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A Study of Water Irrigation Pattern towards Agriculture Power in Haryana

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ABSTRACT

Irrigation water is one of the critical components in agriculture. The natural source of irrigation is rainfall which is unreliable and unpredictable in terms of quantity, incidence, frequency and duration in the present scenario. In order to over the problem of irrigation water deficiency, dependence on artificial sources of irrigation water has increased over the period. The improvement in agricultural production & productivity depends primarily on the expansion of irrigation facilities. Irrigation has also led to an increase in cropping intensity. A significant proportion of net irrigated area in Haryana has been dependent on tube well irrigations. Farmers generally prefer groundwater for irrigation because of its reliability and flexibility. Ground water has been extracted by electric tube wells and diesel pump sets.

1. Introduction

The power sector exerts a critical influence on the performance of the agriculture sector as it affects farmer access to and use of electricity for a variety of irrigation operations, particularly pumping ground water for irrigation. Under the strategy of green revolution state governments have adopted a policy of providing free or subsidized power to farmers to increase agricultural productivity to ensure food security in the country. Consequently, the number of electric tube wells has increased over the period of time. In order to reduce transaction costs, the utilities removed meters and introduced flat tariffs for electricity supply to agriculture sector. Many states shifted to free and unmetered supply to agriculture which has underscored system of energy accounting and internal accountability in power utilities. Lack of adequate/ proper energy accounting system motivates the utilities to hide operational inefficiency and theft of electricity by non-agricultural consumers. Moreover, subsidised supply of electricity motivates people to utilise the scarce resources, particularly ground water and electricity, in an inefficient manner. Consequently, the crisis for sustainable development of agriculture as well as power sector becomes inevitable. Groundwater overexploitation has reached near-crisis level in many of the Indian states. If current trends of declining groundwater tables continue, a majority of all aquifers in India will be in critical condition in near future. With this background, the study on optimisation of agriculture power subsidy and irrigation water intensity is timely as it tends to highlight the implications of the subsidized power supply to over utilisation of ground water and agriculture sector in the state. The study has broadly focused on the perception of the households regarding irrigation pattern and its implications for sustainable agricultural growth in the state along with the estimation of over utilisation of electricity and ground water.

The agriculture sector is a key to the economic development of Haryana as more than 60 per cent population depends, directly or indirectly, on agriculture. Irrigation water is one of the critical components in agriculture. The natural source of irrigation is rainfall which is unreliable and unpredictable in terms of quantity, incidence and duration in the present scenario. In order to over the problem of irrigation water deficiency, dependence on artificial sources of irrigation water has increased over the period. Irrigation water comes mainly from two sources i.e., surface water and ground water. Surface water is provided by the flowing water of rivers or the still water of tanks, ponds, lakes, and artificial reservoirs. The surface water is carried to the fields by canals, distributaries, and channels. Ground water has been extracted by electric tube wells and diesel pump sets. The improvement in agricultural production & productivity depends primarily on the expansion of irrigation facilities. Irrigation has also led to an increase in cropping intensity. A significant proportion of net irrigated area in Haryana has been dependent on tube well irrigations. Apart from tube well irrigations, a segment of the farmers depend on canal irrigation also. Farmers generally prefer groundwater for irrigation because of its reliability and flexibility.

Agrarian transformation in Punjab & Haryana under the Green Revolution strategy generated tremendous demand for power in agriculture sector. Despite that Haryana being close to Delhi, the national capital, industrialisation and urbanisation spread in areas located in the national capital region at relatively faster pace. Punjab & Haryana is based on peasant proprietorship and therefore, increase in production and productivity in agriculture has enhanced the purchasing power of almost all the sections of the society which gave a boost to the commercial activities in the State. The accelerated growth in the wide range of economic activities was made possible by a very high growth in energy consumption by various categories of consumers. The power sector exerts a critical influence on the performance of the agriculture sector as it affects farmer access to and use of electricity for a variety of irrigation operations, particularly pumping ground water for irrigation. Electricity is the most versatile form of energy that is used as an input in agriculture production.

2. The major policy recommendations Water Irrigation pattern in Haryana:

- A significant proportion of power supply to agriculture sector is unmetered at consumer ends.
- The Electricity Regulatory Commission in Haryana has failed to work out and enforce a realistic and progressive tariff structure reflecting consumer category wise cost of supply.

- One unintended outcome of highly subsidized power supply to agriculture sector has led to reduction in diversification of cropping pattern in Haryana.
- Paddy cultivation is most preferred crop in kharif season across the sources of irrigations, except canal irrigation.
- The households who mainly depend on canal irrigation and their land holdings lies near the bank of canal have also shown interest in paddy cultivation.
- Wheat paddy mono cropping pattern is prominently prevailing in most of the Haryana, except southern districts.
- The crop diversification has been influenced from extension of irrigation facilities. The quality & reliability of irrigation water affects the cropping pattern wherein the farmers select crops that give them a higher return from each unit of land they cultivate.
- Wheat and paddy crops have played a major role in pushing up the agricultural production in the state but excess utilisation of ground water and electricity consumption led to agricultural un-sustainability.
- The existing mono cropping pattern has been environmentally & economically unsustainable.
- Paddy is not a natural crop of Haryana and it consumes a lot of irrigation water in hot weather.
- Paddy cultivation is economically viable only because of highly subsidised irrigation water and Minimum Support Price (MSP) provided by the state government.
- Most of the households are stick to their existing cropping pattern mainly due to non-availability of suitable alternate crop on the one hand and lack of adequate cold storage and assured markets to sale agricultural produce on the other.
- Per acre actual irrigations through electric tube wells were relatively high than that of rest of the sources of irrigations in most of the Kharif & Rabi crops. It may be due to a perceptible proportion of the electricity supply to agricultural pump sets is unmetered and is provided at highly subsidised rates in Haryana and consequently the farmers are motivated to utilise groundwater as well as electricity inefficiently.
- Canal irrigation is regulated due to unavailability of sufficient flow of irrigation water whereas irrigation through diesel pump sets put direct financial burden on the farmers which forced them to think about efficient usage of irrigation water to some extent as they utilise diesel pump sets only whenever it is required.
- There are hardly any efforts from the state government to motivate farmers for efficient utilisation of electricity and ground water.
- Deterioration in quality of soil was observed which occurred mainly on account of continuous excess use of ground water for irrigations, chemical fertiliser and pesticides. The households pointed out that canal irrigation is relatively more conducive for cultivation as compared to ground water.
- Deterioration in soil quality has been reflected in terms of low productivity of soil on the one hand and poor quality of produce on the other.
- Majority of the households reported bad quality of groundwater. The quality of ground water tended to deteriorate with excess extraction of ground water for irrigation.
- A majority of the households (64 per cent) reported decrease in ground water table in their fields whereas 27 per cent households rejected this proposition. Nearly 9 per cent households did not have any knowledge about the decrease in ground water table in their fields.
- The highest share of the households reporting decrease in ground water table was in the category of diesel pump sets. These households are relatively more aware about decline in ground water table mainly because diesel pump sets extract water from upper layers of the soil and the households are forced to insert more pipes in the ground more frequently. Electric tube wells are used for submersible pump sets.
- Over extraction of ground water leads to deplete the ground water table on the one hand and deterioration of the quality of ground water due to sea water intrusion and/ or the upward diffusion of deeper saline water on the other.
- The problem of salinity appeared in the areas where ground water is used for irrigations rampantly. Using saline ground water for irrigation may also increase soil salinity.
- A majority of the sampled households reported increase in the problem of soil salinity in their areas particularly in the categories of electric tube wells and diesel pump sets.
- A perceptible proportion of the sampled households (84.51 per cent) reported the problem of irregular supply to their tube wells. The households highlighted that the state government has fixed duration of 8 hours per day for power supply to agriculture sector. But the supply remained interrupted and irregular during most of the period. Such practices have led to inefficiency and wastage of ground water as well as electricity.
- A majority of the marginal & small farm households were interested in metered supply and they were also ready to pay for assured quality supply. But most of big farmers were not interested in paid supply. They were interested in the existing system of subsidised power supply.

3. Irrigation source wise production and productivity

With the extension of irrigation facilities, the utilisation of High Yielding Varieties (HYVs) seeds, pesticides and chemical fertilizers have led to a significant growth in productivity of the crops over the period of time. The irrigation water supply becomes a critical input in the agricultural production process. Timely available irrigation water motivates the farmers to invest in other inputs like HYV seeds, fertilizers etc., all of which are helpful to increase crops productivity. In other word, crops productivity mainly depends on the reliability and quality of irrigation water applied. Improved reliability of irrigation water may ensure better timing of irrigation for crops' growth. Non availability of irrigation water at critical stages of growth can significantly reduce the crop growth and yield. The Table 1 presents irrigation source wise production and productivity of major crops in Kharif season. The data shows that the productivity of bajra was found more than 6.5 quintals per acre across the sources of irrigations. The productivity of gawar was more than 3.50 quintals per acre under all the different sources

of irrigations, except the category of diesel pump sets irrigations.

Table 1: Irrigation Source wise Production & Productivity of Major Crops in Kharif Season

Particulars	Canal Irrigation			Electric Tube well Irrigation			Diesel Pump Sets			Other Sources		
	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)
Bajra	35	228	6.51	635	4395	6.92	247	1734	7.02	213.5	1398	6.54
Gawar	48	168	3.50	457	1602	3.51	185	550	2.97	326	1064	3.26
Paddy	15	278	18.53	1918	35951	18.74	648	9174	14.16	1017	18530	18.22
Cotton	8.5	32	3.76	140	468	3.34	147	538	3.66	383.5	1563	4.08
Onion	-	-	-	45	1440	32.00	14	415	29.64	7	230	32.86
Mung	-	-	-	-	-		-	-	-	27	100	3.70

The data further indicates that irrigation source wise productivity of paddy was 18.53 quintals for canal irrigations, 18.74 quintals for electric tube wells, 14.17 quintals for diesel pump sets and 18.23 quintals per acre for other sources of irrigations. Similarly, the productivity of cotton also varied from 3.35 quintals to 4.08 quintals per acre across the sources of irrigations. It has been observed that the productivity per acre of main Kharif crops under canal irrigations was comparable with the productivity under remaining sources of irrigations. It is also pertinent to note that the households whose land holding lies on the bank of canal generally prefer paddy cultivation in Kharif season in the category of canal irrigations. The Table 2 shows irrigation source wise production and productivity of major crops during Rabi season.

Table 2: Irrigation Source wise Crop wise Productivity in Rabi Season

Particulars	Canal Irrigation			Electric Tube well Irrigation			Diesel Pump Sets			Other Sources		
	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)	Area (Acre)	TP (Qtls)	Prod (Qtls)
Wheat	65	1032	15.88	3511	55045	15.68	1216	19463	16.01	1705	27673	16.23
Mustard	43	279	6.49	650	4139	6.37	286	1883	6.58	372	2420	6.51
Barley	-	-	-	45	675	14.96	2	30	15	10	174	17.40
Vegetables	-	-	-	9	106	11.78	2	18	9	-	-	-
Sugarcane	-	-	-	29	7930	273.45	17	4900	288.23	51	15550	304.90

The data reveals that the productivity per acre of wheat was 15.88 quintals under canal irrigations relatively higher than 15.68 quintals under electric tube well irrigations. The productivity of wheat was 16.01 quintals and 16.23 quintals per acre under diesel pump sets and other sources of irrigations respectively. The productivity of mustard, second major crop in Rabi season, was found 6.49 quintals, 6.37 quintals, 6.58 quintals and 6.51 quintals per acre under canal, electric tube wells, diesel pump sets and other sources of irrigations respectively. Per acre productivity of barley was 14.96 quintals under electric tube well irrigations, 14.17 quintals under diesel pump sets and 17.40 quintals under other sources of irrigations. Similarly, per acre productivity of sugarcane was found 273.44 quintals under electric tube well irrigations, 288.23 quintals under diesel pump set irrigations and 304.90 quintals under other sources of irrigations. Some households have also shown interest in growing seasonal vegetables like onion, carrot, ladyfingers etc. Per acre productivity of vegetables was found 11.78 quintals and 9 quintals under electric tube wells and diesel pump sets irrigations respectively.

It has been observed that per acre productivity of wheat and mustard under canal irrigations was marginally higher than that of electric pump set irrigations. It may be noted that the crop diversification has been influenced from extension of irrigation facilities. Moreover, the quality & reliability of irrigation water affects the cropping pattern wherein the farmers select crops that give them a higher return from each unit of land they cultivate. It may be argued that wheat and paddy crops have played a major role in pushing up the agricultural production in the state but excess utilisation of ground water and electricity consumption led to agricultural un-sustainability. The area under paddy cultivation needs to be brought down on priority basis due to irrigation water shortages. It should also be noted that paddy is not the staple diet of Haryana.

4. Irrigation pattern in agricultural growth in Haryana

Ideal irrigation pattern depends on optimum water requirement by a crop to grow and availability of source wise irrigations. The comparison between optimum numbers of times a crop required to be irrigated with actual number of times of irrigations helps us to estimate wasteful consumption of irrigation water and electricity, if the pump is operated by electricity. It is pertinent to reveal that depth and number of irrigations depends on many factors such as weather conditions, especially the intensity and frequency of rainfall during the crop season, type of soil (sandy, clay, sandy loan etc.), irrigation methods to be adopted (flood, sprinkle etc.) and other management practices being followed.

Table 3: Source wise Crop wise Irrigation Pattern in Kharif Season

Particulars	Optimum No. of Irrigations Required*	Actual No. of Irrigations			
		Canal	Electric Tube wells	Diesel Pump sets	Other Sources
Bajra	1-2	1.33	2.84	2.04	1.83
Gawar	1-2	1	1.82	1.82	1.65
Paddy	15-20	18.33	46.31	36.70	39.51
Cotton	3-4	2.33	4.27	3.87	3.53
Fodder	3-4	4	4.33	4.17	4.33

The Table 3 presents the comparison of crop wise optimum number of times of irrigations required and number of times of actual irrigations per acre with different sources of irrigations during Kharif season. The data clearly shows that average number of times of actual irrigations is significantly higher than optimum number of times of irrigations was required in most of the Kharif crops across the sources of irrigations, except canal irrigation. In case of paddy, being a highly water intensive crop in Kharif season, the recommended optimum number of times of irrigations is between 15-20 per acre but actual average number of times of irrigation through canal, electric tube well, diesel pumpsets and other sources of irrigations was 18.33, 46.31 , 36.70 and 39.51 respectively. It is pertinent to note that average actual number of irrigations (46) with electric tube wells in paddy cultivation is more than double the optimum number of irrigations (15-20) required. Interestingly, actual average number of times of irrigations through electric tube wells is much higher than rest of the sources of irrigations in most of the Kharif crops. It clearly indicates towards over utilisation of ground water through electric tube wells.

Table 4: Source wise Crop wise Irrigation Pattern in Rabi Season

Particulars	Optimum No. of Irrigations Required*	Actual No. of Irrigations			
		Canal	Electric Tube wells	Diesel Pump sets	Other Sources
Wheat	5-6	3.43	5.52	4.62	4.70
Mustard	2	2.00	2.54	2.26	2.10
Barley	4-5	-	5.25	4.00	3.50
Sugarcane	12-14	-	22.00	15.00	14.00
Fodder	6-8	-	6.91	6.07	6.00

The Table 4 presents crop wise optimum number of irrigations required and source wise actual number of irrigations in Rabi season. The data reveals that source wise average number of times of actual irrigations for most of the Rabi crops was within the specified range of optimum number of times of irrigations, except sugarcane & barley in the category of electric tube wells irrigations. It was observed that the average actual number of times of irrigations for sugarcane (22) through electric tube wells was perceptibly higher than the optimum number of times of irrigations required (12-14). It has also been observed that per acre actual irrigations through electric tube wells was relatively high than that of rest of the sources of irrigations in most of the Kharif & Rabi crops. It may be due to a perceptible proportion of the electricity supply to agricultural pumpsets is unmetered and is provided at highly subsidised rates in Haryana and consequently the farmers are motivated to utilise groundwater as well as electricity inefficiently. Due to unmetered supply to agriculture, energy accounting system became ineffective and in fact collapsed. In such a state of affairs when more than half of the electricity supply was not metered, it was impossible to estimate the actual technical and distribution (T&D) losses and the pilferage of power. Obviously, the beneficiaries of the unmetered supply had developed a vested interest in the system to remain unaccountable. Canal irrigation is regulated due to non-availability of sufficient flow of irrigation water whereas irrigation through diesel pump sets put direct financial burden on the farmers which forced them to think about efficient usage of irrigation water to some extent as they utilise diesel pump sets only whenever it is required. There were hardly any efforts from the state government to motivate farmers for efficient utilisation of electricity and ground water. There is an urgent need to ensure metered supply at consumer ends, particularly the agriculture connections, on priority basis to ensure accountability. It will promote efficiency and add to viability in the power supply. Unmetered power supply promotes inefficiency in electricity consumption as well as utilisation of ground water. The power utilities claimed 100 per cent metering at agriculture feeders but it has a significant amount of load of non-agriculture sector, particularly domestic. In the absence of proper metering at consumer ends, the precise estimation of actual electricity consumption by agricultural consumers and the amount of power subsidy is not possible.

5. Status of soil quality

Quality of soil is one of the main ingredients to determine agriculture production and productivity. Broadly soil quality is measured in terms of soil fertility/ productivity. We have classified quality of soil in three categories i.e., good, bad and average to seek perceptions of the households. In case of good quality of soil, the production as well as productivity is

expected to be high. During field survey deterioration in quality of soil was observed which occurred mainly on account of continuous excess use chemical fertiliser, pesticides and ground water for irrigations. The households pointed out that canal irrigation is relatively more conducive for cultivation as compared to ground water.

6. Problem of soil salinity

The problem of soil salinity is also observed mainly due to salt content in soil and/ or ground water. It needs to be highlighted that the problem of salinity appeared in the areas where ground water is used for irrigations rampantly. The problem of salinity is not severe under canal irrigations. Gradually, the soil fertility is affected by irrigations with high total dissolve solids (TDS) groundwater and consequently, several traditional crops have been disappeared. By extracting excess ground water evaporation and evapotranspiration tend to increase salt concentration. Direct evaporation from the soil surface causes a rapid accumulation of salt in the top layers. When a significant amount of ground water is provided for irrigation without adequate provisions for leaching of salt, the soils rapidly become salty and unproductive. In case of intense evaporation ground water storage in the reservoirs tends to increase salt concentration. It may be argued that over extraction of ground water leads to deplete the ground water table on the one hand and deterioration of the quality of ground water due to saline water intrusion and/ or the upward diffusion of deeper saline water on the other. Using saline ground water for irrigation may increase soil salinity.

7. Utilisation of electricity and ground water

Efficiency in agriculture power subsidies implies maximum agricultural production/ output with minimum power subsidy which may help to reduce pressure on finances of the state government on the one hand and ground water extraction on the other. To attain efficiency, we made attempts to calculate possible reduction in the amount of power subsidy per acre without using any sophisticated statistical tools/ techniques. It has been observed from the available data that households with electric tube wells have been using ground water inefficiently particularly in terms of excess number of irrigations as against optimum number of irrigations required for the growth of a crop. There is hardly any control over the utilisation/ extraction of ground water for irrigation purposes by the government agencies. The number of times actual irrigations per acre took place through electric tube wells is relatively higher than that of optimum number of times a crop is required to be irrigated in the sampled households during Kharif as well as Rabi seasons. During Kharif & Rabi seasons some crops like paddy & sugarcane are very water intensive. The households from the category of electric tube wells utilised the ground water and electricity to meet irrigation requirements of these crops in a very inefficient manner. It may happen due to supply of electricity to the agriculture sector at highly subsidised rates in Haryana which motivates the households to misutilise electricity as well as ground water.

8. Conclusion

The agriculture sector is a key to the economic development of Haryana as more than 60 per cent population depends, directly or indirectly, on agriculture. Irrigation water is one of the critical components in agriculture. The natural source of irrigation is rainfall which is unreliable and unpredictable in terms of quantity, incidence and duration in the present scenario. Irrigation water comes mainly from two sources i.e., surface water and ground water. Surface water is provided by the flowing water of rivers or the still water of tanks, ponds, lakes, and artificial reservoirs. The surface water is carried to the fields by canals, distributaries, and channels. Ground water has been extracted by electric tube wells and diesel pump sets. The improvement in agricultural production & productivity depends primarily on the expansion of irrigation facilities. A significant proportion of net irrigated area in Haryana has been dependent on tube well irrigations. Apart from tube well irrigations, a segment of the farmers depend on canal irrigation also. Farmers generally prefer groundwater for irrigation because of its reliability and flexibility. The power sector exerts a critical influence on the performance of agriculture sector as it affects farmer access to and use of electricity for a variety of irrigation operations, particularly pumping ground water for irrigation. Agrarian transformation in Punjab & Haryana under the Green Revolution strategy generated tremendous demand for power in agriculture sector. Until the early 1970s, the state electricity utilities in India levied charges on electric tube wells based on metered consumption. Thereafter, under the strategy of green revolution state governments have adopted a policy of providing free or subsidized power to farmers to increase agricultural productivity to ensure food security in the country. Consequently, the number of electric tube wells has increased over the period of time. In order to reduce transaction costs, the utilities removed meters and introduced flat tariffs for electricity supply to agriculture sector. Many states shifted to free and unmetered supply to agriculture which has underscored system of energy accounting and internal accountability in power utilities. Lack of adequate/ proper energy accounting system motivates the utilities to hide operational inefficiency and theft of electricity by non-agricultural consumers. It may be argued that in the absence of adequate accounting system, reliable estimation of actual electricity consumption by the agricultural consumers and the amount of subsidy cannot be precisely estimated.

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