

Groundwater Irrigation in Punjab

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Abstract:

Punjab located in the north western part of India is a small state comprising 1.54 per cent of the total geographical area and little over 2 per cent of the total population in the country. It is the largest contributor of wheat (around 55 per cent) and second largest of paddy (around 42 per cent) thoughts relative contribution in central pool of food grains both for wheat and paddy has been declining during the last few years. Sustainability of agriculture in Punjab is thus important for the state's economy and also for food security in India Groundwater has played a key role in success of Green Revolution in India especially in original Green Revolution states comprising Punjab, Haryana, and western Uttar Pradesh (UP). The agriculture in state has reached a plateau making it very hard to make further progress under available technologies and the natural resource base; and the very sustainability of rice-wheat production system is under threat and climate change is posing new challenge on future agricultural growth.

Keywords: Agriculture, Green Revolution, Groundwater, Punjab

Introduction:

One of the most important challenges facing humanity today is to conserve and sustain natural resources, including water, for increasing food production while protecting the environment. As the world population grows, stress on natural resources increases, making it difficult to maintain food security. In recent years, efforts have increasingly been focused on environmental pollution and its ill effects on humans and animals. Public concern over the effects of environmental pollution continues to increase because of the industrial revolution and an enhanced understanding of the risk to human and animal health. Water is one of the important and precious

natural resources. In 1995, when the world population was ~5.7 billion, 92% people had sufficient water supply; whereas 5% had a supply considered to be “under stress,” and 3% had scarce supplies. Projections are that in 2025, when the world population is expected to reach 9.4 billion, water supplies would be sufficient for only 58%, under stress for 24%, and scarce for 18% of Indian population. Of all the water available on the earth, 97.5% is present in oceans and 2.5% is fresh water, of which only 20% is groundwater. The latter is the main source for drinking, irrigation, and industrial purposes. Among these, the agricultural sector is the major consumer of water. In India, agriculture accounts for ~89% of total water use, versus 8% by domestic sector and 3% by industrial sector. Predictions are that by 2025, agriculture’s share of the water will be reduced to 73%. Rapid industrialization and urbanization during the past few decades have increased the demand for available water and put stress on the already dwindling water resources.

Agriculture development in Punjab :

Punjab located in the north western part of India is a small state comprising 1.54 per cent of the total geographical area and little over 2 per cent of the total population in the country. It is the largest contributor of wheat (around 55 per cent) and second largest of paddy (around 42 per cent) after Andhra Pradesh to the central pool of the country; though its relative contribution in central pool of food grains both for wheat and paddy has been declining during the last few years (Singh, Grover, and Dhaliwal,(2012); Tiwana et al, 2007). Sustainability of agriculture in Punjab is thus important for the state’s economy and also for food security in India. It is well documented, that the state has witnessed tremendous increase in the agricultural production during the Green Revolution period, supported by a mix of institutional and technological factors. A total of 85 per cent of the area in the state is under agriculture. The area sown more than once has increased by 250 per cent since the late sixties. Consolidation of landholdings, reclamation of new agricultural lands, development of irrigation, use of biochemical inputs comprising high yielding variety seeds, chemical fertilizers, insecticides and mechanical inputs were among the important factors which helped agriculture in the state in making rapid strides. The emerging scene of agriculture in Punjab is facing some serious concerns. Green Revolution sustained till the eighties, after which the agricultural production in the state showed the signs of stagnation¹. This was largely attributed to continuous cultivation of rice-wheat cropping system

having negative implications for soil quality (nutrient balance), infestation of weeds and pests. In the nineties, increase in cost of inputs (increased application of fertiliser and insecticides was required to address soil health and pests issues; with falling water tables additional investment was required for irrigation) further aggravated the situation through squeezing the profitability of agriculture adversely affecting the socio-economic condition of farmers in the state.

Groundwater Issues in Punjab:

Groundwater has played a key role in success of Green Revolution in India especially in original Green Revolution states comprising Punjab, Haryana, and western Uttar Pradesh (UP). On an average there are 28 tube wells per sq. km. of net sown area in Punjab alone. Punjab is a predominantly agricultural state having 85 per cent of its area under cultivation with an average cropping intensity of 188 per cent. The water demand from agriculture in the state is therefore very high. High water demand is also attributed to the water intensive commercial crop models promoted during the green revolution. It is well documented that much of the increase in green revolution wheat and rice crops as well as commercial crop area has come from areas in which traditional rain-fed crops were grown (Punjab, Haryana and western UP). Because farmers began to adopt more water- intensive crops (incentivized by procurement and price support policies, among others) and used fertilizers that required protective irrigation, ground water development for irrigation in Punjab, especially in central Punjab which traditionally was rain-fed but had water-rich alluvial aquifers, saw a massive surge. The area irrigated by government canals² covers only 29 per cent of the total irrigated area of the state. On the other hand, net area irrigated by wells covers 71 per cent of the total irrigated area of the state. In recent decades, however, Punjab's water table has been reducing at an alarming rate, with most of the demand coming from irrigation. The rate of fall in water table was 18 cm during 1982-87; which increased to 42 cm during 1997-2002 (Hira et al, 2004) and further to 75 cm during 2002-06 (Singh, 2006). The current situation of groundwater development in Punjab is the most critical in the country as 80 per cent of the monitored wells are considered overexploited (CGWB, 2012). Annual ground water extraction in Punjab is 31.16 billion m³ as opposed to 21.44 billion m³ availability. Very high level of ground water is being extracted in Amritsar, Fategarh Sahib, Jalandhar, Kapurthala, Mansa, Ludhiana, Moga, Nawashehar, Patiala and Sangrur Districts

Groundwater level under Stress in Punjab

In India, including Punjab, land owners have the right to dig wells on their land; and access and own water underneath (private property right) (Singh Chatrapati, 1992). Given the physical and the hydro-geological attributes of the groundwater it cannot be compartmentalized such that it coincides with the landholding pattern. This unique feature of the resource can potentially constrain the private property right to the extent the wells of neighboring farmers/density of wells in village/block/area interfere with the yield/life of a given/set of well(s)⁴. Since only the landowners can own ground water, it cannot be characterised an open access resource. Further, interactive effects of wells make it difficult to assign common property rights to ground water (Chandrakanth et al, 2011). This study however, notes that a number of studies have attributed common property rights to the groundwater resource⁵. Groundwater use is strongly contextual and Inter-sectorally linked. It is important to emphasize that in India, in general, the primary driver of private groundwater use is neither resource availability nor well yield potential (Shah, 2007), but the inadequacy and unreliability of water provided through the public water supply systems, in the face of escalating water demands.

Welfare Implications

From welfare perspective, rapid decline in water tables can result in significant social cost. Sekhri (2011) uses groundwater data in conjunction with annual agricultural output data at the district level to show that a 1 meter decline in groundwater from its long term mean can reduce food grain production by around 8 percent. Using village level data from UP and the fact that there is a non-linearity in cost to access groundwater at 8 meters, Sekhri (2012b) shows that poverty rate increases by around 11 percent as groundwater depth falls from over 8 meters to below 8 meters . Department of Drinking Water Supply, Government of India estimates that in 2010, approximately 15 percent of the total habitations in the country went from full coverage of drinking water to partial coverage due to drying up of ground water sources.

The Main Issues in Punjab:-

Punjab is a unique case of extreme ecosystem vulnerabilities- while ground water is declining at an alarming rate in many parts of the state, the south-western parts are facing problems of severe water logging and high levels of salinity in water and soils ⁸ (Kulkarni and Shah 2013). The

ground water for irrigation which is a complex situation characterized by overexploitation (largely attributed to crop intensification and unsustainable crop mix), negative externalities (due to interactive effects of wells), inefficiencies (low productivity of water), and inequities (initial and premature well failure). Both the primary and secondary drivers coupled with weak or absent water management policies and institutions are said to be responsible for much of the problem. Incentives and penalties are thus crucial in bringing about sustainability, efficiency and equity in water use.

Policy and Programs for Groundwater Management

For the sake of improvement in the levels of groundwater there are numerous programmes and policies have been initiated as follows:

Legislative provisions: The Indian Constitution provides the states jurisdiction over the groundwater within their boundaries. Also, state governments have the primary responsibility for water supply and irrigation with powers to devolve these functions to up to village level institutions. At the central government level, the Ministries of Water Resources (MoWR) and of Environment and Forests (MoEF) are responsible for evolving policy guidelines and for enforcing protection of surface and groundwater resources both in terms of quality and quantity. Since water is a state subject, the policy guidelines are mostly of an advisory nature with the implementation left to the state governments. Some of the states (See, Planning Commission, 2007) have already enacted groundwater legislation, although at various stages of development. The Planning Commission's Expert Group on Groundwater Management and Ownership has argued that the legislative framework is reasonably robust, in that in principle it enables the groundwater management practices that are likely to be pragmatic and effective in India. The priority lies in enforcement of existing measures, supported by innovative approaches such as an expansion of community- based management.

Administrative and organizational set up: Management of groundwater suffers from fragmentation of responsibility at both central and state levels. Many agencies in various sectors have mandates relevant to groundwater, but there is little coordination among them and a lack of regulatory oversight. Not all states have dedicated groundwater authorities, and in almost all

cases groundwater-related agencies suffer from understaffing, lack of capacity, marginalization, and outdated mandates that prioritize survey and development ahead of resource management.

The Punjab state government is yet to formulate groundwater legislation despite serious depletion of groundwater levels (particularly in central Punjab). Punjab does not mandate rain water harvesting. However, recent initiatives such as:

- (i) Incentives for changing cropping pattern,
- (ii) regulation mandating delayed paddy nursery and sowing activities (The Punjab Preservation of Sub Soil Water Act 2009)
- (iii) Considering reforms in agricultural power sector
- (iv) Other demand and supply side measures are significant positive steps.

Crop Diversity Program

The purpose of this program (government of India designed and funded program)⁹ is to motivate farmers in Original Green Revolution States to divert the area of paddy to alternate crops (maize, Kharif pulses, oilseeds, cultivation of rabi and Kharif inter-crops) from ensuing Kharif season. Through this program the following is expected to be achieved:

- (i) To demonstrate and promote the improved production technologies of alternate crops for diversion of paddy cultivation;
- (ii) To restore the soil fertility through cultivation of leguminous crops that generates heavy biomass and consumes less nutrient intake.

The program will be implemented in the notified over-exploited and critical blocks based on the recommendation of CGWB. At least 5 per cent of area under paddy in identified blocks will be diverted towards alternate crops. The program provides for assistance for land development, farm mechanisation, and establishment of agro-based processing units for value addition, and marketing support to generate additional income and restore soil fertility. The program will be implemented by the central government through a Central Steering Committee constituted for the purpose. An amount of Rs. 500 crore has been earmarked under Rashtriya Kisan Vikas Yojana for the year 2013-14.

The Punjab Preservation of Subsoil Water Act, 2009

It is encouraging that the Government of Punjab has recognized that overexploitation of groundwater is an issue of serious concern and has recently implemented this Act to contain it. The main purpose of the Act is to save groundwater by prohibiting sowing and transplanting paddy before specified dates in hot and dry Crop Diversity Program in Punjab, Haryana, and western Uttar Pradesh (2013-14), Ministry of Agriculture, Government of India summer10 period. The Act prohibits farmers from sowing nursery of paddy before 10th May and transplanting paddy before 10th June in a year. Any farmer, who contravenes the provisions of the Act, shall be liable of penalty of rupees ten thousand for every month or part thereof, per hectare of the land till the period such contravention continues. The authorised officer, either suo motto or on the information brought to his notice regarding the violation of any provision of the Act, shall be competent to issue directions to the farmer, who has violated any provision of this Act to destroy the nursery of paddy or sown or transplanted before the notified date. In case, a farmer does not act as per the directions of the authorized officer given under the section 5, the authorised officer shall cause such nursery of paddy, or sown or transplanted paddy, as the case may be, to be destroyed at the expenses of such farmer. The intuitive reason for this could be in farmers' response to policy in increased number of irrigation applied or more water used per irrigation. The study observes that in the absence of farm level data on number of irrigation applied and water use, it is not possible to establish the mechanism.

Introducing reforms in agricultural power

All tube-wells would be electrified by 2015 although there are no plans of metering of electricity at the tube-well level which is estimated to cost Rs.700 crores. Electricity consumption is currently monitored only at the feeder level. It appears that the government is open to learn from experiences based on the Gujarat model of separate feeders for agriculture and 24 X 7 electricity provisions.

Other Measures

Policy on use of technological solutions such as happy seeders, laser levelers for promoting water use efficiency and other Resource Conservation Technologies (RCTs) for water saving and increasing productivity is under consideration. Some of these technologies are already in use

although there is no government policy yet on promoting the same. There is hardly any rainfall up to 15th June in Punjab and the relative humidity is lowest, wind speed is highest and temperature is maximum, due to which water evaporates very fast (Karam Singh, 2009). These estimates are based on simulations using historic data from central Punjab and does not account for selection issues (Sekhri, 2012a).

Artificial recharge project in Moga District: As per the available estimates, all the blocks in Moga district are categorized as over exploited where ground water withdrawal has exceeded natural recharge by more than 200 per cent. The decline of water levels has severely impacted the farmers of the area especially those having land less than 2 hectare. It was reported that in this area many farmers started migrating to non-farming activities such as dairy farming or even selling off their lands to big landlords having adjoining farmlands. In order to augment the dwindling ground water resources, a project for artificial recharge was taken up for augmenting the depleted aquifer through artificial recharge in Bassian Drain in Moga district. The project is reported to have shown encouraging results. In an area of 11sq. km the observed rise in water level was 0.20m that could also save 15 megawatt of energy due to reduced lift of pumps. The farmers of the area also reported that there is appreciable increase in discharge of their shallow tube-wells due to artificial recharging of aquifer system of the area. This project can potentially be replicated (Gupta and Marwah, 2012)

Conclusion:

Understanding groundwater overexploitation/use is complex and very much influenced by numerous natural, economic and political factors at play; and these factors vary a lot across and within natural-social-economic-political boundaries and interact in many different ways among themselves. Therefore no one solution/success story can be successfully implemented/replicated in entirety. (ii) There is urgent need to put a strategy in place to 'manage' the resource for which the necessary condition is that we know the resource; credible estimates of total consumption of irrigation water, electricity and diesel disaggregated by crops, regions etc. Similarly, credible information on productivity of water under different crops and other local conditions. This will

help identify different aspects (technology, seeds, and other farming practices) which need to be targeted.

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