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Various sources of irrigation and impacts on yield of wheat: A case study of Hyderabad district in Sindh Province of Pakistan

G. M. NANGRAJ[+*], T. MANGAN*, N. LAGHARI*, F. NIZAMANI*,

Agronomist, Agriculture Extension, Government of Sindh

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Abstract: This study **aims** to explore various sources of irrigation in study area and impact of **these** sources on wheat yield. To achieve the objectives of the study 60 wheat farmers were interviewed, including 30 canal farmers and 30 tube well farmers. Results of study highlighted that that tube well farmers **bear** higher cost of production as compared to canal farmers and per acre average yield of wheat obtained by canal farmers is higher as compared to tube well farmers (43 mounds). Similarly, per acre net return earned by the canal farmers is also 33.23 percent higher as compared to tube well farmers.

Keywords: Irrigation sources, wheat yield, canal water, tube well water

1. INTRODUCTION

In developing countries agriculture sectors play a vital role in well-being of people. In Pakistan agriculture sector **contributes** a big share (20.9 percent) in Gross Domestic Product (GDP). Agriculture is a main source of livelihood and more than 43.5 percent of the rural population of Pakistan depends on agriculture for their earnings. In Pakistan wheat crop is one of the most important staple foods and a large area is used for wheat cultivation. The area under wheat cultivation in 2015 was 9180 hectare with total production of 25.478 million tons (GOP, 2015).

Wheat is an important food crop and plays a significant role in economic growth of **Pakistan** but has suffered high fluctuations in production. This fluctuation is caused due to various reasons including use of traditional and old methods of farming, unavailability of new technology, lack of awareness and skills to use updated technologies of farming and higher prices of these technologies. In addition to that shortage of irrigation water and dependency on tube well water is also an important cause that leads to soil degradation and loss of yield of wheat (GOP, 2015).

Pakistan is an agrarian country and there are different source of irrigation such as; canals, tube wells, open wells, lift pumps and a small water diversion system (PARC, 2003). Irrigation sources are very important, without these resources agriculture sector cannot exist. Pakistan has **four** distinct seasons and annual rainfall in this country is about 150 millimeter while evaporation has increased up to 1250 and 2800 millimeter. Pakistan is rich in water resources but due to different reasons these water resources are inadequate to meet the needs of irrigation other water requirements (Bourfa and Kuper, 2012; PARC, 2003).

More than 75 percent of agricultural **area** mainly **depends** on groundwater for irrigation (Qureshi *et al*. 2003). Indus Basin is the largest integrated irrigation system of the **world,** and backbone of irrigated agriculture land in Pakistan because it is major source of irrigation in this country. Indus Basin irrigates more than 70 percent of area of **Pakistan.** More than 16.8 million hectares area is irrigated by canals under the command of Indus Basin irrigated system. Up to 1993 annual inflow from Indus Basin was 181 billion cubic meters. Annually about 131.0 billion cubic meters (72 percent) diversion of Indus Basin Irrigated system is observed at canal heads. In addition to that about 40.0 billion cubic meters (22 percent) outflow of Indus basin irrigated system to the Sea is also observed, while there is about 11.0 billion cubic meters (6 percent) net system loss. The flow of canal under Indus Basin irrigated system is about 106 million acre feet (MAF) (PARC, 2003). Flow **in the** Indus basin river is highly seasonal, in Kharif **season it is high,** approximately 85 percent each year, while in the Rabi season it is about 15 percent. Mostly in the starting of winter and in the end of summer there is shortage of water which results low cropping strength. In Pakistan during last four years supply of water has dwindled therefore, in Pakistan scarcity of water is increasing due to mismanagement of irrigation system, comprising low amount of productivity, unbalanced distribution and supply of water (PARC, 2003). Canal irrigation alone is

[+ *]Corresponding authors e-mail: mustafa_nangraj@yahoo.com
*Sindh Agriculture University Tandojam

not enough to meet crop water requirements (Qureshi and Akhtar, 2003; PARC, 2003; Kiani, *et ai.,* 2008; Samiullah *et al.,* 2014).

In Sindh province of Pakistan reduction in underground canal water supplies and increasing demand of freshwater competition among municipal, industrial and agriculture sector has intensified water crises (Qadir, *et al*. 2003). To overcome scarcity of irrigation water, farmers exploit the ground water resources. Groundwater plays a significant role in agricultural production in Pakistan. Annually more than 48.0 billion cubic meters of groundwater is pumped and used for farming. Mangrio *et al*, (2015) also highlighted that in many parts of Sindh province especially in lower Sindh number of tube wells has increased at significant level during the period of 2000 to 2010. Increased use of water of private tube wells pose a serious threat to fresh water supplies of country and resulted in depletion of water table and interruption of saline water in underground fresh water aquifers and caused high level of salinity in the root zones (Qadir, *et al*., 2003). **Moreover,** with the installation of tube wells **the** cost of production also increases. Studies suggest that canal water is better than tube well water for irrigation **purposes. It was** observed by the Thomas *et al.* (1981) and Gupta (1990) that continuous use of tube well water leads to soil degradation and soil may become hard and saline which **results in a decline** in crop yield (Mangan and Nangraj, 2016; Manjunatha *et al.,* 2011; Qureshi *et al.,* 2010; Ahmad *et al.*, 2001). In Sindh there is no study that **has** examined the choice of irrigation services and the impact of different types of irrigation on productivity and income of farmers. This study is aimed to explore various sources irrigation in study area and impact of those sources on wheat yield.

3. METHODOLOGY

This study is aimed to explore various sources of irrigation in study area and impact of those sources on wheat yield. Both primary and secondary data was used. In this study two categories of the respondents were selected (1) respondents who depend on canal water for irrigation purpose (hereafter they will be referred to as canal farmers) and (2) respondents who depend on tube well water for irrigation purpose (hereafter they will be referred to as tube well farmers). For this study district Hyderabad and four villages of Hyderabad district were purposively selected in order to ensure availability of famers of both canal and tube well water. In Hyderabad district canal and tube well are main source of irrigation for cultivation. From Hyderabad district 60 wheat farmers were randomly selected. Among these 60 farmers of wheat, 30 were canal farmers and 30 were tube well farmers. From two villages 30 wheat farmers were selected and from remaining two villages 30 tube well farmers were selected by random method of selection (from each village 15 farmers were selected). The data was collected through face-to-face interviews of respondents in the study area. Initially an informal survey of wheat farmers of study area was carried out and pretested questionnaires were used to interview 60 respondents. The collected data was tabulated, analyzed and interpreted to meet the objectives of this study.

4. RESULTS

To achieve the objectives of the study 60 wheat farmers were interviewed. Demographic characteristics of the sample respondents are shown in **(Table 1).** Age is very important demographic factor which influences the efficient allocation of resources. Old aged people are more skilled and experienced than the less age people. The average years of age of canal farmers were higher 40 years as compare to tube well farmers i.e. 30 years. Education is also a significant factor and plays a very important role for the uplift rural people particularly in agriculture sector because education helps farmers to take various decisions regarding input choices and farming activities such as choice to use canal water or install tube well for irrigation. According to the data it was found that the **average years** of education of canal farmers were high (12 years) while tube well farmers (7 years). The average family size of canal farmers and tube well farmers were same (7 members). The result revealed that average number of earning members of both categories was same (2 members). On average canal farmers own 10.4 acres while tube well farmers own up to 5.3 acres. Results explain that land owned by canal farmers is almost 50 percent higher than tube well farmers. This shows that canal farmers have more productive asset than tube well farmers. On average canal farmers have more farming experience (16 years) as compared to tube well farmers (14 years).

Table 1 Demographic characteristic of sample respondents in study area

	Tube well farmers			Canal farmers		
Variables	Min	Max	Mean	Min	Max	Mean
Years of age	24	65	30	18	60	40
Years of education	0	16	7	0	18	12
Family size	4	10	7	3	15	7
Number of earning members in family	1	4	2	1	7	2
Acers of land	1	16	5.3	1	45	10.4
Years of farming experience	1	40	14	1	30	16

(Source of data survey)

Bothe tube well and canal farmers **bear** various **costs of** production such as costs incurred for land preparation,

seed, fertilizer, farmyard manure, tube well maintenance and other marketing cost. Result of Table 2 express that tube well farmers bear higher per acre cost of production (Rs.40798) while the canal farmers incurred less amount as per acre cost of production of wheat i.e. Rs. 29689. **(Table 2)** shows that irrigation cost of tube well farmers is higher i.e. Rs. 3674 as compared to canal farmers which is Rs.1228. This result shows that to irrigate land use of tube well water is expensive as compared to canal water **(Table 2).**

Table 2 Per acre average cost of production borne by canal and tube well farmers

Cost Components	Tube well farmers	Canal farmers
	Avg. cost per acre (Rs.)	Avg. cost per acre (Rs.)
Production cost		
Land preparation	6150	6390
Seed	3672	2018
Fertilizer	10288	10432
Pesticide/Weedicide/ Farmyard manure	3188	3369
Irrigation	3674	1228
Tube well maintenance	652	
Harvesting	2257	2172
Threshing	2102	2251
Marketing cost		
Packing	965	976
Loading & unloading	280	250
Transport	570	603
Grant total	33798	29689

(Source of data survey)

The result revealed that per acre average revenue earned by the canal farmers is higher (Rs. 52296) as compared to tube well farmers (48891). This is because of the reason that per acre average yield of canal farmers (45 mounds) is higher as compared to tube well farmers (43 mounds). This result support the hypothesis that canal water is better than tube well water for irrigation purpose because it maintain fertility of soil while continuous use of tube well water leads to soil degradation and soil may become hard and saline which results decline in crop yield **(Table 3).**

Table 3 Per acre average yield and income earned obtained by canal and tube well farmers

Particular	Average mounds (40kg) per acre	Average price per mound/40kg	Avg. Revenue earned per acre (Rs.)
Tube well farmers	43	1137	48891
Canal farmers	45	1162	52296

(Source of data survey)

The results depicted in the **(Table 4)** are about the per acre net return earned by the sample respondents. The result indicates that per acre net return earned by the canal farmers was 33.23 percent higher as compared to tube well farmers because canal farmers earn Rs. 22607 while tube well farmers earn Rs. 15093 net revenue per acre.

Table 4 Per acre net return earned by the respondents of study area

Particular	Total Revenue (TR)	Total cost (TC)	Net return (TR-TC= NR)
Tube well farmers	48891	33798	15093
Canal farmers	52296	29689	22607

(Source of data survey)

Fig.1 shows the cost of tube well installation. The tube well farmers respond that in 2010 on they incurred cost of Rs.162167 on installation of tube well while now cost of tube well installation has increased by 54 percent up to Rs. 359667. With the passage of time not only cost of installation of tube wells has increased but study results of **(Table 5)** show that depth of installation of tube wells also has increased. When respondents were asked about the reasons of installation of tube wells they informed that they are helpless to install tube wells because of shortage of irrigation water.

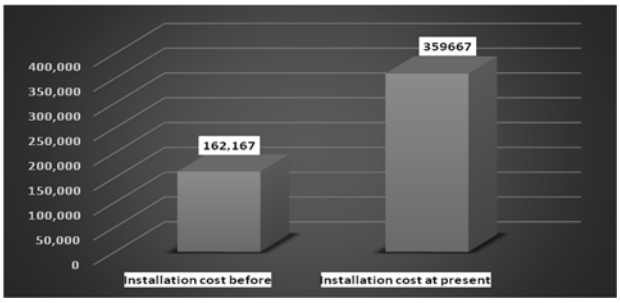
Table 5 Cost of Tube well installation in study area

Variable	Minimum	Maximum	Average
Years of Tube well installation	8	26	17
Depth of tube well installation in feet	100	140	100
Reasons to use tube well water			
Shortage of water	100%		
To irrigate extra land	0		
other	0		

(Source of data survey)

Fig. 1 Tube well installation cost incurred by the growers in 2010 and 2016

(Source of data survey)



5. CONCLUSION

To achieve the objectives of the study 60 wheat farmers were interviewed. Results of study highlighted that that tube well farmers borne higher per acre cost of production of wheat crop (Rs.40798) while the canal farmers incurred less amount as per acre cost of production of wheat i.e. Rs. 29689. Especially irrigation cost of tube well farmers is higher i.e. Rs. 3674 as compared to canal farmers which is Rs.1228. This result shows that to irrigate land use of tube well water is expensive as compared to canal water. Per acre average yield of wheat obtained by canal farmers (45 mounds) is higher as compared to tube well farmers (43 mounds). This result support the hypothesis that canal water is better than tube well water for irrigation purpose because it maintain fertility of soil while continuous use of tube well water leads to soil degradation and soil may become hard and saline which results decline in crop yield. Per acre average revenue earned by the canal farmers is higher (Rs. 52296) as compared to tube well farmers (48891). Similarly, per acre net return earned by the canal farmers is also 33.23 percent higher as compared to tube well farmers because canal farmers earn Rs. 22607 while tube well farmers earn Rs. 15093 net revenue per acre. Results of study also show that during last five years tube well installation cost has also increased by 54 percent. Not only cost but depth of installation of tube wells has also increased.

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