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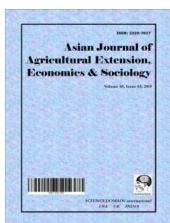
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## **Implications of Irrigation Water Crisis on Socio-economic Condition of Farmers in Faisalabad District, Punjab, Pakistan**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors SF and NM designed the study, wrote the protocol and supervised the work. Author MAN helped in statistical analysis and authors Muhammad Muddassir and Muhammad Mubushar managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Agriculture is an integral component of Pakistan economy as sixty five percent of the population resides in rural areas and their livelihood primarily depend on agriculture. Pakistan has the world largest contiguous irrigation system. Unfortunately, the farming community is facing severe water shortage. Prime objective of current study was to explore the effects of canal water crisis on the yield of major crops and its socio economic implications on farming community of District Faisalabad, Punjab-Pakistan. A study sample of 160 farmers household was selected through multistage sampling techniques. Results showed that irrigation water shortage directly affects farming community economically and they have to rely upon tube well water for crop survival.

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Therefore, an increase in farmer's expense was seen for purchasing fuel for tube well engine. Our findings also showed that socio-economic problems due to water crisis, such as the lower crop production, loss of soil fertility, decrease in cultivated area, increase in poverty and frustration badly affects the life of farming community.

**Keywords:** *Water crisis; socio economic problems; farmers; Jaranwala; Pakistan.*

## 1. INTRODUCTION

Pakistan is purely an agricultural country having an area of 79.61 million hectares (Mha) out of which 29.42 Mha is cultivable. The cultivated area is approximately 21.17 Mha, whereas 19.27 Mha area is under all sort of irrigation from which 10.93 Mha is under canal irrigation [1]. The agriculture sector contributes 20.9% in gross domestic production (GDP) and 43.48% of labor force employment [2]. In addition, providing food to consumers and fiber to domestic industries, the agriculture sector is an important source of foreign exchange earnings. The share of food group alone in the total export of country for the year 2010-11 stood at 17.5 percent [3].

Generally two crop seasons, winter and summer are prevailing in country. Winter crops are grown normally in the months of November to April and summer crops are grown from May to October. Agricultural output in Pakistan is closely linked with the ample supply of irrigation water but unfortunately, there is shortage of water to the agriculture community. Unit production of crops is getting lower in country as farmers are facing economic problems in maintaining their agriculture. In the last fifty years, water used for agricultural purpose has been increased due to change in cropping patterns. The success of sustainable agriculture in arid and semi-arid regions of the world depends only on the availability of the quality water [4]. Uplifting global population growth is expected to cause increase in demand for cereals including wheat by 1.27% annually between 2000 and 2025 [5].

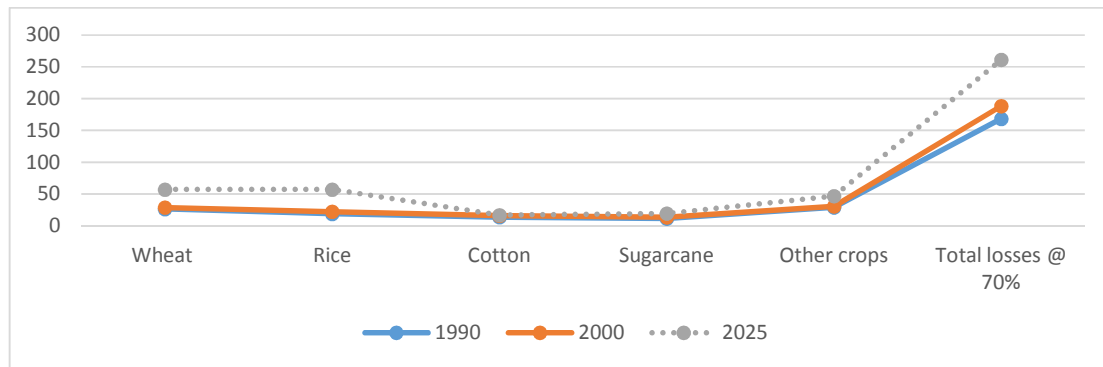
To maximize the crop production, irrigation of crop plants is considered vital from ancient times. It is estimated that approximately 5 percent of agricultural land around the world (264 million hectare) is irrigated within South Asia (35%), South East Asia (15%) and East Asia (7%) showing higher dependency of crop production on irrigation water [6]. Many parts of the world are confronting with water shortage, both for irrigation and human needs. Since 1950, the area of irrigated land in Pakistan has been tripled to increase agricultural production; land is not a

limiting factor as there is more agricultural wasteland that can be irrigated properly to get production [7].

The agriculture sector depends heavily on irrigation as it accounts 90% in output of agriculture in Pakistan [8]. According to a survey conducted, it was predicted that irrigation water requirements for the year 2000 and 2013 would be 143.1 and 206.4 MAF respectively and shortfall will increase from 107.8 MAF in year 2013 to 150.8 MAF in year 2025 [9]. The water situation for the upcoming years has been projected at 107.3 and 126.6 MAF (if three dams namely Kalabagh, Basha and Dattu are operationalized) in year 2013 and 2025 respectively [8]. The graphical representation (Fig. 1) provides information about water requirement (MAF) of major crops to maintain self-sufficiency. The predicted water demand increased gradually from 1990 to 2000 but a drastic increase in water demand will occur during 2000 to 2025 [10].

Due to massive investments in irrigation infrastructure in Pakistan, China and India during the 1960s and 1970s, their success was driven to achieve future food demands [11]. In present scenario, regional disputes with the neighboring country on building dams would cause serious problems for Pakistan national security and agriculture [12]. According to World Bank, due to future water crisis in Pakistan, there is dire need to build new water storage reservoirs on emergency basis [13]. The farming community in Pakistan mostly facing two barriers viz. crops water use efficiency in prevailing irrigation practices and the shortage of irrigation water badly affecting the crop yields [14]. Majority of water reservoirs are locating in Punjab because Punjab is the hub of agricultural production and the largest province in terms of population as well as yield production. The land area of Punjab is about 14.3 million hectares Contributing one-fourth of the country's total GDP.

At present, per acre yields of our country are far less than other countries despite the favorable combination of climate, temperature, soil and



**Fig. 1. Agriculture water demand**  
Source: Federal Bureau of statistics 2008-2009

water resources [15]. Research shows that water crisis in Pakistan is due to incompetency of federal government and negligence of irrigation water department. Water is the key source for GDP, poverty alleviation and growth of farm productivity, therefore, from the last decade water crisis is a burning issue of Pakistan's agriculture.

## 2. IMPORTANCE OF STUDY

Irrigation water is the life of Pakistan's agriculture, but the country is facing challenging circumstances to conserve available water resources. The agricultural productivity is decreasing due to shortage of irrigation water. The continuous water scarcity will be hard for socio economic, conditions of rural farming community. The prime objective of this study was to assess the socio economic implications of the irrigation water crisis on farmers of District Faisalabad, Pakistan.

## 3. MATERIALS AND METHODS

Sociology is the scientific study of behavior, attitude and perception of human beings in various social setups. Study was conducted in the rural areas of Faisalabad, Pakistan. There are four rural towns in Faisalabad district viz. Chak Jhumra, Samundri, Jaranwala and Tandaliwala. A sample of 160 respondents was selected systematically from Faisalabad through multistage sampling technique. At first stage, one town Jaranwala was randomly selected out of four rural towns. Then from 57 union councils (UCs) of Jaranwala, 4 UCs were selected randomly at the second stage. At third stage, two villages were selected randomly from each union council, and at the final stage 20 respondents were selected from each village by random

sampling. Questionnaire comprising open and closed ended questions was prepared and tested as pilot study to verify its validity and reliability. Descriptive analysis such as frequency distribution, percentage distribution, mean and standard deviation were calculated by using SPSS to describe the data.

## 4. RESULTS AND DISCUSSION

Demographic results from conducted study showed that 29.8% of the respondents were female and 70.2% of the respondents were male, in which majority of the respondents (84.4%) were married. The major portion of the respondents (43.75%) belonged to 41+ year's age group and (35.0%) respondents belonged to within 35 years of age group. Obtained data regarding family system revealed that most of the respondents (60.6%) were living in a joint family system. Whereas, 39.4% of the respondents were living in the nuclear family system. In joint family system, social customs are rigorously followed and family remain under the supervision of males, who is liable for the welfare of his/her dependents. Women in joint families of rural areas are involved in domestic and agricultural affairs. Approximately, one eighth (13.125%) of the respondents had matric or above education whereas, major portion (48.75%) of the respondent were illiterate. Women of rural areas were lagging behind in the sphere of education. The data shows that mostly women (59.7%) were illiterate as compared to male (41.3%), which shows rural people were carelessness about female education. In South Asia, the literacy rate of an adult female is 66% while, male youth were higher with 79% literacy rate [7]. Similarly, in our male dominant society the rural women are engaged in agriculture and animal rearing activities but they are not properly

acknowledged. The data regarding total family members shows that majority of respondents (60.6%) had 6 to 10 while 24.4% had up to 5 family members in their families. The majority of respondents (75%) were getting their livelihood from agriculture and 7.5% were engaged in their business. The data obtained for household income shows that 53.75% of the respondents had  $\geq$  \$1421 income and 28.13% of the respondents had \$947 to \$1421 income.

Due to scarcity of irrigation water, number of respondents (86.3%) argued that their crop production was decreased significantly. Khan [16] found that the water crisis had a direct effect on the yield of major crops. The data obtained from water crisis effect on yield of major crops shows that the vast majority of respondents (94.38%) shows their concerns about the reduction of wheat yield followed by rice (90.63%), maize (81.25%), sugarcane (84.38%) and cotton (86.88%). Similar results were found [17] that the main crops grown were wheat, rice, cotton, maize and sugarcane in Pakistan. These crops covered an area of about 63% of total cropped area. The production of these crops is approximately restricted to irrigated areas due to severe water scarcity affecting these crops badly. Results obtained from water crisis impact on crop production and soil exhibit that (87.5%) of respondent believes that cultivated area had decreased whereas, (86.3%) on declined crop production, (87.5%) on soil fertility decreased

and (75.0%) on loss of livestock production. Agriculture is the main economic source of the majority of rural families. The data shows that (75.0%) of the respondents of this study were getting their livelihood from the agriculture sector.

Therefore, water crisis had a significant economic impact on respondent livings, because number of farmers (55.0%) are facing economic constraints due to water scarcity. Regarding social impact of irrigation water crisis, results showed 98.1% of respondents are facing frustration, 96.3% water theft crime, 88.1% poverty, 56.9% social disputes, 18.1% destruction of interaction and only 5.0% are facing migration issues.

Regarding reasons of water crisis the respondents had an opinion that poor policies (60.0%), shortage of dams (91.3%), mismanagement of irrigation department (58.8%), water theft (65.0%) and regional disputes (18.8%) has a significant negative contribution in present water crisis. The data collected about problems faced by local farmers showed that (66.3%) of the respondents were facing hardships with greater extent due to improper cleaning of canals and water channels, 87.5% by small and high level of water channels, 81.3% by non-availability of cemented water channels and (13.8%) unscheduled canal water distribution, directly affecting their agriculture production.

**Table 1. Socio-economic parameters of the respondents**

Age of the respondents	Mean	Std. Dev.	Marital status	Frequency	Percentage
Up to 35	29.32	3.30	Married	135	84.4
36-40	39.31	3.17	Unmarried	25	15.6
41+	31.37	4.53	<b>Type of family</b>		
			Nuclear	63	39.4
			Joint	97	60.6
<b>Education of the respondents</b>			<b>Total family members</b>		
<b>Illiterate</b>			Up to 5	39	24.4
Primary	4.10	0.44	6-10	97	60.6
Middle	8.81	1.44	Above 10	24	15.0
Matric and above	9.91	1.76	<b>Main occupation</b>		
<b>Respondents household income (R.s)</b>			Agriculture	120	75.0
$\leq 100,000$	87,926	7,113	Govt. servant	11	6.9
100,000 to 150,000	141,786	6,580	Pvt. job	8	5.0
$\geq 150,000$	175,700	9,702	Business	12	7.5
			Shopkeeper	9	5.6

**Table 2. Distribution of the respondents in relation to water crisis in agriculture and its impact on socio- economic condition of farmers**

Effect on yield of major crops	Great extent		Some extent		No effect		Total
	Freq.	% age	Freq.	% age	Freq.	% age	
Wheat	151	94.375	7	4.375	2	1.25	160
Rice	145	90.625	14	8.75	1	0.625	160
Maize	130	81.25	28	17.50	2	1.25	160
Sugarcane	135	84.375	21	13.125	4	2.5	160
Cotton	139	86.875	13	8.125	8	5.0	160
<b>Effect on crop production and soil</b>							
Decrease in cultivated area	140	87.5	16	10.0	4	2.5	160
Decrease in crop production	138	86.3	8	5.0	14	8.8	160
Decrease soil fertility	140	87.5	13	8.1	7	4.4	160
Losing livestock production	120	75.0	29	18.1	11	6.9	160
<b>Social impact of irrigation water crisis</b>							
Social disputes	91	56.9	60	37.5	9	5.6	160
Destruction of interactions	29	18.1	72	45.0	59	36.9	160
Water theft crime	154	96.3	6	3.8	0	0.0	160
Frustration	157	98.1	3	1.9	0	0.0	160
Poverty	141	88.1	7	4.4	12	7.5	160
Migration	8	5.0	48	30.0	104	65.0	160
<b>Reasons of water crisis</b>							
Poor policies	96	60.0	41	25.6	23	14.4	160
Shortage of dams	146	91.3	11	6.9	3	1.9	160
Mismanagement of irrigation department	94	58.8	58	36.3	8	5.0	160
Water theft	104	65.0	40	25.0	16	10.0	160
Regional disputes	30	18.8	26	16.3	104	65.0	160
High cost land leveling technology	138	86.3	20	12.5	2	1.3	160
<b>Problems faced by the local farmers</b>							
No proper cleaning of canals and water channels	106	66.3	51	31.9	3	1.9	160
Size of water channel small and high	140	87.5	14	8.8	6	3.8	160
Non cemented water channels	130	81.3	25	15.6	5	3.1	160
Level of land high	94	58.8	60	37.5	6	3.8	160
Unscheduled canal water distribution	22	13.8	66	41.3	72	45.0	160
High cost land leveling technology	138	86.3	20	12.5	2	1.3	160
<b>Famers satisfaction with irrigation water department performance</b>							
	Yes		No		Total		
Freq.	46		114		160		
% age	28.7		71.3		100		

**Table 3. Distribution of the respondents according to size of land holding (hectare), source of irrigation water, tube well status and an average cost of tube well water on major crops (n=160)**

Size of land holding (hectare)	Frequency	Percentage
≤2.41	61	38.1
2.42-4.04	66	41.3
Above 4.04	33	20.6
<b>Source of irrigation</b>		
Tube well	30	18.75
Canal	25	15.625
Tube well and canal	105	65.625
<b>Tube well status</b>		
Shared	124	77.50
Owned	36	22.50

Present problems were compelling the farmers to utilize the modern technologies e.g. land-leveling technologies in their fields, as 58.8% of the respondents had high level of land. Moreover 86.3% of the farmers were facing problem of high cost of land leveling technology. Whereas the majority of the respondents 71.3% were not satisfied with the performance of irrigation water department.

Results published by Zaidi [18] revealed that 67% of farmer families in rural areas of Pakistan had no access to agricultural land. The farmers are not just facing low level of land holding but highly unequal land distribution leading to a class of "land haves and have-nots". The data obtained about the size of land holding reveals that major

**Table 4. Farmer's perception about the effect of irrigation cost on major crop**

<b>Crop</b>	<b>Freq.</b>	<b>% age</b>	<b>Mean (Rs.)</b>	<b>Std. Dev.</b>
Wheat	145	90.6	3116.55	972.97
Cotton	27	16.9	1425.93	980.81
Sugarcane	135	84.4	19499.26	8897.86
Rice	7	4.4	16142.86	4552.36
Maize	138	86.3	3369.57	2459.13

portion of respondents (41.3%) had 6 to 10 acres, (38.1%) had up-to 5 acres and (20.6%) had ten acres of land under cultivation. In Pakistan three major sources of irrigation water includes surface water, rainfall and sewage and sea water. Besides these other major source of irrigation water is ground water. The data shows that 15.63% of the farmers were irrigating through canals, 18.75% through tube well and a large majority 65.63% of farmers irrigated through tube well and canal sources. The findings of Mir [19] depicted 565,000 tube-wells present in Pakistan. He further added that many water experts had warned government that over exploitation of remnant water could lead to disaster conditions. Majority of the farmers (77.50%) had shared tube well connection meanwhile and small number of farmers (22.50%) had their own tube wells. Regarding the average cost of tube well water on major crops, sugarcane cost was Rs.19499.29 followed by rice Rs.16142.86. That explains tube well water was costly source to get irrigation water for crops.

## 5. CONCLUSIONS

Water crises have significant negative implications upon the socio-economic conditions of farmers in the study area. Shortage of irrigation water leads to certain problems including lower yields, decrease cultivated area and ultimately less livestock production. Negative social impacts include water theft crime, poverty, frustration and social disputes, destructing the agricultural productivity in surveyed area. Potential reasons for all these issues were predicted as poor policies regarding irrigation water management, regional disputes and the high costs for efficient use of available water. Current findings suggest that there must be efficient and strong policies for the better management of available water resources, ensuring equal availability to every farmer. Awareness must be created among farming community about the precise use of irrigation water by adopting land leveling techniques and avoiding water crimes.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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