



Precision Irrigation: The Next Avenue of Highly Irrigated Punjab

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ABSTRACT

Precision in irrigation means to cater to the water requirements of every individual plant and not that of the soil, thereby yielding higher production and productivity with reduced costs and increased water use efficiency. The net irrigated area of Punjab has increased during the 1970s to the present day i.e. from 71% to 99% against the national average of 34.5%, thereby, making it the highly irrigated state of the country. Laser land leveler, tensiometer, Happy Seeder, and zero-till – drill are some of the resource conservation technologies (RCT's) that have been widely adopted by the farmers. Some of these technologies have been developed by the Punjab Agricultural University over time and the University has been imparting the technical know-how and economics of usage of these RCTs. This paper tries to economically review the land degradation problems and the prevalent precision irrigation technologies in the state to save the resources and the cost as well. Over the years, the share of irrigation cost in the total cost of production for wheat has declined from 4.35% in 1970-71 to 2.02% in 1991-2001 and 0.96% during 2015-16 while the production of wheat has increased from 5.1 thousand MT in 1970-71 to 15.09 thousand MT in 2000-01 and 16.08 million MT during 2015-16. This indicates that the irrigation cost has a negative, while the irrigation has a positive relationship with wheat production.

Keywords: Precision irrigation, Punjab, Resource Conservation Technologies (RCTs), Mechanization

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INTRODUCTION

From time immemorial, it has been said that agriculture couldn't be carried out without water. In the early texts regarding domestication and cultivation of crops, it is very clearly mentioned that people used to cultivate according to the anticipation of monsoon. The Encyclopedia Britannica has mentioned that during the later Vedic period (1000-500 BC) irrigation was practiced. Megasthenes was a Greek diplomat who visited India during 300 BC and documented his experiences in the book Indika, stating that 'since there is a double rainfall (i.e. the two monsoons) each year the inhabitants of India almost always gather in two harvests annually'. So this literature from the history of Indian agriculture proves that the farmers have always considered water/ irrigation as one of the important ingredients for crop husbandry. The irrigation has then traveled a long course from flooding the entire field to applying water to each plant according to its need. Earlier draught animals were used for lifting water for irrigation which has been replaced by diesel pumps or electric motors, leading to the mechanization of irrigation.

A lot of advancements in irrigation took place over time, but the precision irrigation practices have been proven to be the most prominent and resource-efficient. Some studies have concluded that the irrigated gross cropped area positively affects the cropping intensity and productivity of the crops (Verma, 2006; Lohan *et al*, 2015) [13] [4]. The facilities of tube-well irrigation and the usage of mechanical power for irrigation helped the farmers in raising the cropping intensity of their farms (Patil & Sirohi, 1987)[5]. Another study carried out by Singh (2001) pointed out that the cropping intensity largely depended upon the availability of both annual water and farm power. He further concluded that the highly irrigated states like Punjab, Haryana and Uttar Pradesh which are having access to higher availability of fertilizer dosages and power per hectare, as well, were reaping higher grain yield per hectare than the rest of the country [8]. Singh (1992) used rank correlation analysis to prove that the agricultural irrigation facilities and crop productivity were the important determinants of tractorisation of agriculture [6]. Ghosh (2010) applied

logit analysis to the study variables and revealed that irrigation had a positive significant bearing on the farm mechanization level in the farms of West Bengal [3]. All the studies that have been carried out to relate grain yield with that of the availability/ actual application of irrigation have more or less concluded on the same line that these two variables show a positive relationship. Singh *et al* (2015) studied the performance of zero-till-ferti-cum-seed drill for wheat cultivation at farmers' fields in Uttar Pradesh and calculated the cost incurred by the farmers following traditional vis-a-vis new technology. The average cost incurred on irrigating the field in case of zero-till drill sown crop was found to be Rs. 2592 per hectare, which was Rs. 667 per hectare lower than the conventional system thus saving 21 per cent of the cost incurred on irrigation [9]. The Punjab farmers enjoy the free electricity connection for irrigation purpose, thereby leading to wide-spread adoption of mechanization in agriculture.

Today's irrigation technology is offering a customized irrigation schedule and service for every crop. For example, laser land leveling technology can level undulated fields of any area, big or small and it is an important operation for ensuring better distribution of water on the field in one hand and saving it on the other hand; increasing crop productivity and even helping in precision farming. There are other technologies such as zero-tillage, raised bed planting, precision irrigation, micro-irrigation, mulching, etc. which are used by the farmers to conserve water and cater to the needs of individual plants than that of the field. Before the introduction of these technologies, irrigation was considered to be one of the most labour intensive operations in agricultural production, especially in crops like cotton and groundnut. The government has allotted a tax slab of 18 % on the irrigation and related equipment's thereby leading to an increase in the cost of these machines and structures (FICCI, 2017) [2].

Government intervention in precision irrigation

Rural electrification has played a major role in mechanizing the irrigation activity and there has been a tremendous increase in both the no of motors installed by the farmers and the size of these motors, due to gradual decline in the water-table in several areas. The state government of Punjab has provided financial assistance to the farmers to purchase irrigation machinery for popularizing its usage thus, making Punjab the highest irrigated state (> 90%) in the country. Presently, the state government is focusing on resource conservation technology (RCT) like laser land leveler, happy seeder and zero-till-drill. Pradhan Mantri Krishi Sinchai Yojana (PMKSY) was launched by the central government for five years (2015-16 to 2019-20) with an outlay of Rs. 50,000 crores. 'Har Khet Ko Pani' is one of the major components of PMKSY which aims at creating minor irrigation; repair, restoration, and renovation of water bodies; and command area development as new water sources. Efficient water conveyance and precision water application equipment such as drip, sprinkler, etc. are being promoted under the 'More Crop per Drop' scheme and during 2017-18, an outlay of Rs. 2500 crores earmarked for micro-irrigation. The government had extended Interest Subvention Scheme during 2017-18 to provide agricultural credit at affordable rates, thereby, helping farmers in getting short term crop loans up to Rs. 3 lakh at only a 4 per cent interest rate for purchasing micro-irrigation types of equipment. The government is promoting advanced irrigation systems in order to decrease the cost of cultivation and increase the water use efficiency, thus making agriculture more profitable for the farmers. Irrigation pumps, sprinklers, and drip irrigation sets are the major tools that have been adopted by the farmers under the category of mechanization in irrigation. The level of mechanization in irrigation is up to an extent of 34 per cent in Indian agriculture. Western India has a comparatively highest consumption of irrigation systems (2.1 %) in comparison to the other regions as it comprises of dry farming states such as Rajasthan, Gujarat and Madhya Pradesh. Singh (2017) calculated the mechanization index for irrigation and found that it was very low because a very less proportion of sample farmers used the generator for irrigation purposes in Punjab [7].

RESULTS

The secondary data about the mechanization in Punjab agriculture has been extracted from various sources like statistical abstract of Punjab, research papers.

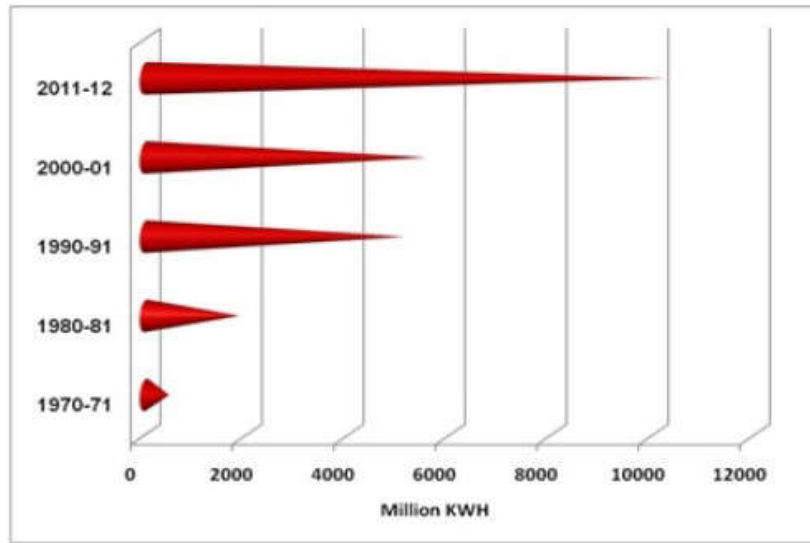


Figure 1: Consumption of electricity by agriculture in Punjab. Source: Statistical Abstract of Punjab, 2011-12

Figure 1 clearly shows the decadal increase in the consumption of electricity by the agriculture sector in Punjab.

Table 1: Average cost of cultivation of wheat along with per cent share of irrigation charges (Rs. /hectare)

Year	Irrigation charges		Average cost of cultivation for wheat		% share of irrigation to total cost	
	Punjab	India	Punjab	India	Punjab	India
1970-71	71.95	83.99	1654.59	1417.05	4.35	5.93
1970-81	109.96	134.56	2489.91	2100.57	4.42	6.41
1981-91	179.56	297.98	5592.92	4291.48	3.21	6.94
1991-01	321.8	832.29	15964.32	12669.42	2.02	6.57
2001-05	431.33	1724.32	23135.18	19269.48	1.86	8.95
2004-05	461.72	2034.49	24197.48	19910.52	1.91	10.22
2014-15	498.45	2576.20	52590.47	40700.49	0.95	6.33
2015-16	545.04	3220.76	56985.24	46466.88	0.96	6.93

Source: DES, Ministry of Agriculture & Farmers Welfare [1]

Table 1 reveals that the state of Punjab has always had a higher total cost of cultivation of wheat than that of the national average total cost but it has always had lesser irrigation cost than that of the national average irrigation cost. The table further reveals that the cost of irrigation has contributed less and less towards the cost of cultivation of wheat in the case of Punjab farmers.

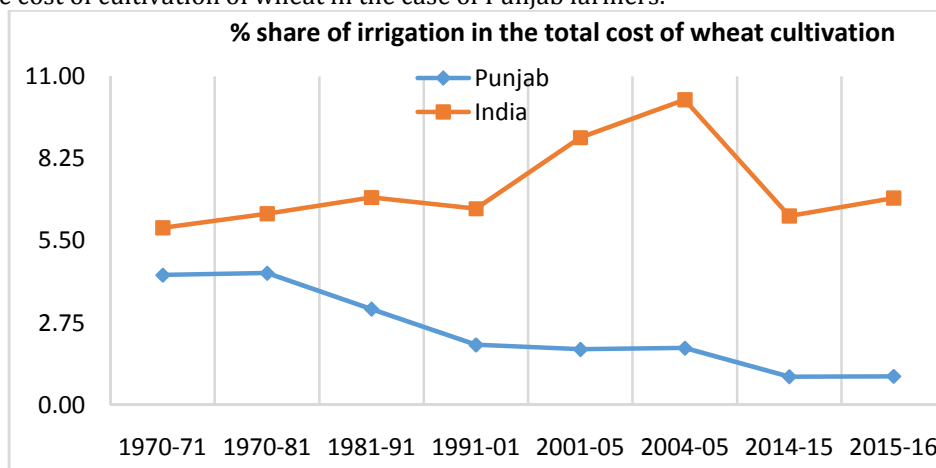


Figure 2: Per cent share of irrigation in the total cost of cultivation of wheat in Punjab and at national level.

The share of irrigation in the total cost of wheat cultivation has gradually decreased over the years for the Punjab state growers but for the country as a whole, the share of average irrigation cost has increased. The major reasons behind this decreasing cost may be attributed to the fact that in Punjab, farmers have access to almost free electricity for carrying out irrigation work. While, in the rest of the country, there aren't many programmes for providing free electricity services to the farmers.

	Weight	CIPI				Changes in CIPI of 2017-18 over 2016-17
	2015-16	2014-15	2015-16	2016-17	2017-18	
Irrigation	0.13	117.58	121.34	125.8	130.56	3.8

Source: CACP Calculations [12]

Table 2 shows that the year of 2011-12 was taken as the base year and the Rabi Crops Input Price Index (CIPI) has continued to increase from 2014-15 to 2017-18, depicting a positive change in CIPI. Different weights were assigned to different inputs, irrigation along with fertilizer were given the third highest weight age amongst all the tangible farm inputs i.e. 0.13.

Table 3 (a): Water saved and yield advantage achieved by Punjab Agricultural University, Ludhiana for various crops under Surface drip irrigation

Crops	Water saving (%)	Yield Advantage (%)
Kinnow	40	8-10
Spring Maize, Spring Sunflower	33-40	21-28
Potato, Chilli, Onion, Pea, Brinjal	33-50	10-15

Table 3 (b): Water saved and yield advantage achieved by Punjab Agricultural University, Ludhiana for various crops under Sub-surface drip irrigation

Crops	Water saving (%)	Yield Advantage (%)
Wheat-Maize (2018)	53	9
Wheat-Rice (2018)	47	2
Sugarcane	30	23

An additional saving of 20 per cent of fertilizers was realized when fertigation was employed by the farmers. The approximate investment for field crops for ~ 60 cm drip line spacing was found to be Rs. 1,20,000/acre while for larger blocks i.e. >5 acre it was found to be Rs. 80,000/acre. The field capacity of the machine for underground laying of drip lines is 1 acre/4 hours.

DISCUSSION

Decadal growth in electricity consumption in Punjab agriculture can be mainly attributed to the increase in usage of electrically operated motors used for irrigation purposes (Table 1). There is no doubt that the cost of cultivation of wheat surpasses the national average but the irrigation cost incurred in the state is lesser than that of the country's average (Figure 1). The underlying reason for this being the power subsidy, has led to a lot of debates to what should be done about the subsidised agricultural practises. According to Punjab State Electricity Regulatory Commission, this power subsidy has amounted to Rs. 6060 crores in the agricultural sector alone, which is yet to be paid by the state government to the Punjab State Power Corporation Ltd. as of 2019. Centre for Research in Rural & Industrial Development's Report only 18.448 per cent of the beneficiaries of power subsidy belong to the category of small and marginal farmers, while the rest of the 81.52 per cent belong to the middle and large farmers category. A strict action needs to be taken up for targeting the end beneficiaries of this power subsidy scheme as the state government is in a situation of heavy debt by loosening up its burden by cutting off the >80 per cent self-sufficient medium and large farmers and hence saving up on the cost.

Irrigation is considered as one of the important inputs in case of Rabi crops as water is essential in all the stages of the plant right from germination to the maturity, any excess or lack of irrigation can lead to significant yield loss. The All India Rabi Crops Input Price Index (CIPI) has continued to increase from 2014-15 to 2017-18, depicting a positive change in CIPI, which in turn indicates towards the rising irrigation cost in the country as a whole (Table 2). This irrigation cost can be minimized to some extent by employing precision irrigation practices i.e. by catering to the needs of the plant and not that of the soil, thereby saving the water and the cost incurred in doing so. The research work carried out by researchers in various parts of the country has proven that precision irrigation not only helps in saving water but also helps in maintaining the soil and plant health coupled with increased water use efficiency. The depleting

water table of Punjab is another problem which can adversely affect the Punjab Agriculture, therefore precision farming can be used as an alternative technique for helping the farmers carry out agricultural operations at ease, without facing water scarcity. Some studies have even shown that the drip and sprinklers are a cost-cutting technology, as they help the farmers in saving the cost incurred to them. Therefore, precision irrigation has proven to be better than conventional irrigation systems on the economic front as well. The major hindrance that can be pointed out is the non-availability of the funds with the farmers, required to buy and install these systems.

CONCLUSION

The data have shown that over the years Punjab has become the highly irrigated state of India (99%) along with providing irrigation services at almost free of cost to the farmers under power subsidy. This power subsidy has helped the farmers to save their cost on irrigation and invest in installing precision irrigation systems, but the problem of targeting the beneficiaries under the power subsidy scheme is still questionable. Most of the kinnow growers in the state have employed micro-irrigation systems in the field to save water and irrigation cost. In addition to this, the farmers in the state have recently added laser land levellers in their farm inventories as 7200 levellers were found in the state during 2012-13. Water harvesting, resource conservation technology (RCTs) machines such as laser land leveller, furrow-ridge and bed planter, Inter-crop planter, pneumatic precision planter, sugarcane harvester, a cotton picker, tractor operated pond excavation machinery, drip, and sprinkler irrigation system needs to be promoted so that their adoption could be increased. Government can also come up with some schemes for encouraging farmers to take up precision farming as providing blanket power subsidy to all the farmers is not a long term solution to save on the cost but precision irrigation is and can be that solution for not just the Punjab farmers but also for the whole nation.

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