water above pH value 8.5 is generally not considered as good for drinking. Failure to control pH can result in both microbial and chemical contamination of drinking water, and in adverse effects on its taste, odour and appearance. World Health Organization (WHO) recommends water having pH range between 6.5 and 8.5 as safe for drinking purpose.

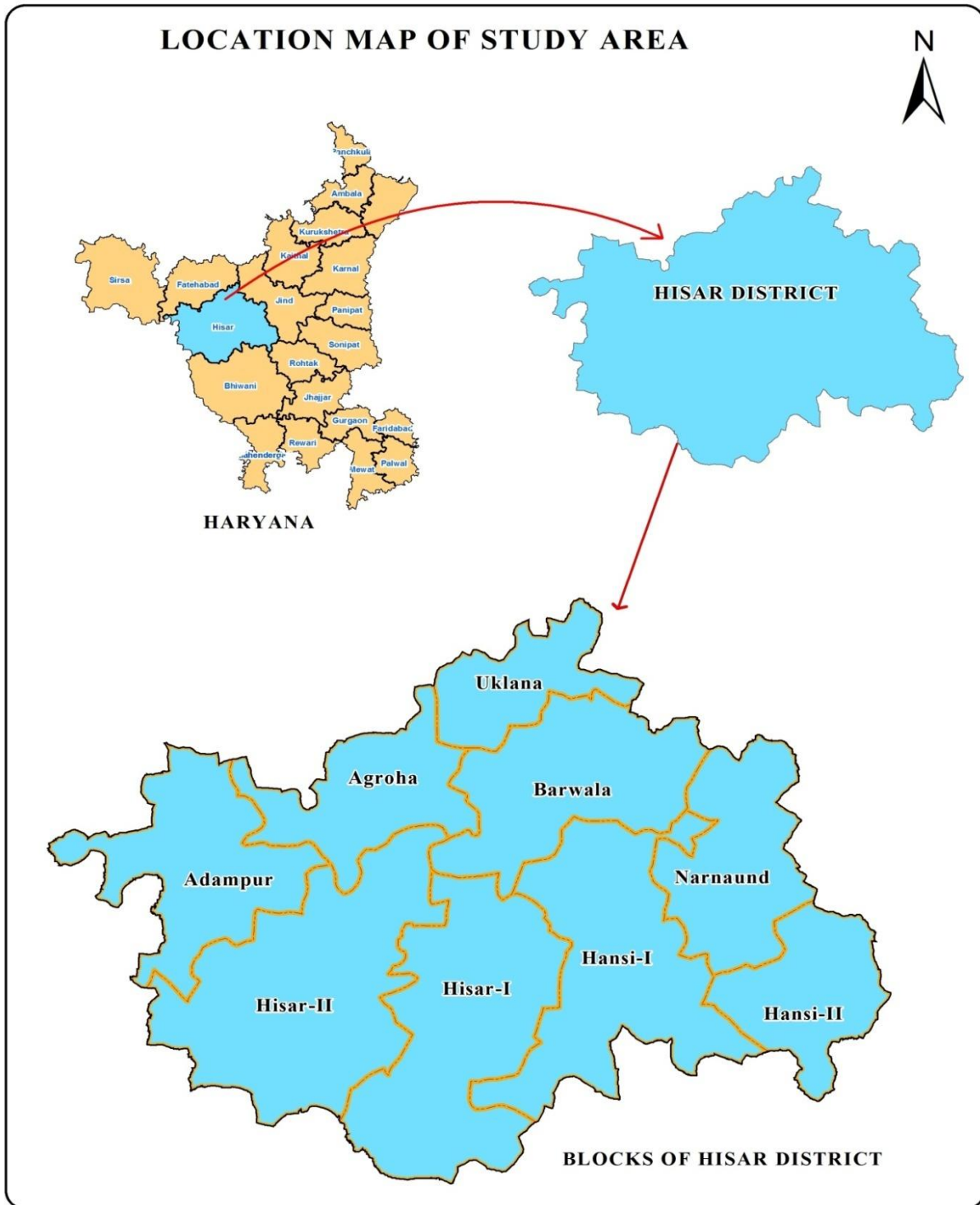
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In the present study, pH value has been taken into account to carry out the temporal changes in the groundwater quality of Hisar district of Haryana state between 2005 and 2010.

Study Area

Hisar district, a part of the Indo-Gangetic alluvial plain is situated between 28°53'45" and 29°49'15" north latitudes and 75°13'15" and 76°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.



Map 1

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Objectives

The objectives of the study are given as under:

- a) To carry out the pH value of groundwater in the study area for 2005 and 2010 and to underline the temporal changes thereof.
- b) To carry out the trend of change in the groundwater quality in the study area during the pre-monsoon and post-monsoon season.
- c) To highlight the impact of change in groundwater quality on the human life.

Data Base and Methodology

The methodology includes the preparation and reformatting of available water quality data pertaining to two time periods i.e. 2005 and 2010 collected from District Groundwater Cell, Hisar with their GPS locations. Different multi temporal thematic maps of groundwater quality have been reformatted using interpolation technique done in GIS mode. A classification system has been developed to classify water quality data. Interpolation method has been used to classify water quality 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 groundwater 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

Groundwater Quality in 2005

The total geographical area of the district has been classified into five categories on the basis of pH value of groundwater. The area with pH value 7-8 has been considered as area of safe water whereas the area with pH value between 6.5-7 and 8-8.5 is

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characterized with marginally safe water.
The extreme classes i.e. < 6.5 and >8.5 show

that the water quality is not safe for drinking
purposes.

Map 1: pH- Pre-Monsoon (2005)

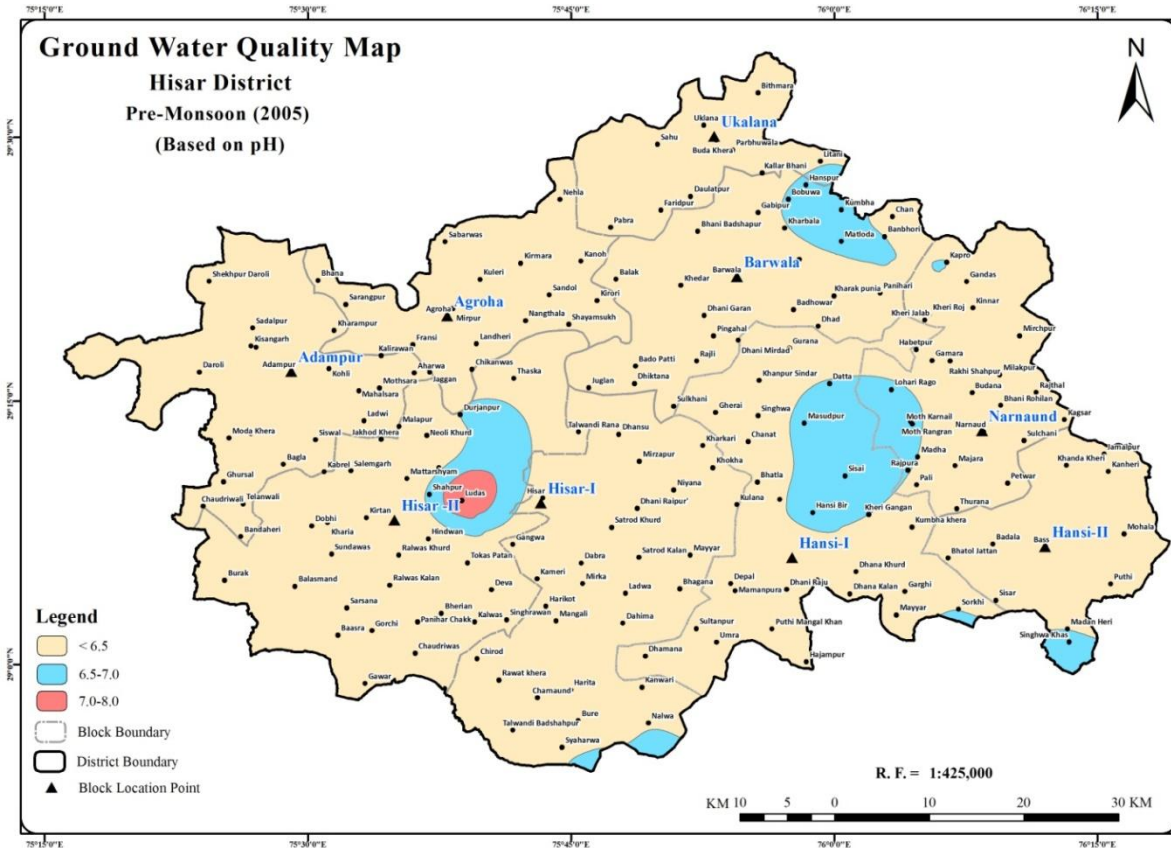


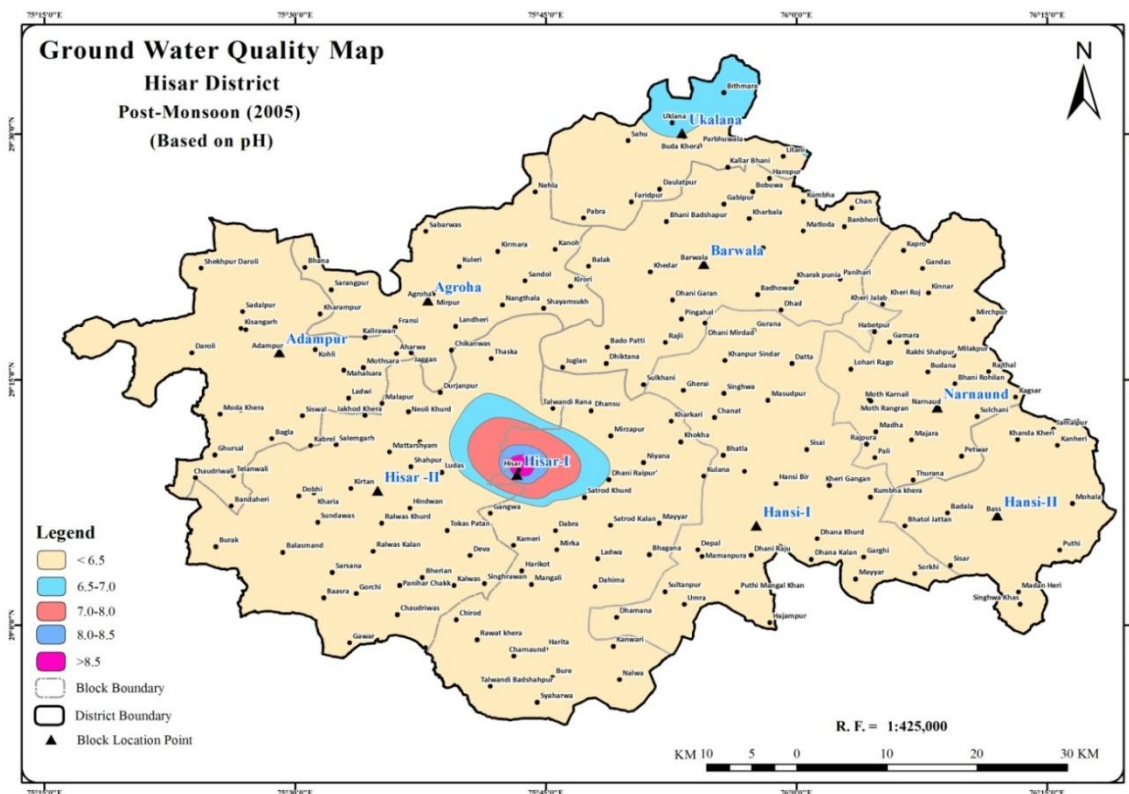
Table 1 : pH Area- Pre-Monsoon (2005)

pH	Area (Sq. km.)	Percentage to Total Geographical area of District
< 6.5	4026.42	96.50
6.5-7	125.63	3.01
7-8	20.35	0.49
8-8.5	0.00	0.00
>8.5	0.00	0.00
Total	4172.4	100.00

Table 1 shows that during pre-monsoon 2005, while 96.5 percent area of Hisar is having Acidic water with pH value <6.5 which could not be considered as safe for drinking purposes. Not a single place was found with basic/alkaline water. Only 3.5 percent area of the District has within the permissible limit of 6.5 to 8 as prescribed by the Bureau of Indian Standard and World

Health Organization. Out of it, marginally safe water (6.5-7) is available in 3.01 percent of the area and just 0.49 percent area has perfectly safe water (7-8). The pH value of groundwater of the study area is ranging between 4 (Daya village) to 7.6 (Ludas village) where the quality of groundwater was found extremely critical (Table 1 and Map 1).

Map 2: pH- Post-Monsoon (2005)



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Table 2: pH Area- Post-Monsoon (2005)

pH	Area (Sq. km.)	Percentage to Total Geographical area of District
< 6.5	3983.57	95.47
6.5-7	115.53	2.77
7-8	55.85	1.34
8-8.5	12.58	0.30
>8.5	4.87	0.12
Total	4172.4	100.00

A higher range of groundwater quality was observed during post-Monsoon (2005) period as the lowest pH value was noticed 4.4 in Dhansu and Sekhpura villages whereas it was found highest 8.9 in Hisar city. Though there was no significant change in the groundwater situation in the post-monsoon period as compared to the pre-monsoon period as the acidic water area decreased by just 1.03 percent (from 96.50 percent to 95.47 percent) and safe water

category (6.5 to 8.5) area increased just by 0.91 percent. Out of which, 2.77 percent area was marginally safe and that of 1.34 was perfectly safe. Interestingly after rainy season, basic water (above 8.5) was observed in 0.12 percent area spread over Hisar city and Chaudhriwas village. As a whole the condition of groundwater quality remained critical in the post-monsoon season as well (Table 2 and Map 2).

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Map 3: pH- Pre-Monsoon (2010)

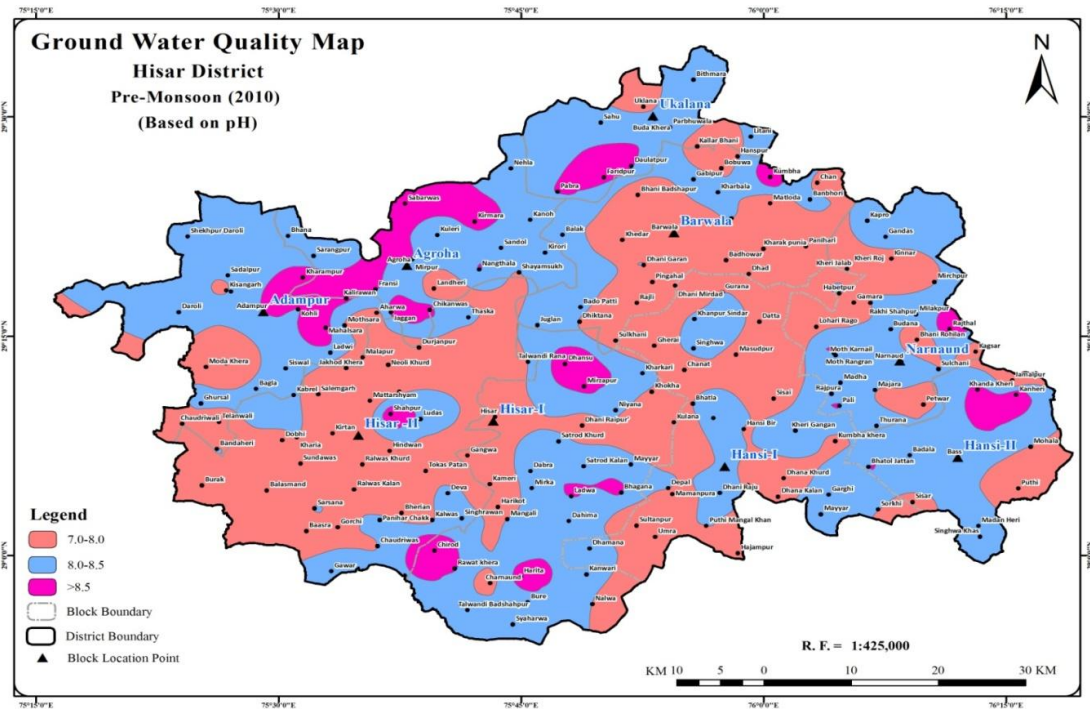


Table 3: pH Area- Pre-Monsoon (2010)

pH	Area (Sq. km.)	Percentage to Total Geographical area of District
< 6.5	0.00	0.00
6.5-7	0.00	0.00
7-8	1814.34	43.48
8-8.5	2061.64	49.41
>8.5	296.42	7.10
Total	4172.40	100.00

During pre-monsoon season in 2010, the pH value of groundwater ranged from 7.2 (Kaimri, Kulana and Rawalwas Khurd villages) to 8.9 (Chirod village). Interestingly while during pre-monsoon in 2005, 96.5 percent area of Hisar District had

acidic water (pH below 6.5), not a single place in Hisar district has this water after a span of just 5 years. It is heartening to note that as per BIS recommendation 92.9 percent area of Hisar has safe water. But, we should not forget that the basic water has

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increased from none to 7.10 percent during these 5 years (Table 3 and Map 3). It indicates that the chemical composition of

groundwater has changed abruptly in Hisar and demands immediate investigation and thereafter remedial actions

Map 4: pH- Post-Monsoon (2010)

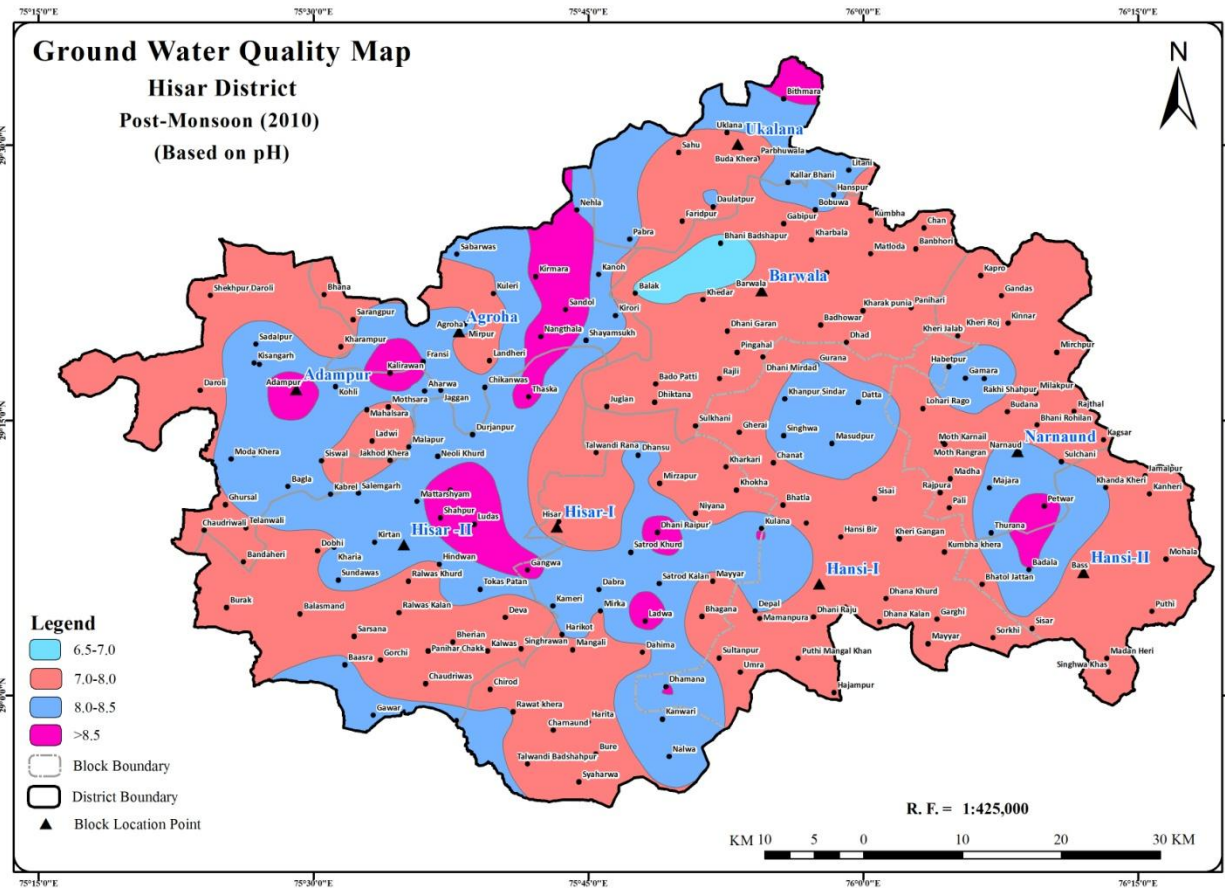


Table 4: pH Area- Post-Monsoon (2010)

pH	Area (Sq. km.)	Percentage to Total Geographical area of District
< 6.5	0.00	0.00
6.5-7	53.24	1.28
7-8	2494.33	59.78
8-8.5	1377.43	33.01
>8.5	247.4	5.93
Total	4172.4	100.00

Post-monsoon pH of Hisar during post-monsoon 2010 ranged from 6.8 (Bhani Badshapur) to 8.9 (Kalirawan). After rainy season due to recharging of groundwater, the pH has decreased on a whole in the district. While 59.78 percent area has completely safe pH water (7-8), 34.29 area

has marginally safe one (6.5-7 and 8-8.5 combined) (Table 4 and Map 4). The future of this parameter is very critical in Hisar because most of the villages are either near the figure of 8 or beyond it. Basic/alkaline water decreased from 7.10 (pre-monsoon) to 5.93 (post-monsoon).

Block Level Analysis

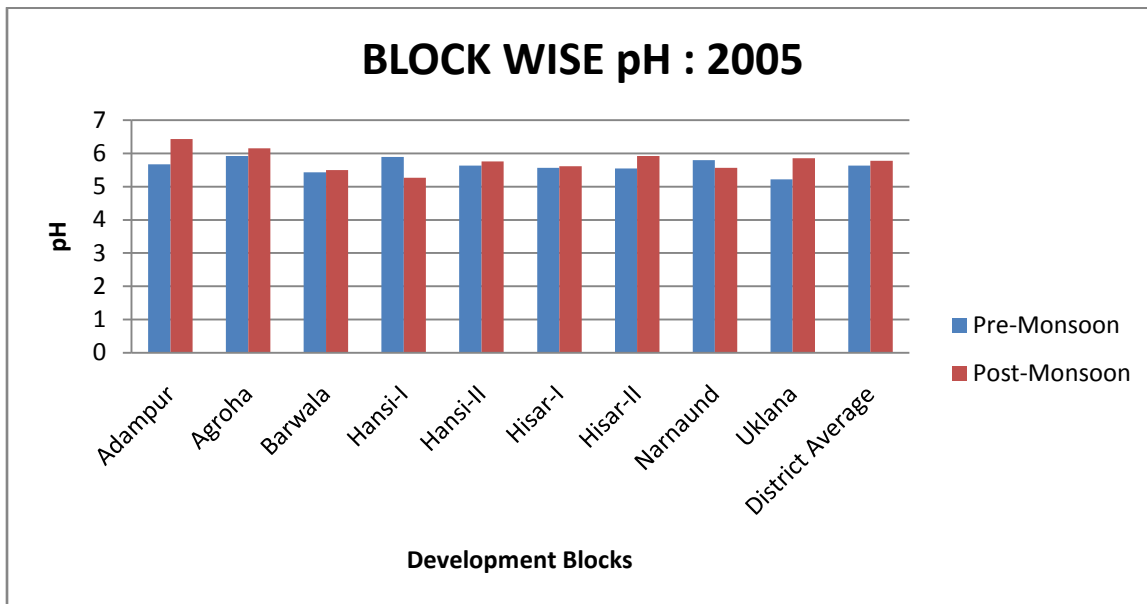


Figure 1

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Table 5: Block wise pH – 2005

Name of Block	pH		Absolute Change	Proportional Change (in percentage)
	Pre-Monsoon	Post-Monsoon		
Adampur	5.67	6.43	0.76	13.4
Agroha	5.92	6.15	0.23	3.88
Barwala	5.43	5.5	0.07	1.29
Hansi-I	5.89	5.27	0-.62	-10.52
Hansi-II	5.63	5.76	0.13	2.3
Hisar-I	5.57	5.61	0.04	0.72
Hisar-II	5.55	5.92	0.37	6.66
Narnaund	5.8	5.57	-0.23	-3.96
Uklana	5.22	5.85	0.63	12.07
District Average	5.63	5.78	0.15	2.66

Table 5 and Figure 1 show that during 2005, the pH value of groundwater in all the blocks was below the permissible limit (6.5 to 8.5) prescribed by the BIS. The average pH of all blocks is below 6.43 (during both the seasons) which clearly indicate the

dominance of acidic water. While in pre-monsoon season there was not a single village with pH above 7, during post-monsoon also only two places i.e. Chaudhriwas (8.8) and Hisar city (8.9) witnessed pH value above 7.

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Figure: Block wise pH – 2010

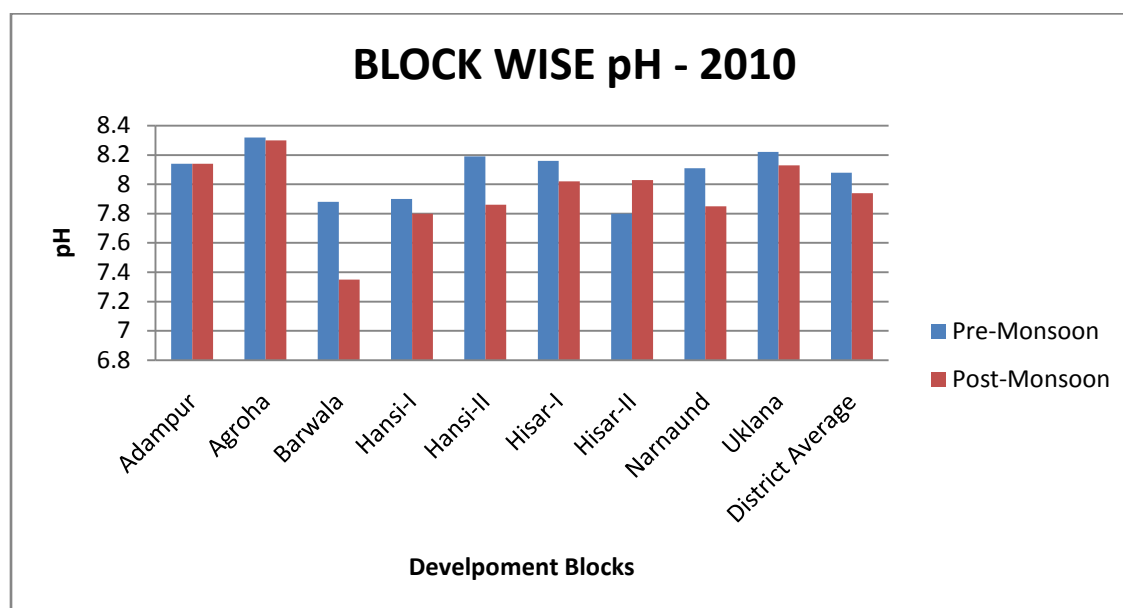


Figure 2

Table 6: Block wise pH – 2010

Name of Block	pH		Absolute Change	Proportional Change (in percentage)
	Pre-Monsoon	Post-Monsoon		
Adampur	8.14	8.14	No Change	No Change
Agroha	8.32	8.30	-0.02	-0.24
Barwala	7.88	7.35	-0.53	-6.72
Hansi-I	7.90	7.80	-0.10	-1.26
Hansi-II	8.19	7.86	-0.33	-4.03
Hisar-I	8.16	8.02	-0.14	-1.71
Hisar-II	7.80	8.03	0.23	2.95
Narnaund	8.11	7.85	-0.26	-3.20
Uklana	8.22	8.13	-0.09	-1.09
District Average	8.08	7.94	-0.14	-1.73

In 2005, only three villages in Hisar had recorded pH value above 8.5 (which is the upper limit for safe drinking water). But within 5 years as average pH value of all

blocks has seen an upper inclination and numerous villages have the pH value above 8.5 in 2010 (Figure 2 and Table 6). Chirod and Kalirawan villages had the highest pH

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value of 8.9. After rainy season the situation improved in all blocks except in Hisar-II. Remedial actions must be taken from letting

water becoming basic/ alkaline in nature. It also indicates that the groundwater in near future will become importable

Figure: Block wise pH – Pre-Monsoon

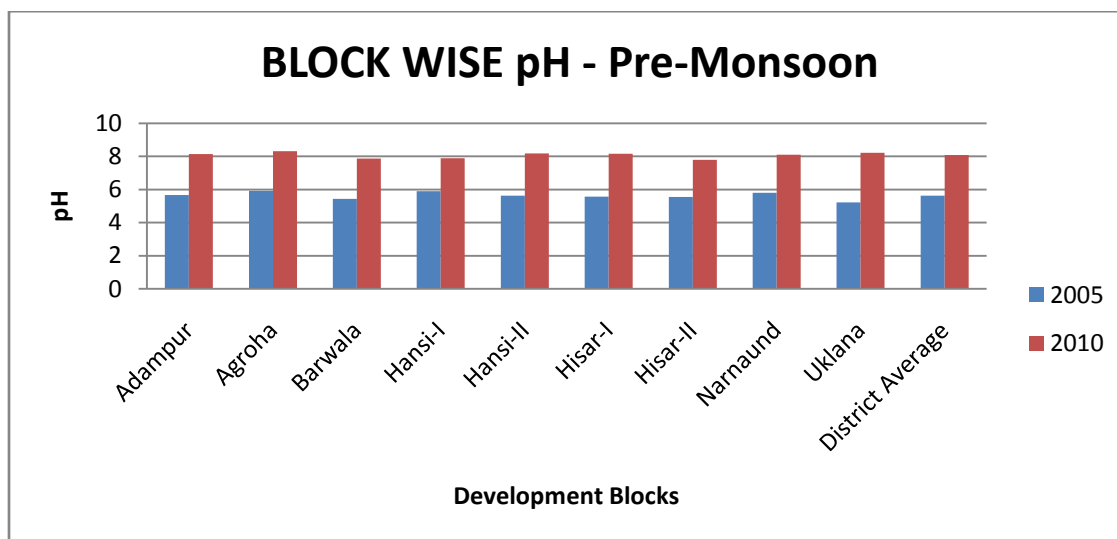


Figure 3

Table 7: Block wise pH – Pre-Monsoon

Name of Block	pH		Absolute Change	Proportional Change (in percentage)
	2005	2010		
Adampur	5.67	8.14	2.47	43.56
Agroha	5.92	8.32	2.4	40.54
Barwala	5.43	7.88	2.45	45.19
Hansi-I	5.89	7.9	2.01	34.12
Hansi-II	5.63	8.19	2.56	45.47
Hisar-I	5.57	8.16	2.59	46.5
Hisar-II	5.55	7.8	2.25	40.54
Narnaund	5.8	8.11	2.31	39.82
Uklana	5.22	8.22	3	57.5
District Average	5.63	8.08	2.45	43.5

The pH value has undergone a drastic change just within a span of five years in

Hisar and is about to cross the dangerous limit of 8.5 in all blocks (Figure 3 and Table

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7). On the upper surface, the average pH seems to be normal but it is a matter of great concern whereas in 2005 a handful of villages had pH above 8.5, it has become a normal figure in a large number of villages in the district in 2010. A water pH above 7.5

is usually associated with high bicarbonates. It ties up some nutrients and makes them unavailable to plants, and it is a leading cause of surface crusting. Here an application of safe acids is recommended

Figure: Block wise pH – Post-Monsoon

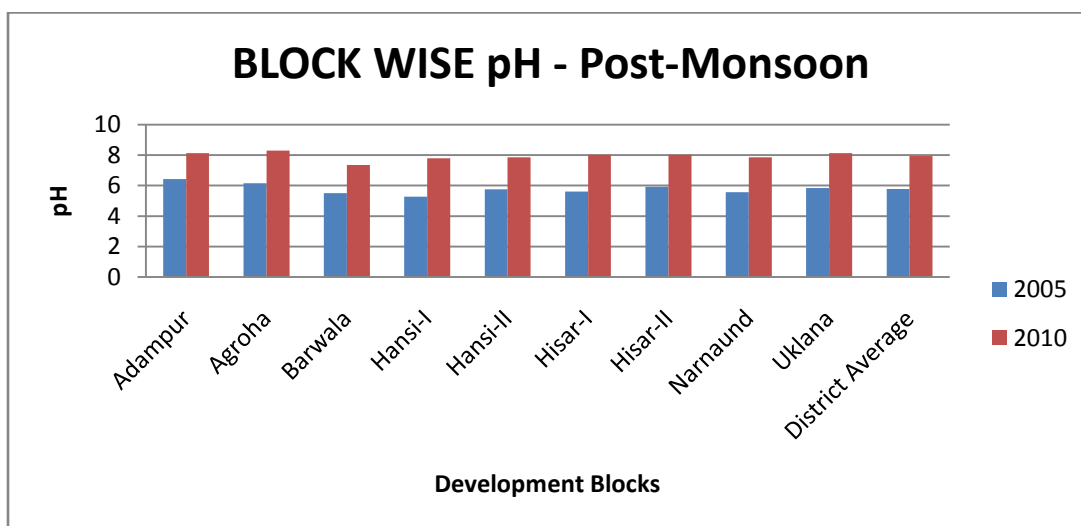


Figure 4

Table 8: Block wise pH – Post-Monsoon

Name of Block	pH		Absolute Change	Proportional Change (in percentage)
	2005	2010		
Adampur	6.43	8.14	1.71	26.6
Agroha	6.15	8.3	2.15	35
Barwala	5.5	7.35	1.85	33.64
Hansi-I	5.27	7.8	2.53	48
Hansi-II	5.76	7.86	2.1	36.46
Hisar-I	5.61	8.02	2.41	43
Hisar-II	5.92	8.03	2.11	35.64
Narnaund	5.57	7.85	2.28	41
Uklana	5.85	8.13	2.28	39
District Average	5.78	7.94	2.16	37.4

Though in post-monsoon, the pH value has seen an increase of 37.4 percent (2.16), it is less than that of the pre-monsoon (43.5 percent). It is due to percolation of fresh water from rainfall (Figure 4 and Table 8). This upward pH value change varies from 26.6 percent (Adampur) to 48 percent (Hansi-I). If proper measures are taken then it is still time to control the groundwater pH as most of the villages have the figure below 8.5.

Conclusions and Suggestions

A significant shift in the pH value of groundwater has been observed in the study area during the two points of time. During pre-monsoon 2005, 96.5 percent area had acidic groundwater (pH below 7). Surprisingly after just five years it became zero in 2010. Likewise, safe drinking water (pH between 6.5-8.5 as per B.I.S. and W.H.O.) area increased from just 3.5 percent in 2005 to 92.9 percent in 2010. On the other hand, during 2005 basic water was not found in Hisar but it became prevalent in 7.10 percent area of the District. The post-monsoon season witnessed insignificant changes from the pre-monsoon season during both the periods under study. It is

clearly observed that the groundwater of Hisar has undergone a sea of change from near-acidic to basic in a very short span of five years. It is the need of hour that the anthropogenic activities like sewage contamination and addition of chemicals through agricultural activities should be monitored; otherwise the groundwater above pH of 8.5 would become unsafe for human consumption in Hisar.

References

1. Bureau of Indian standards IS: 10500-2012 *Drinking Water Specification* (Second Revision).
2. Central Ground Water Board (2007) *Ground Water Information Booklet-2007*. Ministry of Water Resources Government of India, North Western Region, Chandigarh, 2007.
3. CWC (2011) *Water Resources at a Glance*, New Delhi, 2011. (www.cwc.nic.in)
4. Govt. of India (1987) *Gazetteer of India, Haryana, Hisar*. Haryana Gazetteers Organization, Revenue Department, Chandigarh, India, 1987.
5. Govt. of Haryana, Kamal (1973) *Ground Water Pollution in Haryana*

“GROUNDWATER-pH SITUATION IN HISAR DISTRICT:
A SPATIO-TEMPORAL ANALYSIS: 2005-2010”

- (First Approximation)*. Technical report No. 115, Directorate of Ground Water, 1973.
6. Ground Water Cell, Haryana Agriculture Department, Hisar.
 7. Ground Water Cell, Haryana Agriculture Department, Panchkula (2011) *Report on Geohydrological Conditions and Scope of Ground Water development in District Hisar*.
 8. Khandelwal K. (2010) *Haryana Encyclopedia-2: Bhoogol Khand Part-2*. Vaani Prakashan Dariyaganj, New Delhi, 2010.
 9. U.S. Department of the Interior, U.S. Geological Survey (2013) *USGS Water Resources :Appraising the nations Ground-water Resources* (pubs.usgs.gov/gip/gw/quality.html)
 10. WHO (2012) *Rapid Assessment of Drinking-water Quality; A Handbook for Implementation*. Geneva, World Health Organization.