

**MANAGEMENT OF GROUND WATER RESOURCES FOR SUSTAINABILITY OF
AGRICULTURE IN PUNJAB**

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Abstract

Ground water is a very important input for agriculture in Punjab. As other sources of water are inadequate to fulfil the water demand of the state agriculture, the availability of ground water is of utmost importance for sustaining agriculture in Punjab. Due to sudden shifts from low water requiring crops to high water consuming crops particularly rice since 1970, the consumption of water in the agriculture sector has increased many times. As over reliance on ground water resources, the exploitation of ground water has gone faster than the aquifers can be replenished by natural process. Because of over exploitation, the ground water situation is alarming in the state as 80 percent blocks are over exploited and declared as dark blocks. In the prevailing conditions, it is difficult to sustain the present level of agriculture in the coming years. Keeping in mind the seriousness of the problem, present topic has been selected for the investigation. In the present paper an attempt has been made to show the present status of ground water resources and important management measures required to check the depleting ground water resources for sustainability of agriculture are suggested.

Keywords: Ground Water, Agriculture, Tubewells, Water Level, Stage of Ground Water Development.

Introduction

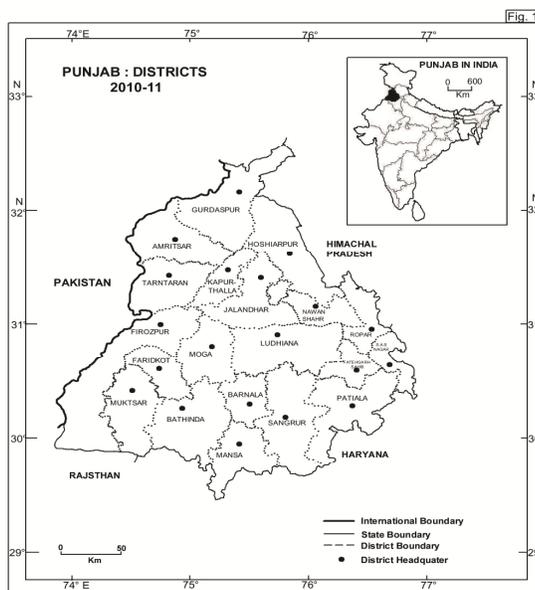
Ground water is the most important natural resource of the earth. The development of an area is largely dependent upon water resources especially ground water resources where other sources of water are inadequate to fulfil the water demand of the civilizations. At global level, out of total, 3 percent water is available as fresh water and it is suitable for different type of uses. Ground water is considered as fresh water and it accounts 0.5 percent of the global water. Ground water is almost universally available with variation in levels, quantity and quality (Rahi, 2011). Punjab is basically an agrarian state of India. The economy of the state is primarily agro based. About 83 percent land of Punjab is under agriculture and 97 percent of the cultivated area is under assured irrigation. Agriculture is the most water consuming activity in Punjab and it alone consumes nearly 80 percent water resources of the state (Kaur, 2010). Ground water is the most significant input in agriculture in Punjab. Out of total ground water consumption of the state, 98 percent is consumed by agriculture (CGWB, 2011). Punjab upto 1970-71, was the food deficit and water surplus area of the country.

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The turning point in the ground water consumption came in 1965-66 when high water consuming rice-wheat crop combination was introduced by the central govt. as state policy for ensuring food security for the country. Due to extensive and continuous adoption of rice-wheat crop combination, Punjab has converted from food deficit to food surplus and from water surplus to water deficit state. Presently nearly 95 percent areas of the state are suffering from ground water depletion problem. Because of declining water table, the tubewells have to be deepened and the farmers are shifting to the use of submersible pumps in place of centrifugal pumps which were used by them previously, resulting in additional expenditure and extra power consumption. This has adversely affected the socio-economic condition of small farmers (Jha, 2009). Because of the high cost of deep tube wells and energy consumption, it is very difficult for debt ridden farmers especially marginal and small which are in the majority, to install deep tubewells to save their agriculture. In such circumstances, sustainability of agriculture has become a question mark.

Study Area

Punjab is located in north western part of India and has an area of 50362 sq. km which constitutes 1.5 percent of the total area of the country (Fig. 1). The population of Punjab is 27704236 persons giving a density of 550 person/sq. km (Census, 2011). The plains of Punjab are formed by the deposition of alluvium brought down by rivers from the Himalayas (Mavi, 1993). Climatologically, temperature conditions of Punjab favour for the cultivation of variety of crops throughout the year whereas rainfall is inadequate, irregular and highly variable in amount (Singh, 2012).



Data and Methodology

The present study is based on secondary and primary sources of data/information. The data regarding no. of the tubewells is collected from various issues of statistical abstracts of Punjab. Whereas stage of ground water development and depth of ground water data is obtained from central ground water board, ministry of water resources, govt. of India. The relevant information related to the present investigation is also collected from various journals, books, newspapers, govt. reports etc. Apart from these, the primary information helpful for the study has also been obtained by interviewing various persons associated with ground water resources including progressive farmers, kisan union leaders, tubewell mechanics and unskilled people. To check the authenticity of secondary data personal observations are also made in different corners of the state. For deriving rational results, suitable statistical/cartographic techniques have been applied for data mapping.

Results and Discussion

Present Status of Ground Water Resources

Ground water, surface water and atmospheric rainfall are the three sources of water in Punjab. Out of total available water resources of Punjab, ground water shares 58.4 percent. From a supply point of view, due to over exploitation, ground water fulfills 67 percent water demand of the state. Ground water resources are replenished every year from different sources.

In Punjab, it is replenished/recharged from rain, rivers, canal seepage, return flow from irrigation etc. Punjab was the water surplus state of the country up to 1970. Since 1970, with the sharp adoption of high water consuming rice-wheat cropping pattern by the farmers replacing low water requiring crops like pulses, oilseeds, bajra, barley etc has led fast utilization of ground water as the other sources are inadequate to fulfil the water demand of the rice-wheat cropping pattern.

In this direction to meet the increased water demand large no. of tubewells have been installed in the state. Significantly, there were 1.92 lakh tubewells in 1970-71 in Punjab. But they rose to 8 lakhs in 1990-91 and finally 13.82 lakhs in 2010-11 (Statistical Abstracts of Punjab, various issues). With this development ground water extraction goes faster than the aquifers can be replenished by natural process especially in the central parts of the state. Due to over exploitation of ground water in Punjab, the extraction of ground water has increased by 200 times during the last three decades (Hundal, 2009). Punjab has in less than 30 years used up ground water resources built up over the last 105 years in the state (Kler, 2012).

The recent assessment of stage of ground water development (ratio of ground water utilization to net ground water availability) shows that Punjab (170 percent) is on the top of ground water development among all the Indian states.

Table: 1, Punjab: Districtwise stage of ground water development (31.03.2009)

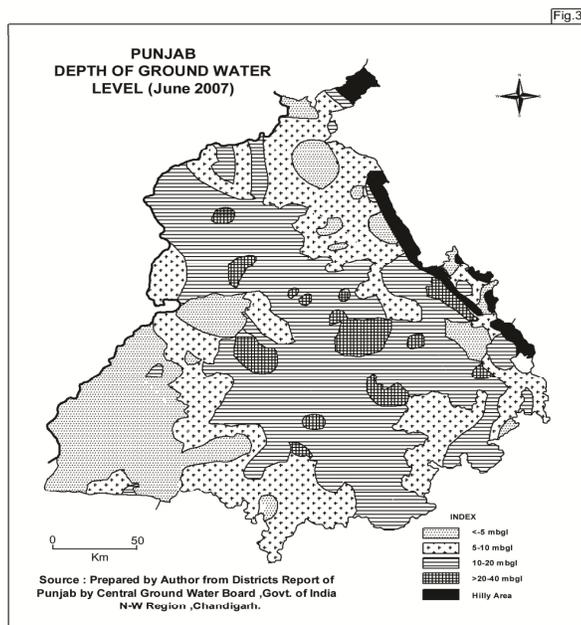
Sr. No.	District	Stage of Ground Water Development (%)
1.	Amritsar	179
2.	Barnala	197
3.	Bathinda	124
4.	Faridkot	159
5.	Fatehgarh Sahib	210
6.	Firozpur	141
7.	Gurdaspur	126
8.	Hoshiarpur	104
9.	Jalandhar	229
10.	Kapurthalla	235
11.	Ludhiana	170
12.	Mansa	214
13.	Moga	203
14.	Muktsar	70
15.	S.B.S. Nagar	112
16.	Patiala	195
17.	Ropar	110
18.	S.A.S. Nagar	102
19.	Sangrur	264
20.	Tarn Taran	181
	Punjab	170

Source: Central Ground Water Board, Ministry of Water Resources, Govt. of India, Faridabad, 2011.

According to Table 1, districtwise stage of ground water development is found highest in Sangrur (264 percent) followed by Kapurthalla (235 percent) and Jalandhar (229 percent). The lowest stage of ground water development i.e. 70 percent is observed in Muktsar district. Due to areal difference, three categories of ground water development are identified in Punjab (Fig. 2). The first category ground water development more than 169 percent is present in the central part of the state covering the districts of Sangrur, Kapurthalla, Jalandhar, Mansa, Fatehgarh Sahib, Moga, Barnala, Patiala, Tarn Taran, Amritsar and Ludhiana. The second category ranges between 120 to 169 percent is noted in two parts comprises the districts of Gurdaspur (north), Firozpur, Faridkot and Bathinda (South-west). The third category less than 120 percent is also divided in two parts includes the districts of Hoshiarpur, Nawan Shahr, Ropar, S.A.S. Nagar (hilly and undulated part) and Muktsar district.

The recent blockwise position of ground water reveals that out of 138 blocks of Punjab, 110 blocks (80 percent) are over exploited and declared as dark blocks, whereas 3 (2 percent) and 2 (1 percent) blocks are in critical and semi critical stages respectively. The remaining 23 blocks (17 percent) are in safe zone but unfortunately in these blocks ground water is brackish and unfit for human use. Areally these blocks are lying in south western part of the state comprising the districts of Muktsar, Faridkot, Bathinda and Ferozpur.

The ground water level in major part of the state comprises the areas of Amritsar, Kapurthalla, Jalandhar, Ludhiana, Moga, Sangrur, Barnala, Patiala, S.B.S. Nagar and Fatehgarh Sahib are in the range of 10 to 20 mbgl. But in some pockets which are situated especially in the central part and in big cities like Ludhiana, Amritsar, Jalandhar, Patiala, Moga, Nakodar and Barnala are in the range of 20 to 40 mbgl. The water level ranges between 5 to 10 mbgl. is observed in the parts of Patiala, S.B.S. Nagar, Gurdaspur, Hoshiarpur, Bathinda, Mansa, Faridkot and Ferozpur districts. Shallow water level ranges between 0 to 5 mbgl is recorded in patches in the of southwestern, northern and eastern parts of the state (Fig. 3). The districts of Moga, Sangrur, Patiala, Jalandhar, Ludhiana and Kapurthalla are the worst hit as the water table depletion beyond 10m has increased from 3 percent in 1973 to 95 percent area in 2005. It is predicted that in about 66 percent area of the central districts, the depth of water level will be receded to 50 meters by the year 2030 (Hira, 2006).



Today in about 95 percent areas of the state water level is declining up to 60cm. per year. The ground water in village Rajpur block Bholath district, Kapurthalla was 2 mbgl in 1981. But due to over exploitation, it decreased to 10 mbgl in 2003 and the trend continues till today. Now in this village ground water is available at 15 mbgl. The ground water level in village Gopalpur block Rajpura district Patiala was 3 mbgl in 1975. But due to high stage of ground water development it reached to 10 mbgl in 1985 and finally 22 mbgl in 2012 and the trend still continues. The ground water picture in another corner of the state i.e. in village Sarawan block Kotkapura district Faridkot reveals that the whole village was waterlogged between 1980 to 1985. But due to introduction of rice cultivation in the village, ground water has started depleting. Now in this village ground water is available at 9 mbgl. Significantly here ground water is depleting at the rate of 30 to 40 cm per year (Personal Observation).

The personal observation and interviews in different parts of the state show that shallow tubewells and hand pumps have dried up in most areas (especially in the central Punjab) in the last about 30 years. The ground water level decline has forced farmers to lower the pumps and further deepen the well, increasing the costs of pumping and energy use and thus decreasing the profitability and efficiency of agriculture (Singh, 2001). In this situation ground water can create a serious economic and social crisis in Punjab.

Management Measures

To sustain the agriculture, following measures are suggested to check the depleting ground water.

Crop diversification

The present cropping pattern of Punjab is dominated by most water consuming rice-wheat crops which jointly shares about 85 percent of the total cropped area of the state. In the prevailing conditions, it is not possible to continue the existing rice-wheat crop combination in the state. Therefore to sustain the agriculture and overall development of the state, there is an urgent need for the diversification of cropping pattern. Towards this direction govt. should immediately encourage the cultivation of low water consuming crops by giving remunerative prices and assured marketing.

Promotion of improved irrigation methods

Flood irrigation is commonly practiced in Punjab which results waste of a lot of water. It has been recognized that water required to irrigate one hectare in flooding system is enough to irrigate three hectares in sprinkler system and nine hectares in drip system. To check the wastage of water through flood irrigation, govt. should promote sprinkler and drip irrigation at large level.

Management at farm level

To save the water, use of laser leveling of land, zero tillage, furrow plantation methods etc. should be encouraged.

Artificial recharge of ground water

To recharge aquifers there is an urgent need to involve farmers and the whole community. On this side micro reservoir should be built in every village and urban areas of the state. To control the surface run off during rainy season especially in northeastern and some central part of the state check dams/borewells/recharge well etc. should be made for percolation. Besides these water harvesting tanks can be built and be used to irrigate crops.

Apart from these roof rainwater harvesting and rain water available in the open spaces around the buildings may be recharged into the ground through bore wells or other suitable methods according to the available conditions. There is also need to renovate village ponds which have been neglected over the last many years.

Ban on high water consuming trees

Planting of high water consuming trees like eucalyptus should be banned especially in those areas of the state where stage of ground water development is very high.

Policy issues

To check the depleting ground water govt. should formulate some strict rules regarding installation of tubewells and extraction of ground water. Above all govt. should formulate a solid water policy of Punjab especially ground water which till date does not seem practical in the state.

Conclusion

Punjab is basically an agrarian state of India. The economy of the state is primarily agro based. About 83 percent land of Punjab is under agriculture and 97 percent of the cultivated area is under assured irrigation. Agriculture is the most water consuming activity and it alone consumes nearly 80 percent water resources of the state. Ground water is the most significant input in agriculture in Punjab. Out of total ground water consumption of the state, 98 percent is consumed by agriculture as the other sources are inadequate to fulfil the water demand of the agriculture. The stage of ground water development is very high in the state.

In majority areas of the state, ground water extraction goes faster than the aquifers can be replenished by natural process. In such areas shallow tubewells and hand pumps have dried up and sustainability of agriculture has become a question mark. To save the agriculture and livelihood of lakhs of people, there is an urgent need to check the depleting ground water. In this direction there is an immediate need to diversify the present cropping pattern, promotion of improved irrigation methods, banning of high water consuming trees like eucalyptus, artificial recharge of ground water and formation of solid water policy in the state.

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