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EVALUATING GROUND WATER FLUCTUATION IN DISTRICT HISAR, HARYANA: A TEMPORAL ANALYSIS (1974-2018)

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ABSTRACT:

There has been significant fluctuation in Ground Water in Haryana. It is because of seasonal rainfall, recharges agronomic practices during the every year. The present study examines the fluctuation of groundwater of Hisar district of Haryana. On the basis of secondary data, collected from groundwater cell, provide a true picture of the groundwater; which is recharged after the rainfall. The findings of the study show that there has been significant fluctuation of ground water, during the period 1974-2018. The study also establishes the cause-effect relationship of ground water fluctuation during different successive periods. The study also touches various problematic areas which directly or indirectly affect the seasonal fluctuation of water table during different successive periods. It also shows a minor and major fluctuation of water table which has given rise to considerable regional disparity in the different parts of the state, undertaken for the study.

INTRODUCTION:

Ground water fluctuation is a natural phenomenon. It is the consequences of seasonal fluctuation of rainfall and human activities; occur in a year. However, Bagher and Rasoul (2010) rightly said, "Water level fluctuation can result from a wide variety of hydrological phenomenon, some induced by man". An effective water management, demand adequate information on the

magnitude of volume varied with time. The amount of ground water which is collected; acquired by periodic examining the depth of water level with some of reference point to keep the track of these measures during different successive periods; rising of water level in the well means to increasing the storing capacity and it is vice-versa. Chaudhry (2003) discusses the significance of ground water data on depth in the whole planning and development and focus on an integral component for resource planning. The water table decline in the long-term and shows that the inflows are make equilibrium with outflows. However, it is not often the case, eg. whereas the water in confined a aquifers which is released by the force of compression , the level of water may not be declined at least; initial stage, in condition of over drafting. In the numerous of cases, as a result, it tend to decline and create the local or regional cones of depression and responded by the lagged nature of aquifer to tend to pump or changes the inflow, but not the actual abstraction. Despite the case needed in discussing the alteration of water-level; and well make available the best, observable information on conditions of changing ground water (Aggarwal, M.C 1996).

Ground water one of significant component of the global fresh water resource which is primary source of drinking water, irrigation, and industrial development where the water is needed in various parts of the world (Singh and Sharma, 2010). Globally, ground water provides about 50 per cent of current potable water supplies, 40 per cent demand of industrial water and 20 per cent of water, make use for agriculture irrigation (Villhoth, 2006). It is a renewal resource and has the significantly differentiated and being a highly dependable and safe and sustainable source of water supply (Singh and Singh, 2002).

Ground water constitutes the most important source of irrigation and plays a vital role in ensuring the livelihood security, across the world; particularly in the agronomy economies (Mukherji and Shah, 2005). India, Pakistan, Bangladesh and China account bulk of ground water use for agriculture purposes (Kaur et al; 2011). According to Shah et al. (2003), there are 55-60 per cent of the Indian population, depend directly or indirectly, on ground water for their some of livelihood. The importance of ground water resource in India, can be realized from fact that nearly 2/5 of the agriculture depend upon irrigation from the ground water resources (CWC, 2013) and about 60 per cent of the irrigated food production depends on irrigation from the ground water (Central Water Commission, 2013). Hence, it is obvious that there has been significant fluctuation in ground water level, during different successive periods.

OBJECTIVES OF THE STUDY:

1. To examine the fluctuating trend of Ground Water during period, since 1974-2018.

2. To establish the cause-effect relationship between the factors and ground water level fluctuation.

3. To analysis the factors affecting the fluctuation of ground water level.

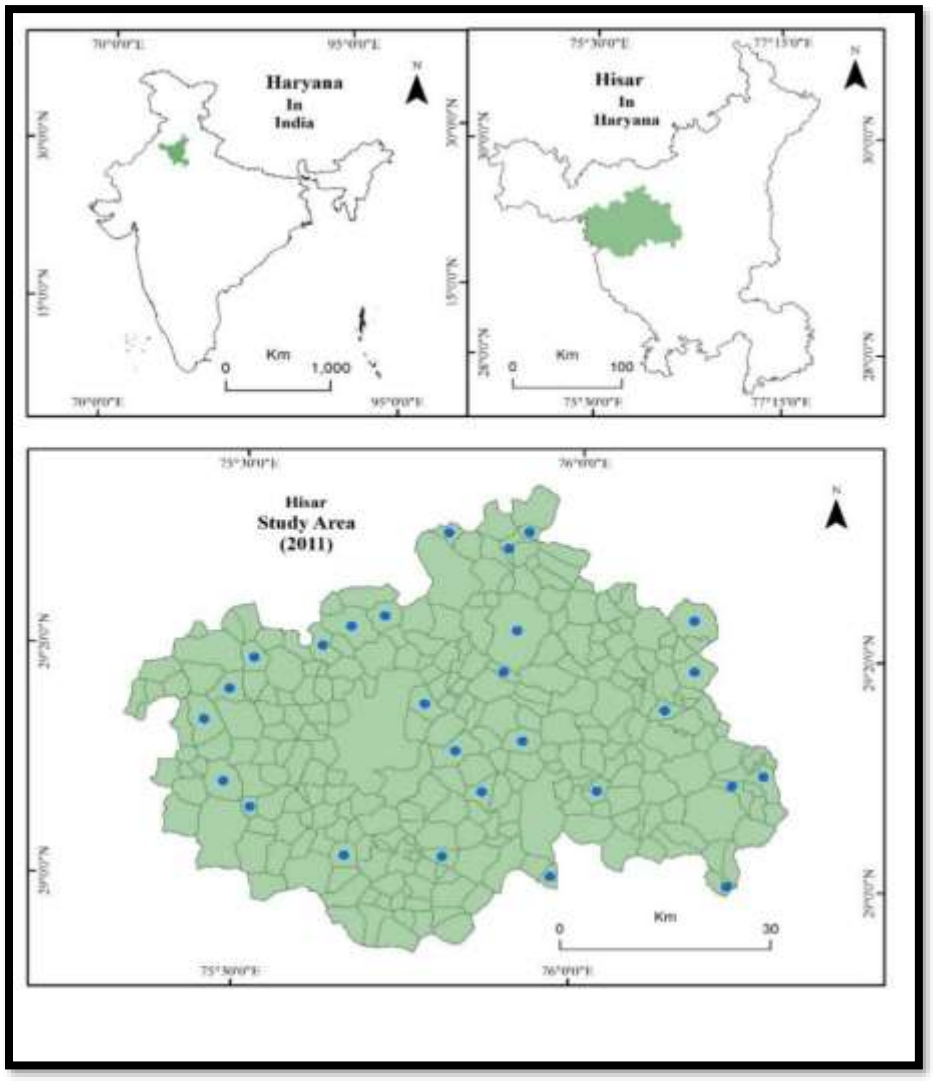
STATEMENT OF PROLEM:

In the Hisar district where the rainfall is relatively lower than that average rainfall of state. In this situation, the periodic data of ground water shows a significant fluctuation. It is partly because of fluctuation of seasonal rainfall and partly because of the useage of ground water for the aquaphil plants, like paddy; which has led to exploit the ground water at very fast rate in the study area. It is therefore, in the present study; a focus has been given on establishing the cause-effect

relationship of fluctuation of ground water and its factor; affecting the fluctuating nature of ground water in the study area; undertaken for the study.

THE STUDY AREA:

Hissar district is situated between the latitudinal extent between 28°53'45" to 29°49'15" N latitude and 75°13'15" to 76°18'15" Eastern longitudes. The geographical area of the study area is 3,983 square kilometers; including 3835.53 sq. km. of rural and 147.41 square kilometers, belonged to urban area, sharing 9 % of total area of State. The study area is having 9 blocks. From the Physiography division, the district is divided into three broad divisions, which include the Indo-Gangetic plain, which has been formed by unconsolidated clay, sand silts and gravels formed by deposition of alluvial layer of soils through some seasonal streams. The slope is often gentle to the ground is from north to south, but it tend to become reverse towards south and south-west with the regional characteristics with mounts and undulating topography. The soil texture of the soil of state shares 55 per cent sandy loam soil, 30 per cent loamy sand, 10 per cent loamy and 5 per cent sand which gives a good response to a most of the crops. In addition, the district is facilitated with very good network of canals system for agriculture irrigation (Ombir and Amrita, 2015).



The district Hisar is characterized with the weather conditions with hot summer and cold winter. The summer season is since the month of May and June and the winter season is December and January is the coldest months of the year. The maximum temperature rises to 45^0 C in the month of June; whereas the average minimum temperature falls to below 5^0 C in the month of January. During summer season, the dust storms are common. The normal annual rainfall falls in between 150 mm to 300 mm. The 80 per cent of the rainfall is received during monsoon season (July to September). The rest of the rainfall comes during the winter season which is in between the December to February. The co-efficient of variability of rainfall is over 45 % in the district. There is more than 60 per cent of the area of district lies within the arid and semi-arid zone and characterized with scanty rainfall to sufficiently erratic nature of rainfall, both in distributional pattern and quantity (Statistical Abstract Haryana, 2018).

DATA BASE AND METHODOLOGY:

The present study is primary based on secondary data collected for the period 1974-2018 from the unpublished record of Ground Water Cell, Hisar. This unpublished ground water table fluctuation data are the only reliable and official source for this purpose. For the present study, pre-monsoon (June) ground water table fluctuation data of 9 blocks have been percussed, carefully examined for discrepancies, missing values, other errors, etc. carefully examined and interpreted. The spatial and temporal variations in ground water table behavior have been exhibited with the help of tabulated figures (Ombir and Amrita, 2015).

In addition, ancillary data pertaining to the factors affecting the variability of ground water table (tube-well irrigated area, area under rice cultivation, canals irrigated area and amount of rainfall have been collected for the same period from the Statistical Abstract, Haryana. In order to compute the multi-variate correlation, SPSS Software (trail version) has been used to get the desired results. . Change detection maps were generated using Kriging (ordinary, spherical) interpolation technique in Arc Map Software. Depth to water level data at 10-year interval has been considered for monitoring the changes. Long-term variations have also been monitored by using data of 1974-2018 to understand the changing groundwater regime in the area.

RESULTS AND DISCUSSION:

Keeping in view the block wise worked out figures on ground water fluctuation; the results have been discussed as follows:
In case of Adampur block, which have selected three villages; namely Adampur, Khermpur and Mohabatpur. In case of Adampur; which shows a 11.90 meters below groundwater level. On the other hand, the fall of ground water level of the village Khermpur shows a decline of 7.55 meter from the average water table. Lastly Mohabtpur village, show a slightly rise of 3.35 meters, from average water table. All these villages, belonged to Adampur block indicate a steady declining trend of reducing the level of ground water; with minor fluctuation during the period 1974-2018.

Table no. 1: Periodic Fluctuation of Ground Water Level of District Hisar (1974-2018).

Sr. No.	Name of Block	Name of Village	June 1974	June 1984	June 1994	June 2004	June 2014	June 2018	Present Situation + / - of

									Ground water level
1.	Adampur	Adampur	17.88	9.7	4.35	5.63	4.7	4.35	- 11.90
		Kherampur	11.5	5.4	3.45	2.9	4.9	7.95	- 7.55
		Mohabatpur	7.0	4.83	6.6	7.75	6.6	9.2	+ 3.35
2.	Agroha	Agroha	22.07	21.07	18.63	18.24	11.05	5.1	- 16.7
		Kirmara	27.3	25.3	21.32	14.35	10.25	9.15	- 16.61
		Kuleri	23.15	21.85	15.22	11.35	7.35	7.05	- 16.61
3.	Barwala	Barwala	24.38	23.34	19.58	12.90	8.35	7.05	- 17.33
		Juglan	29.85	27.35	9.8	5.5	3.58	2.5	- 27.35
		Panghal	30.18	26.88	23.12	13.6	8.8	7.35	- 22.83
4.	Hansi-1	Channat	12.42	11.47	9.5	6.9	3.72	3.55	- 8.87
		Hajampur	16.14	14.5	11.08	8.61	4.35	4.44	- 11.69
		KheriGangan	6.42	3.12	4.2	5.5	4.68	6.17	+ 0.45
5.	Hansi-2	Bhaklana	8.1	6.6	5.5	3.55	2.35	2.17	- 5.93
		Madanheri	19.8	16.7	7.65	2.95	0.8	3.55	- 22.32
		Uglan	14.6	8.76	5.1	4.2	4.35	5.05	- 9.55
6.	Hisar-1	Alipur	6.6	4.47	6.55	7.6	6.1	6.15	- 0.45
		Dahima	18.7	15.96	14.8	11.87	9.25	6.5	- 11.70
		Mirzapur	15.9	14.88	10.68	3.45	4	5.65	- 11.35
7.	Hisar-2	Dhobi	16.97	15.98	12	11.9	14.18	14.48	- 6.87
		Kaluwas	17.69	16.34	11.58	10.98	8.1	8.76	- 7.41
		Sundawas	17.24	15.2	12.95	12.35	10.58	11.18	- 6.06
8.	Narnaund	Budana	6.5	5.42	8.25	7.9	9.2	13.15	+ 6.65
		KothKalan	23.15	20.8	17.2	12.1	10.9	13.1	- 10.05
		Mirchpur	9.9	8.72	9.85	9.15	11.4	14.95	+ 5.05
9.	Uklana	BudhaKhera	11.3	5.95	4.86	6.05	4.2	10.00	- 1.30
		ChamrKhera	10.25	8.88	8.05	7.78	4.55	5.85	- 11.4
		Sure Wala	15.82	14.78	8.32	7.00	3.35	3.20	- 12.42

Source: Ground water Cell, Hisar.

In case of Agroha block where, there were three villages have been selected for the study. These villages were Agroha, Kirmara and Kuleri. In case of Agroha, all the villages, including Agroha, Kirmara and Kuleri indicate a more or less same trend of declining of ground water during different successive period. The present status of all the three villages also indicate the same trend; i.e. 16.97, 16.61 and 16.61 meters respectively; between the 1974-2018 period.

In case of Barwala block, where were three villages, including Barwala, Juglan and Panghal indicate more or less same; declining trends of ground water levels, during the period; between 1974-2018. The present status of ground water level is 17.33, 27.35 and 22.83 meters. In case of Juglan village, where a sharp declining has been noticed in June 1994, which indicate a declining of ground water table with 35.83 per cent. Rest of the villages experienced more or less same trend.

In case of Block Hansi-1, which includes Channat, Hazampur and Kheri Gangan; where the ground water level of Channat and Hazampur experienced a steady declining trend, during the year 1974-2018. In case of Kheri Gangan where; there is a slight improvement in water level (0.45 meter) in the current years. The situation of other sample villages which Channat and Hazampur; shows a decline of 8.87 and 11.69 meters respectively.

In case of Hansi-2 Block, selected three villages Bhaklana, Madanheri and Ugalan; indicate a steady declining trend during the year (1974-2018). In case of Madanheri a maximum declining trend has been observed during different successive periods. The current decline of ground water level has experience a decline of 22.32 meters, which is maximum among the sample villages; taken for the study. On the other hand, the situation of Bhaklana and Uglan, indicate a decline of 5.93 and 9.55 meters respectively.

In case of Hisar-1 block, which have three sample villages; namely Alipur, Dahima and Mirchpur. In case of Alipur, which indicate a minor fluctuation in periodic seasonal change in ground water level. The current decline is only 0.45 meter. On the other hand, the ground water level of Dahima village indicate steady declining trend as indicated -11.70 meter declining in the current years. Lastly, more or less same trend has been indicated by the ground water level of Mirzapur. However, the ground water level of the current year is -11.35 meter; indicated a significant change taken place during 1974-2018. In case of Hisar-2 block, which have also three villages; namely Dhobhi, Kaluws and Sundawas, indicate more or less same trend as indicated by the village of block Hisar-2. In case of Dhobhi village, indicate more or less steady declining of ground water level, except minor fluctuation during the period 1974-2018. The current scenario of declining trend indicates -6.87 meter in Dhobhi village. The other sample villages also indicates more or less same trend as observed by the researcher.

In case of Narnaund block, which have three sample villages, including Budana, Koht Kalan and Mirchpur. In case of Budana, the ground water level indicates a steady trend, as indicated by the observed data with minor fluctuation. However, the current increase in ground water level is +6.65 meters. On the other hand, the ground water level of Koth Kalan indicates a steady declining trend as indicated the current ground water level, shown as -10.65 meters. Lastly, the ground water level of Mirchpur village shows a steady increase in ground water level, as a result, it indicates +5.05 meters. Lastly, the Uklana block, comprised of three sample villages including BhudaKher, ChamarKhera and Surewala, indicate a steady declining trend in ground water levels. All the three sample villages, shows a minor fluctuation during the period 1974-2018, as the current ground water is -1.30, -4.4 and -12.42 meters. However, the observed data indicates that there has been significant variability in the declining trend of ground water levels of the sample villages taken for the study.

In the following maps where a trend of fluctuation of water table shows a temporal dimension of the ground water table in different blocks; taken for the study in the Hisar district of Haryana. In case of the period, June 1974 the fluctuating trend is confined to north western part of the district. On the other hand, in the period June 1984, the situation shows more or less same, as experienced in the year June 1974, but the situation of June 1994 to 2004 period shows a significant fluctuation of ground water. It is because of steady growth in ground water depletion within the core areas of the blocks, belong to Hisar district. During this period, a fast land use from the traditional crops to rice cultivation has given rise to change in seasonal ground water change during different successive periods. The same trend we observe in the periods between

the year June 2014 and June 2018 which indicates more or less same trend with some minor regional changes which has been clearly shown in the maps which are as follows:

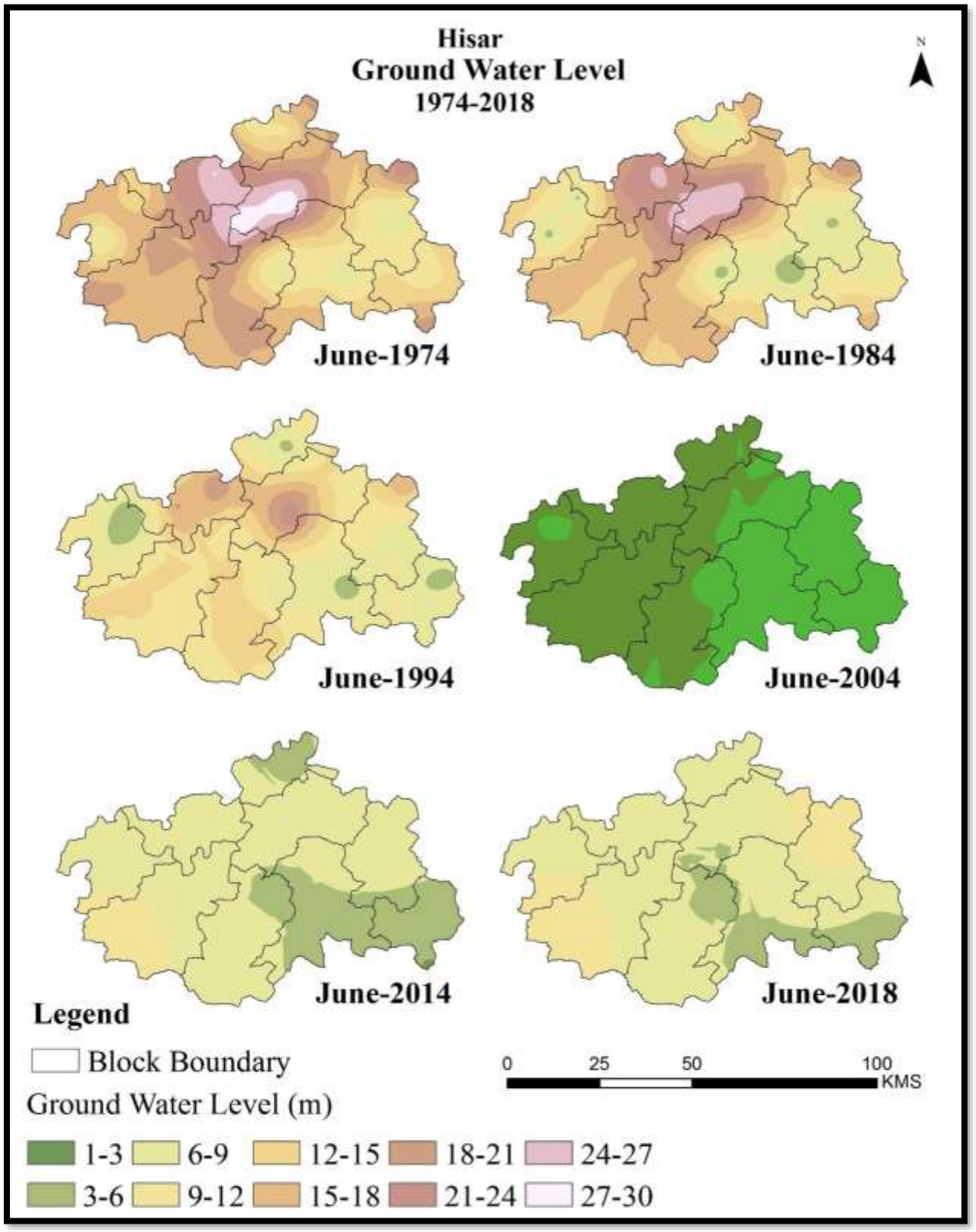


Figure 1(a): Depth to water level maps of years (June-1974, June-1984, June-1994, June-2004, June -2014 & June-2018.

ESTABLISHMENT A CAUSE-EFFECT RELATIONSHIP:

In order to knowing the behavior of the trend of declining trend of ground water of the sample villages, taken for study indicated by some of the factors, which has been affecting the probability of declining/increasing trend of ground water. All these parameters are as follows:

X1 = Ground Water-table depth;

X2 = Tube-well irrigated Area;

X3 = Number of Tube wells;

X4 = Area under Rice Cultivation;

X5 = Canal irrigated Area;

X6 = Amount of Rainfall.

All the mentioned parameters, shows a significant and insignificant correlations with the level of fluctuation of water table during to period of 1974 to 2018. The multi-variate correlation matrix, shows a varied degree of correlation with different parameters, shown as follows:

Table no. 2: District Hisar: Correlation Matrix between various indicators

Parameters	Ground Water Depth	Tube-well Irrigated Area	Number of Tube-Well	Area Under Rice Cultivation	Canal Irrigated Area	Amount of Rainfall
Ground Water Depth	1					
Tube-well Irrigated Area	.824*	1				
Number of Tube-well	.841**	.81**	1			
Area Under Rice Cultivation	.831**	.715**	.79**	1		
Canal Irrigated Area	- .615**	- .715**	- .67**	- .731**	1	
Amount of Rainfall	- .671*	- .316*	- .231*	- .02*	.481*	1

Source: Compiled by researcher.

** Significant at 0.1 percent level.

* Significant at 0.5 percent level.

Keeping in view the various parameters, which indicate varied level of correlation worked out by SPSS. The multi-variate correlation also indicates varied level of significant values, positive or negative correlation with the selected parameters, taken for the study. The study shows a 'cause-effect relationship' between the selected parameters and their impact on ground water fluctuation in the study area, taken for the study.

FINDINGS AND CONCLUSION:

Keeping in view the block-wise observed data, collected from Ground Water Cell, Hisar indicate a significant fluctuation of ground water. In this study, the sample villages were taken from each block of Hisar district indicate a major and minor fluctuation during different successive periods. On the basis of worked out study on the block-wise tabulated data indicate a steady declining trend of ground water levels with some minor fluctuation during the year 1974-2018. In this study, there are only few cases where an increasing trend has been noticed, where a steady declining trend, experienced by the sample villages.

In case of the significant correlation with some of parameters indicate a strong correlation with some selected variable taken for the study. The multi-variate correlation between the fluctuating trend of water table during the period; 1974-2018. The significant value of correlation matrix shows a strong correlation with some of parameters, affecting the trends of fluctuating of ground tables of the study Area. Keeping in view the gravity of problem, it is requires a judicious use of ground water; so that a balance may be maintained in accordance with the demand and supply of the ground water levels in the state of Haryana.

Hence, it is obvious that the fluctuating trend of ground water of Hisar district has been affecting by various factors. Thus, all these factors, are to be addressed in accordance with prevailing local conditions, so that a sustainability may be maintained to regulate the supply of ground water for the irrigation and drinking purposes not only district or state but for the whole country too.

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