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Management Measures for Punjab Ground Water Resources

D.S. Cheema
E-mail - didar.cheema@postgrad.curtin.edu.au

Abstract : Despite the limited knowledge on Punjab's ground water protection policy regarding ground water resources allocation, quality and its regulatory measures, this paper provides a high level overview of: a) the ground water issues in Punjab; and b) suggest feasible management measures to ensure its sustainable use for the current and future generations of Punjab.

BACKGROUND

Punjab constitutes 1.56% of India's total land area. The State is home to approximately 24.4 million people (2001 Census) which represents approximately 2.4% of the total population of India.

About 83.13% of the total geographical area of Punjab is used for agricultural purposes. Ground water source represents approximately 80% for its irrigation and is therefore the main source of water for Punjab.

Notwithstanding the high reliance placed on ground water as a key source of water supply in Punjab, there are some fundamental issues with how ground water is currently being managed. Such inefficiencies in water management have led to a sharp depletion in the quantity and quality of water sources in Punjab.

This paper explores the principle deficiencies in water management, and suggests practical solutions to restore water quantity and quality for Punjab.

AQUIFER SYSTEM

Aquifers have historically been extremely important source of water supply for a variety of uses, including for watering livestock, irrigating crops, powering mills, and as a source of scheme water. However, whilst their use is important and extensive, aquifers are naturally recharged at a very slow rate. Therefore, in circumstances where the rate of removal of water from aquifers exceeds the rate of their recharge, there is a significant lowering of the water table, that is, depletion of aquifer.

Low water tables require deeper wells. This not only presents a significant increase in the cost of pumping water from aquifers but also further depletes water from the already lowered aquifer.

GEOMORPHOLOGY

Almost 90% of the State is underlain by Quaternary alluvial deposits - with the exception of the north-eastern part of the State - which is occupied by Tertiary formations outcropping as the Siwalik Hills.

The fluvial deposits of the Ravi, Beas and Sutlej rivers have formed the alluvial plains. The quaternary deposits are divided into:

a) Piedmont deposits occurring along a narrow belt along the Siwaliks locally known as "Kandi";

b) The alluvial plains which are the most important ground water reservoir;

c) Aeolian deposits occurring in the southwestern part of the State; and

d) An intermontane valley near Anandpur Sahib in the Ropar district.

Alluvial formations in Punjab are important sources of abundant and dependable ground water supplies. Most of the aquifers in Punjab are shallow aquifers and can be replenished (Sushil Gupta, 2009)

Past investigations of Ground water resources in Punjab indicates the following:

a) Central Ground Water Board ground water investigation has revealed the thickness of fresh water sediments is greater than 450m (explored depth) in north-eastern part of the State. This fresh water sediments decrease towards south-eastern part with a large variation ranging from 200 to10m (Sushil Gupta, 2009).

b) As per the ground water assessment carried out, net dynamic ground water resources of Punjab State are 21.443 MCM (Million Cubic meters), whereas net draft is 31.162 MCM, leading to ground water deficit of 9.719 MCM . The stage of ground water development for the State as a whole is 145% and the State falls under "over-exploited" Category (Sushil Gupta, 2009).

CONSEQUENCES OF POOR WATER MANAGEMENT

In the past four or so decades, an over-pumping of aquifers in Punjab has resulted in the situation which appears to have had serious consequences on the quantity and quality of water available.

As such it is imperative that proper and effective management systems enabling the effective control of this precious natural resource be put in place (including regular monitoring plans forming part of such management systems) to ensure that the minimum threshold limits necessary for various sub regions are maintained. In this regard, any tightening or relaxation of these management systems needs to take into account the competing interests of the various users.

Additionally, there needs to be an improvement in the means of managing and using surface water through well managed irrigation systems. At present, it appears that the systems in place are not making full use of the potential irrigation systems. For example, due to the practice of lining the main irrigation channels (instead of lining minors at the distribution end):

a) there has been a significant impact on the recharging of groundwater; and

b) the trend of balanced and efficient irrigation application has significantly diminished.

Such inefficiencies in the use of proper irrigation systems could potentially lead, to the State losing a continued and consistent supply of underground water in order to sustain its agricultural industry - which to date has been backbone for the State's economy.

Furthermore, a lack in sustainable water supply, will also come with other associated problems. For example, if scheme water supply is not maintained to a sufficient level and quality, the State will be unable to meet its domestic and industry demand for water within an affordable range.

Consequently, in the absence of implementing proper management systems, there is a high risk of a significant downturn in relating to Punjab's agricultural economy going forward.

SUGGESTED MANAGEMENT MEASURES

As part of an Integrated Water Resources Development Programme, conjunctive uses of surface and subsurface water resources are generally the way to go. This may require the separate determination of available ground and surface water resources in any sub-regional situation. Where both sources of water are available, a careful balance can be maintained in the abstraction from either source, in order to sustain long term supply.

Set out below, are a list of measures which should be considered in whole or in part and in integration with one another to achieve a well managed water resource system for the State:

1. Participants in the agricultural industry should be encouraged to diversify their cropping pattern. For example the following crops result in a water saving, with percentage saving as follows:

   a. Cotton -52%,
   b. Sunflower- 53%,
   c. Maize -53%,
   d. Chilly- 63%,
   e. Cauliflower -38%,
   f. Potato -23%,
   g. Tomato- 41%,
   h. Pea- 50%,
   i. Bottle gourd- 47.6%; and
   j. Carrot -17.6%

   Source: Presentation by Dr AK Jain & Dr Raj Kumar, Water Management Issues– Punjab, Punjab Agriculture University, Ludhiana, India. (http://akicb.ifas.ufl.edu/powerpoints/Tuesday/watermanagement-issues-punjab.pdf).

2. To promote a trend in diversification, a government subsidies scheme may need to be put in place in order to offset any significant negative economic impacts suffered by farmers, should they wish or be obliged to participate in a diversified cropping regime as suggested above.

3. To soften the current demand on the State's ground water resources, measures could be put in place to regulate (and as part of this, put in place maximum caps on) the growth of water intensive crops such as paddy. For example, a cap could be determined by reference to a farmer's landholding, such that a farmer can only be allowed to grow a water intensive crop on up to 50% of the farmer's landholding. In implementing such a regulatory regime, there would need to be a clear assessment and guidelines issued on what is considered to be 'water intensive' crops.

4. Regulating bore water pumps. For example one 100mm bore/5 acre of land holding either owned individually or combined and two up to 20acres holding provided the second bore is supporting sprinkler and drip irrigation and similar norms for large holdings. Such controlled abstraction will assist the farmer to make efficient use of available irrigation system.

5. Establish more recharging zones in addition to the ones investigated by Central Ground Water Board at other suitable central locations as required. Data collection from these recharging zones will assist in establishing trend over different time of the year regarding the level of replenishment of ground water resources for various sub regions.

6. Improving the irrigation system and changing the policy regarding the lining of main irrigation channels, by setting-up unlined loop water channels alongside lined channel alignments as a recharging basin can assist in managing the negative impact of over-pumping aquifer significantly. Such improvement works can also be viewed as a water feature for the nearby villages/locality both for recreational and vegetation purposes. This is demonstrated in Figure 1 below.

7. Damming rainfall run-off in hilly and semi-hilly areas for irrigation and recharging aquifer purposes as shown in Figure 2 below.

   Kumar, Water Management Issues– Punjab, Punjab Agriculture University, Ludhiana, India. (http://akicb.ifas.ufl.edu/powerpoints/Tuesday/watermanagement-issues-punjab.pdf)

8. Setting up network of monitoring bores will assist in assessing the replenishment and depletion level of aquifers representing the sub-regional boundaries at regular intervals. This will form the basis for effective

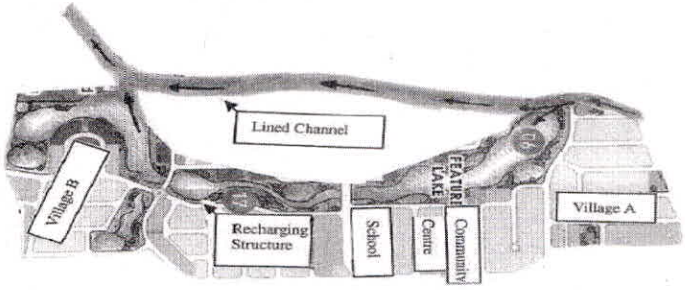

Fig. : 1

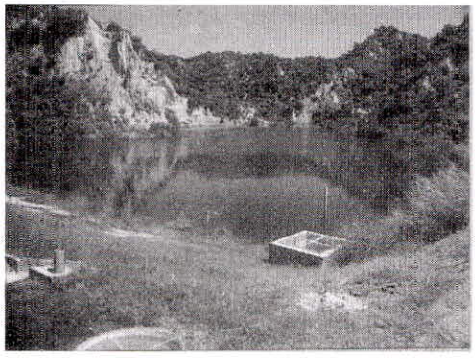

Fig. : 2

Source: Presentation by Dr AK Jain & Dr Raj Kumar, Water Management Issues– Punjab, Punjab Agriculture University, Ludhiana, India. (http://akicb.ifas.ufl.edu/powerpoints/Tuesday/watermanagement-issues-punjab.pdf).

management of groundwater demand from time to time for various sub-regions.

9. Introducing mass public awareness program on, how to be a water-wise for in both private/ domestic and industry use.

CONCLUSION

Regulatory measures proposed above, controlled pumping of aquifer and harvesting surface water to recharge ground water by creating ground water recharging zones as highlighted above will alleviate the negative impacts on the ground water regime to a considerable extent. Such practices will tend to reverse the trend over time replenishing the State's ground water reserves to a level required by the State going forward.

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