



punjab geographer

A JOURNAL OF THE ASSOCIATION OF
PUNJAB GEOGRAPHERS, INDIA

VOLUME 3

OCTOBER 2007



TUBEWELL IRRIGATION AND ITS IMPACT ON AGRICULTURAL LANDSCAPE IN NOTRH-EASTERN TRACT OF HARYANA

Daljit Kaur Sandhu

Abstract

The water available for agriculture is one of the elementary base of farming in dry lands. An assured water supply makes the farming superior, stable, diversified and commercially profitable. Rainfall being meagre, concentrated and highly truant both in time and over space, farming without irrigation seems a difficult proposition. It is, therefore essential to tap the available water resources for irrigation. The inadequacy of surface water resources is being made up in the recent past by the use of sub-surface water resource. Tubewells are the major source of irrigation and has a great significance for the development of agricultural economy in the study area. Analysis of changes in cropping pattern reveals that emphasis has shifted from coarse food grains to commercial crops particularly rice and sugarcane. There has been a major change in the area under rice and sugarcane cultivation. These water demanding crops resulted the declination in groundwater level. In the present paper an effort has been made to study the groundwater potentials and its use through tubewells. At the same time distribution and concentration of tubewells and their relationship with the depth of groundwater have also been investigated in the northeastern parts of Haryana.

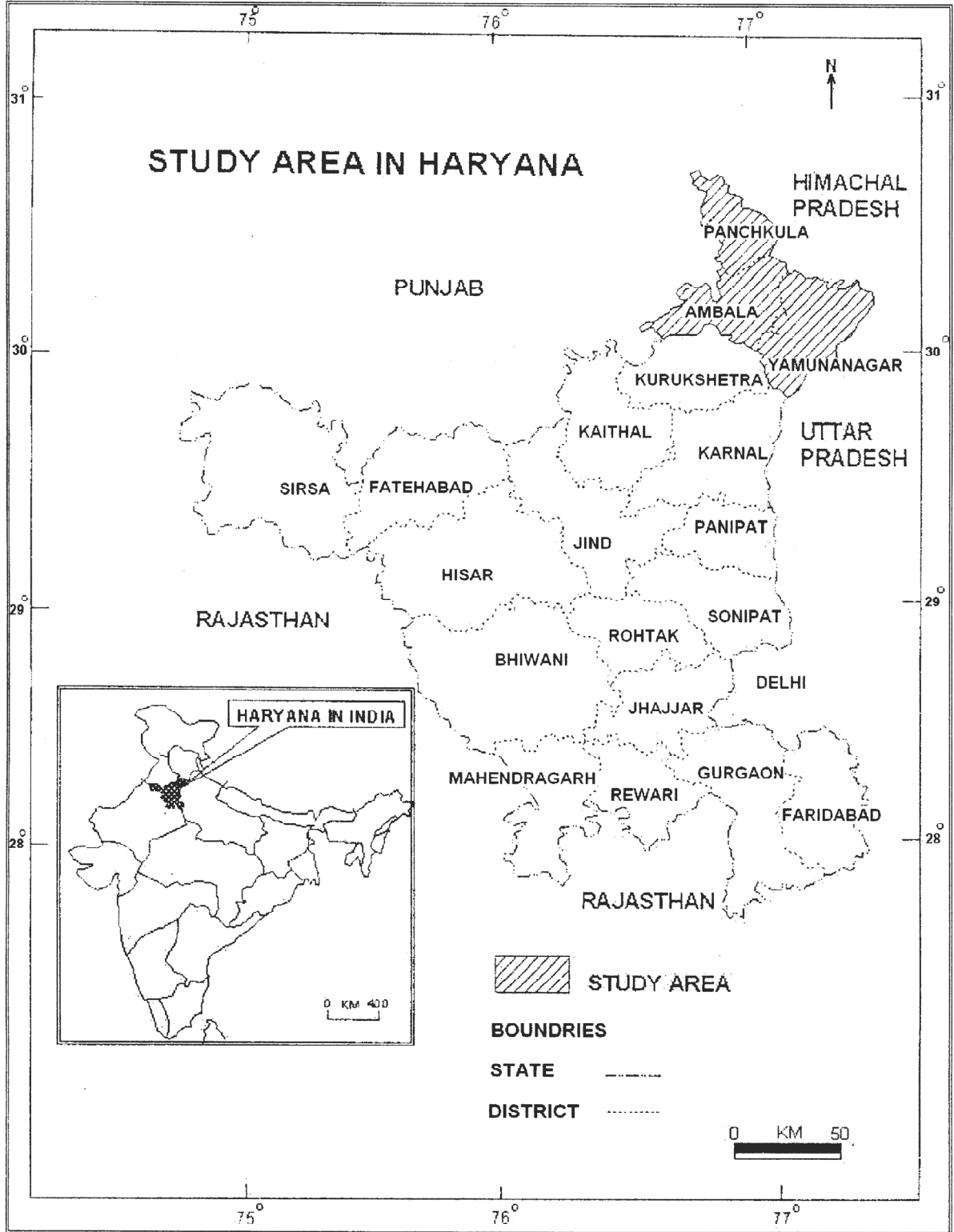
Introduction

Water for agriculture is one of the most important and basic factors in the process of agricultural transformation. It is the primary innovation in itself and also a precondition for, and stimulus to, further adoption of innovations. Without an assured supply of water neither the high yielding varieties of seeds nor chemical fertilizers pivots of modern agricultural growth can profitably be used (Singh, Jasbir 1976). It is evident that farmers with assured irrigation facilities, innovate quickly, but the element of risk otherwise prohibits the adoption of innovations by the farmers of dry farming regions (Dhillon, 1987).

The spatio-temporal patterns of agricultural water supplies depend upon the quantity and quality of water available in an

area. The study area is drained by the perennial river Yamuna and the ephemeral stream Ghagger and its tributaries Markanda and Tangri. All these immensely contribute in recharging the groundwater which is tapped through tube wells and pumping sets (both submersible and non submersible). These contribute about 90 per cent (2000-03) of the total irrigated area of the study area. Irrigation is one of non-physical parameter that has transformed the agricultural landscape of study area. Undoubtedly, irrigation is the life-line of agriculture and it has assumed the greater importance after the induction of modern technology in agriculture particularly, after the introduction of high-yielding varieties of seeds, chemical fertilizers, pesticides, insecticides etc. (Abha Lakshmi, 1992).

Punjab and Chandigarh in the north-



During the past four decades there has been a phenomenal increase in the utilization of groundwater resource. The number of tubewells and pumping sets has increased from 0.1 per square kilometre in 1971-74 to 11.6 per square kilometre in 2000-03 in the study area. These form an important means of irrigation for isolated tracts to which no other means of irrigation can be economically extended, though a very small amount of irrigation is done through kulhs in Panchkula and Kalka tehsils and through canals in Ambala and Jagadhari tehsils. Rich under groundwater reservoirs and high water table have made tubewell irrigation more feasible. In Indian situation, a tubewell, besides being a dependable source of water, functions as a nodal place for the movement of many other inputs. More water demanding valuable crops concentrate near its location pushing other crops (maize, fodder etc.) to outer fields. Tubewells play a magnetic role in the selection of crops (Singh Jhujjar, 1994). Tubewell irrigation is considered as a better source of irrigation than canal irrigation in study area because of many reasons such as courses are short, seepage losses are meagre and no extensive water distribution system is required for tubewell irrigation.

Study Area

The study area is a part of the Haryana state, which is bounded by Himachal Pradesh in the north, Uttar Pradesh in the east, Rajasthan in the south and south-west and Punjab and Chandigarh in the north-west.

Being located in the north-eastern part of Haryana it comprises Panchkula, Ambala and Yamunanagar districts (Fig.1). It is located between 30° 02' 35" and 30° 55' 45" north latitudes, and 76° 32' 45" and 77° 36' 20" east longitudes covering an area of 3832.26 square kilometres (Haryana Gazetteers Association Revenue Department, Haryana 1984). The

major part of the study area being located in Indo-Gangetic Alluvial Plain its soils have fluvial deposits consisting of sand, silt, clay, gravel, pebbles and conglomerates ranging in age from the Middle Eocene to Lower Pleistocene. These are non-calcareous and well drained in the study region. Soils of the undulated tract are mainly sandy loams whereas the soils in the plains of the Yamuna, Markanda and Ghaggar rivers are sandy loams on the surface and loam to clayey loams at the depth (Bhatia, 1988-89). The climate of the study area is governed by its continental location. Thus, it is sub-tropical continental monsoon type impinging upon all agricultural activities (Dhillon, 1981). Adequate warmth and sunshine are available in abundance throughout the year, but rainfall is deficient in amount and is uneven in spatio-temporal distribution (Dhillon and Dhaliwal, 1990).

Objective

The major objective of the study is to highlight the tubewell irrigation and its impact on agricultural landscape of the study area.

Data Base and Methodology

The proposed research is based mainly on secondary data collected at the block level from various offices and organizations of the state. The data pertaining to the groundwater depths and fluctuations from 1974 to 2003 are obtained from Ground Water Cell, Ambala. The statistical data pertaining to study the associated changes in irrigated area under water demanding crops have been collected from Deputy Directorate of Agriculture, Haryana. The data for agricultural years 1971-72 to 1973-74 and 2000-01 to 2002-03 were collected from district headquarters. Thereafter the triennial averages were worked out for the present study. The data have been processed and analyzed with quantitative techniques and

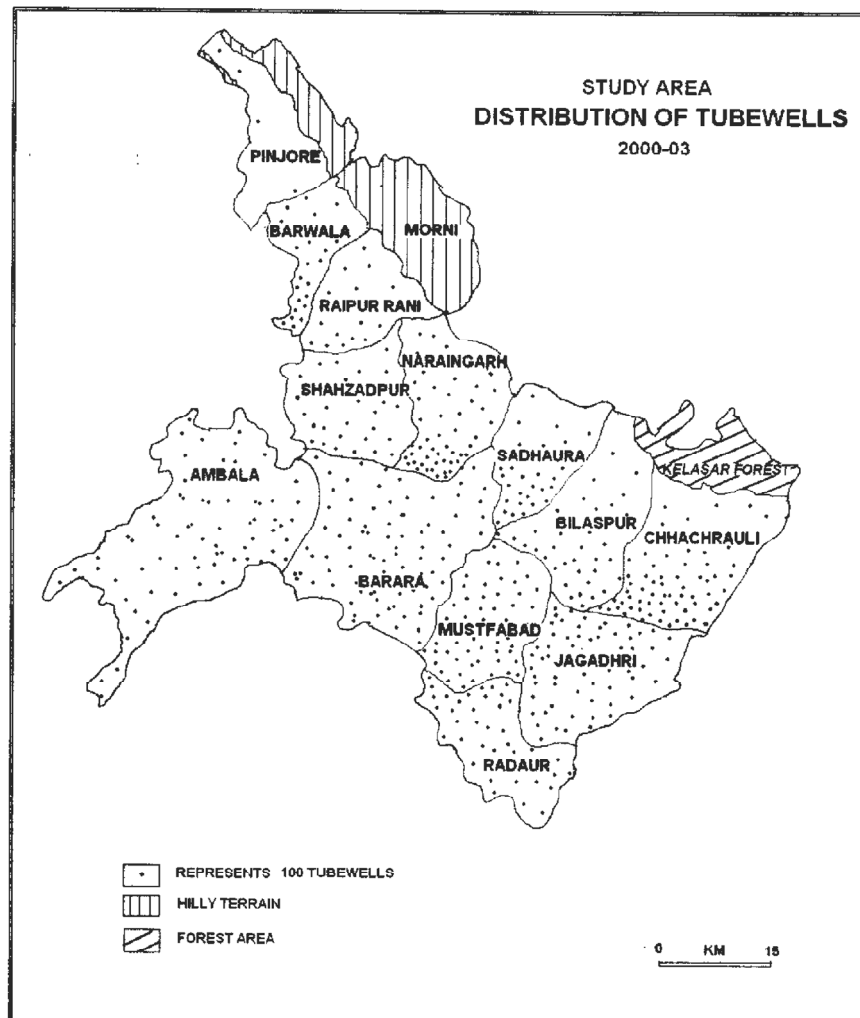


Fig 2

Source: Ground Water Cell, Ambala (Haryana).

results are presented cartographically in maps.

Distribution of Tubewells

Both tubewells and pumping sets form an important means of irrigation for isolated tract to which no other means of irrigation can be extended. Since 1971, the number of such tubewells has been increased more than four times in the study area. The number of both shallow and deep tubewells increased from 12,060 in 1971-74 to 51,564 in 2002-03. The block-wise distribution of these tubewells is depicted in Fig 2, wherein the Yamunanagar

district has the maximum number i.e., 25,083. In this district Chhachrauli block has maximum number (5873), while Sadhaura block recorded minimum number (2422) due to its piedmont topography. Ambala district has 22,172 tubewells and pumping sets. Barara block of this district has maximum (7753) and Shahzadpur block has minimum number (2757). Panchkula district has the least numbers of such tubewells (4312) due to hilly terrain. In hilly regions boulder formations do not allow the drilling process for the installation of tubewells.

Density of Tubewells

Irrigation from groundwater with the help of tubewells and pumping sets is substantial in amount in the study area. There is an immense increase in the ground water abstraction due to augmentation of both tubewells and pumping sets and electrification of villages. The density of these tubewells in the study area was 0.1 per square kilometre in 1971-74 (average), which has increased to 11.6 per square kilometre in 2000-03 (average). Such an enhancement in the density of such tubewells shows the development of groundwater resources. But this density is very uneven. There were 14 tubewells and pumping sets per square kilometre in Ambala district, 5 tubewells per square kilometre in Panchkula district and 16 tubewells per square kilometre in Yamunanagar district during the period of 2000-03 (Statistical Abstract, 2004).

Extent of Tubewell Irrigation

The extent of irrigation is the percentage ratio between the net irrigated area and net sown area.

Table 1
Study Area: Extent of Tubewell Irrigation
(1971-74 and 2000-03)
(Values in Percentage)

Study Area/Districts	1971-74	2000-03
Ambala	14.90	90.00
Punchkula	25.29	55.35
Yamunanagar	29.53	78.06
Study area	23.24	74.47

Source: Statistical Abstract of Haryana (1971-74 and 2000-03)

The extent of tubewell irrigation has increased by 74.47 per cent in 2000-03, which was only 23.24 per cent in 1971-74 (Table 1). This enhancement is more than three times which has immensely contributed to the

development of agriculture. Ambala is the leading district with 90 per cent extent of irrigation in 2000-03 while it recorded lowest in 1971-74 (Table 1). The extent of irrigation in Yamunanagar district has increased from 29.53 in 1971-74 to 78.06 per cent in 2000-03. Such a rapid increase in these parts of the study area is due the availability of subsoil fresh water in abundance, which is being tapped by tubewells and pumping sets. Though the extent of irrigation in Punchkula district almost doubled in 2000-03 over the year of 1971-74 (Table 1) yet it has recorded the lowest extent of irrigation among other districts of the study area. It is because of the presence of Siwalik hills and piedmont plain inhibiting the development of tubewell irrigation. As a result the farmers have developed dry farming techniques.

Concentration of Tubewell Irrigation

Concentration of tubewell irrigation is computed with the help of statistical technique i.e., *Location Quotient*. It is the ratios between tubewell irrigated area in the block to the total irrigated area by all modes in the same block and the tubewell irrigated area in the study area to the total irrigated area of all modes in same area. It is a measure showing the degree of concentration of tubewells Irrigation.

The values of the concentration of irrigation in each block of the study area are grouped into three distinctive categories i.e., higher concentration (more than 1.00), moderate concentration (0.50 to 1.00) and low concentration (less than 0.50). These categories are presented in Tables 2 and 3 and Fig. 3 and 4.

Table 2 shows that in 1971-74 there was higher concentration (>1.00) of tubewell irrigation in Raipur Rani block of Panchkula district, Shahzadpur and Naraingarh blocks of Ambala district, and Mustfabad, Radaur, Sadhaura and Bilaspur blocks of

Table 2
Study Area: Block-Wise Concentration of Tubewell Irrigation (1971-74)

Higher concentration(>1.00)	Raipur Rani (1.776), Shahzadpur (1.776), Naraingarh (1.776), Sadhaura (1.776), Radaur (1.626), Bilaspur (1.776), Mustfabad (1.066)
Moderate concentration(0.50-1.00)	Barwala (0.739, Jagadhri (0.761), Ambala (0.48), Barara (0.553)
Lower concentration(<0.50)	Pinjore (0.207), Chhachhrauli (0.429).

Source: Statistical Abstract of Haryana (1971-74)

Yamunanagar district. There was moderate concentration of tubewell irrigation in Barwala block of Panchkula district, Jagadhri block of Yamunanagar district and Ambala and Barara blocks of Ambala district. There was lower

concentration (<0.50) of tubewell irrigation in Pinjore block of Panchkula district and Chhachhrauli block of Yamunanagar district (Fig 3).

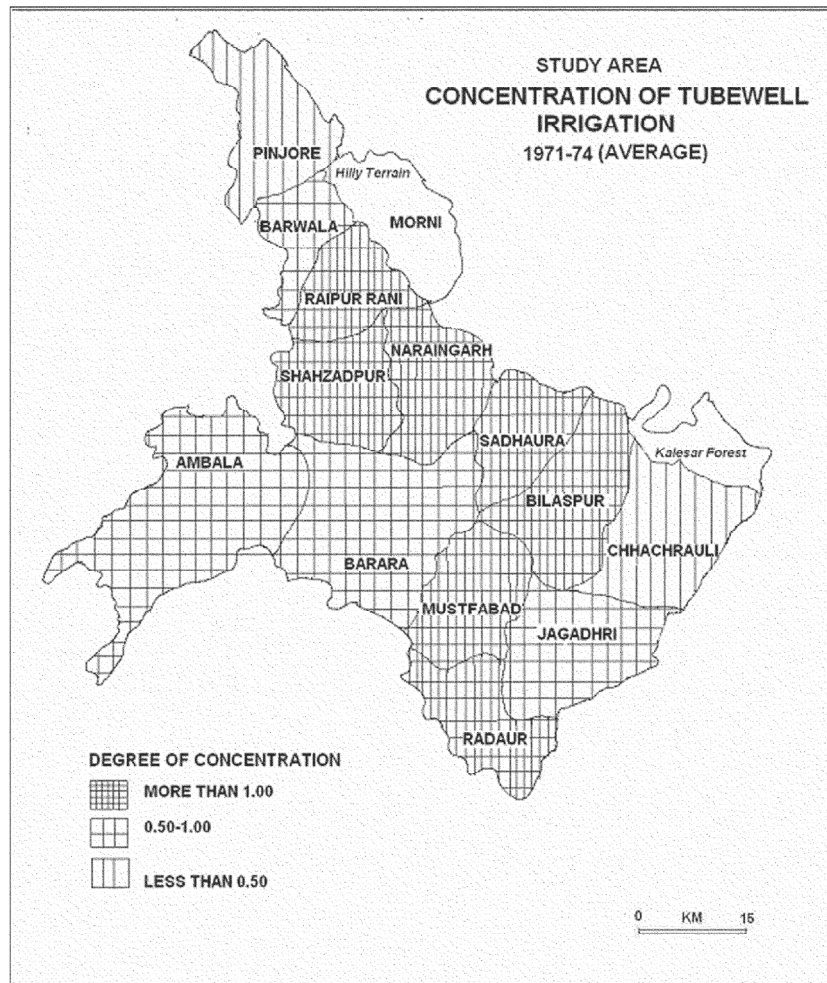


Fig. 3

Source: Statistical Abstract of Haryana (1971-74)

Table 3
Study Area: Block-Wise Concentration of Tubewell Irrigation (2000-03)

Higher concentration(>1.00)	Raipur Rani (1.106), Shahzadpur (1.106), Naraingarh (1.106), Barara(1.106), Sadhaura(1.106), Radaur(1.106), Mustfabad(1.106), Bilaspur(1.106), Chhachhrauli (1.046).
Moderate concentration(0.50-1.00)	Ambala (0.924), Jagadhri (0.839)
Lower concentration (<0.50)	Pinjore (0.478), Barwala (0.133)

Source: Statistical Abstract of Haryana (2000-03)

Table 3 shows that in 2000-03 both Ambala block of Ambala district and Jagadhri block of Yamunanagar district have a moderate concentration (0.50-1.00) of tubewells. Such a concentration has emerged due to canal irrigation by Narwana branch and its distributaries in Ambala block and Western Yamuna Canal and its distributaries in Jagadhri Block. Pinjore and Barwala blocks of

Panchkula district recorded lower concentration of tubewell irrigation (Fig 4). And the rest nine blocks have a higher concentration of tubewell irrigation. Morni block of Panchkula district is situated in the lesser Himalayas. Therefore, there is no possibility of tubewell irrigation due to rugged topography which otherwise do not hold water due to steep hydraulic gradient.

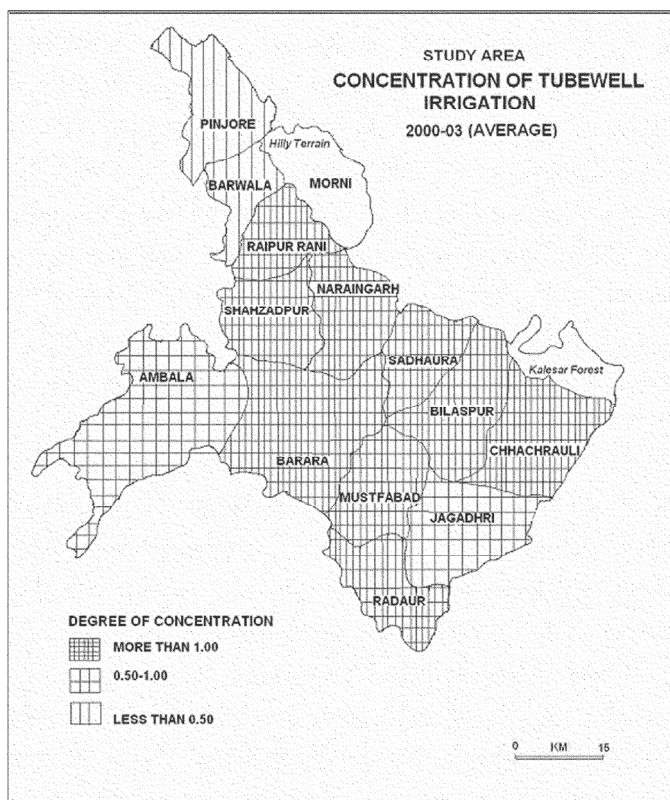


Fig. 4

Source: Statistical Abstract of Haryana (2000-03)

Relationship between Number of Tubewells and Groundwater Levels

The main stress has been given on tubewell irrigation, which irrigates most of the cultivated area in the study region. The extent of lift irrigation has increased manifold over a thirty year period. It is perhaps due to a tremendous increase in the number of tubewells and pumping sets. These have put an extra pressure on the groundwater because of over drafting for irrigation demanding crops of the study area, resulting depletion in groundwater resources.

Table 4
Study Area: Relationship between Number of Tubewells and Depth of Water Table (2003)

Co-efficient of Correlation	Pre-Monsoon June	Post-Monsoon October
	+0.6737	+0.7394

Source: Ground water Cell, Ambala, Haryana (2004)

The co-efficient of correlation between the depth of groundwater and the number of tubewells apparently shows the positive relationship (Table 4). It is linked to ever increasing number of tubewells and pumping sets and decreasing the levels of groundwater over the last three decades. This correlation is highly positive (+0.7394) in the post- monsoon period because of excessive over drafting for the Kharif crops (rice and sugarcane) and meagre recharging of groundwater.

In the pre-monsoon period the relationship between these variables is indeed positive (+0.6737) but it is relatively low than that of post- monsoon period. The groundwater is perhaps being continuously recharged by ephemeral streams and sub-humid conditions of hilly area. Moreover, extra recharge is also taken from surface water bodies such as canals, tanks, ponds and return flow from irrigation. Even otherwise it is a practice that no major

crops is grown during the hot dry season from April to June except the sugarcane as a ratoon crop and some green fodder (*chari-bajra*), hence draft is very low.

Groundwater Fluctuations and its Impact on Agricultural Landscape

Since some crops particularly, rice as a *kharif* crop and sugarcane as a *continual* crop require more water than other crops like wheat, maize, gram, pulses etc. therefore, the extent of tubewell irrigation is increasing in the area under water demanding crops i.e. rice and sugarcane. The percentage increase in an area under rice and sugarcane in different blocks from 1971-74 to 2000-03, and on average groundwater fluctuations (1974-2003) in both pre and post- monsoon periods are analyzed (Table 5).

Table 5 reveals that the maximum increase in cropped area under rice and sugarcane is recorded in Chhachrauli block (43.7 and 24.31 per cent respectively), Radaur block (19.02 and 24.91 per cent respectively) and Barara block (10.56 and 11.13 percent respectively). High groundwater fluctuations are observed in Radaur and Jagadhri blocks located in plains followed by Naraingarh and Chhachrauli blocks having piedmont and plain topography because of moderate to high concentration of tubewells and pumping sets. A constant withdrawal of groundwater occurs all the times. Pinjore and Barwala are not considered in terms of their groundwater fluctuation because these are located in Siwalik hills, where groundwater is already very deep due to steep hydraulic gradient. Moreover these blocks do not grow rice and sugarcane crops.

Explicitly increase in area under rice and sugarcane cultivation is observed in Chhachrauli block but its groundwater fluctuation is -2.20 metres. It is due to less

Table 5
Study Area: Groundwater Fluctuation and Percentage Increase in Area under Water Demanding Crops

Blocks of the study area	Groundwater fluctuation in metres (average of pre and post- monsoon period) from 1974-2003	Percentage increase in area under water demanding crops 1971-74 to 2000-03 (average)	
		Rice	Sugarcane
Pinjore	-5.89	--	--
Barwala	-5.04	--	--
Morni	-----	--	--
Raipur Rani	-1.44	0.9	--
Shahzadpur	*	5.6	8.0
Naraingarh	-2.08	5.7	1.2
Ambala	+1.71	11.67	1.0
Barara	-1.52	10.56	11.13
Sadhaura	-0.26	13.8	1.0
Bilaspur	-1.05	8.4	10.6
Mustfabad*	*	*	16.0
Radaur	-7.42	19.02	24.91
Jagadhari	-3.58	2.9	12.3
Chhachrauli	-2.20	43.7	24.31

(* newly formed block after 1990)

Source: G.W.C., Ambala and Statistical Abstracts, Haryana

concentration of tubewell irrigation (Fig. 3) and high groundwater level i.e. 7.95 metres and 10.27 metres (average values of pre and post monsoon groundwater depth in 1974-2004, Table 5). Secondly, there are many seasonal tributaries of the Yamuna river like Pathrala, Somb, Bhoili, Rakshi nala etc. which pass through this block and recharge the ground water. On other hand, Jagadhri and Radaur blocks do not have any recharging source. Therefore, fluctuations in water table are high in these blocks. Thus, high positive correlation between area under major water demanding crops and depth of groundwater level in 2003 has been observed. In other words, as the area under rice and sugarcane increases, the depth of water level also increases. In post- monsoon period the correlation is highly positive

(+0.825) as compared to pre- monsoon period (+0.711) in Table 6.

Table 6
Study Area: Relationship between Area under Water Demanding Crops and Depth of Groundwater Level (2003)

Co-efficient of Correlation	Pre-Monsoon	Post-Monsoon
	June	October
	+0.711	+0.825

Source: G.W.C., Ambala and Statistical Abstracts, Haryana (2004)

It is assumed that in monsoon season there is more recharge due to surface flow. But due to more withdrawal of groundwater through tubewells and pumping sets for rice and sugarcane cultivation (water demanding crops) groundwater is constantly depleting leading to

strong positive correlation between water demanding crops and level of groundwater. Thus, continuing withdrawal of groundwater for rice and sugarcane cultivation is the main cause for decline of water level in the study area especially after the green revolution when more emphasis has been given on non-physical parameters for better yield and agricultural development.

Agriculture as a complex operation has been carried in the study area for ages. During the study period extending from 1971 to 2003 various agricultural programmes were launched to bring about rapid transformation in the agrarian structure. But the introduction of both biological and mechanical technification has brought a remarkable success in promoting agricultural production. The credit goes to tubewell irrigation which is coupled with tractors, mechanized sprayers, dusters, power operated threshers, use of chemical fertilizers and HYVs of seeds etc. which are essentially considered basic to the agricultural growth and development. These have apparently transformed the traditional agricultural landscape of the study area.

Conclusion

The proceeding analysis clearly indicates that irrigation development has rapidly taken place in the study area. The main stress has been laid on installation of tubewells and pumping sets, which irrigate most of the cultivated area of the study region. There has been a major change in the area under rice and sugarcane cultivation. These crops are grown commercially and perhaps because of the farmers are very keen in their farming. Rice as *kharif* crop and sugarcane as an *annual* crop requires more water than coarse grains like maize, grams, pulses, etc., obviously, the pressure on groundwater has increased manifold over the last thirty years. Therefore,

due to over exploitation of groundwater for irrigation through tubewells, the groundwater table is rapidly declining at a rapid rate. The most alarming situation is in the blocks of Jagadhri and Radaur of Yamunanagar district. It is, therefore, imperative that the existing water supplies for irrigation and farming practices are designed in such a way that it may increase irrigation efficiency to achieve maximum farming output.

At present, there is a need to put a check on the over drafting the groundwater by readjustment in cropping pattern. Farmers should make the optimum and efficient use of available resources along with reorientation towards the integrated use of surface water and groundwater. For conserving surface waters, check dams should be constructed to collect water. Further groundwater exploitation should be taken up with utmost care in the study area.

References

- Abha Lakshmi, (1992): "Impact of Different Sources of Irrigation on Cropping Patterns, Yields and Farms Practices", *The Geographical Review of India* (54); pp.19-25.
- Bhatia, A.K. (1988-89): *Reappraisal Hydrogeological Survey in Ambala District*, unpublished report of C.G.W.B., NWR, Chandigarh.
- Dhillon, S.S. (1981): A Technique for Measuring the Degree of Agricultural Profitability, *Geographical Review of India*, Vol. 45, No. 3, p. 253.
- Dhillon, S.S. (1987): "Dimensions of Green Revolution in Haryana", *Geographical Review of India*, vol. 53 No. 2 pp. 80-82
- Dhillon, and Dhaliwal, (1990): "Irrigation in Haryana: Potentials and Limitations", *Asian Profile*, Vol. 18 No. 3. pp. 247-248.

- Govt. of Haryana (1984): *Ambala District Gazetteer*, pp. 79-85.
- Govt of Haryana.(1970-73,2002-03,2004): *Statistical Abstracts*.
- Singh, Jhujjar.(1994): "Tubewell Irrigation and Spatial Organization of Agriculture", *Geographical Review of India* (56) pp. 43-46.
- Singh, Jasbir.(1976): *An Agricultural Geography of Haryana*, Kurukshetra :Vishal Publications, pp. 111,132,137 and 138.

Daljit Kaur Sandhu
Lecturer in Geography,
Guru Nanak Khalsa College,
Yamunanagar(Haryana).