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Impact Assessment of Water Crisis on Socio Economic Life of Agrarian Community

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Abstract

The objectives of the present study will be to explore the effects of scarcity of water on farmers' socio economic values & standard of living while taking adoption of water saving technologies or better water resource management plan by farmers as moderating variable. A sample of 150 household farmers in district Okara was selected through multistage sampling techniques. A well structured questionnaire was designed on five point licker scale covering various dimensions of water crises and their impact on socio economic dimension of farmer's lives. For data analysis quantitative techniques of multiple regression & regression for moderation were applied by using SPSS 16.

Keywords: Water crises, socio economic problems, irrigation, productivity

Introduction/ back ground of research problem

Agriculture plays a pivotal role in the national economy of Pakistan. 65% of total population of Pakistan is living in villages and their major source of livelihood depends upon agriculture. Pakistan has the largest world irrigation system its irrigation strength three times more than that of Russia. Pakistan has the world's largest interconnected irrigation canal system. In 1999-2000, the total irrigated area in Pakistan was 181,000 km².

Majority of water reservoirs are in Punjab—because Punjab is the hub of agriculture production and largest province in terms of population as well as yield consumption. The land area in Punjab is about 14.3 million hectares that contributes one-fourth of country's total gross domestic product (GDP) Okara and Sahiwal regions are most fertile agriculture areas of Punjab. Major crops in this area are potato, wheat and maize. Rain fall position is not too favorable in this middle area of Punjab as it touches southern

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Punjab so ground water is not enough for agrarians needs. Sutlaj and Ravi passes through Okara but these rivers are under the control of India (Reference Indus water treaty; 1960) so these are filled most of the time in flood. But unfortunately, Pakistani farmers are facing serious water shortage problem in these days. Water is basic source for all human needs either social or economic. As population both urban and rural is increasing rapidly, water needs in all spheres like agriculture, industrial, energy and development sectors is rising. This results in severe pressure on level of ground and surface water as well as on eco system of our land.

Significance of study

Agriculture is the back bone of our economy and it needs water for meeting human and industrial needs but right after independence India is occupying major sources of rivers. As maximum land is irrigated by irrigation water in our country so if there is scarcity of irrigation water, there will be socio-economic implications. Our purpose of conducting this study is to explore the socio-economic implications on the life of the farmers due to water shortage. Moreover literature will help us to devise different water saving techniques for agriculture and making an environmentally sustainable water management plan for Pakistan.

This research will give insight not only into socio economic problems due to the water crises such as irrigation water disputes, less cultivation, lack of interest of livestock but also will given useful insights for future environmental sustainable water resource management system in Pakistan.

Research problem

Haq & Khan (2002) reported in Pakistan water concerns on the problem of shortage of water that crops productivity is decreasing in agriculture sector due to water crises for irrigation.

Theoretical foundations & literature review

Water crises

Water crises is a situation when there is scarcity of water resources or level of quality is not match able relative to human demands for it.

Agriculture sector depends maximum on irrigation as it accounts 90% into output of agriculture in Pakistan. (Afzal, 1996). According to survey, 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. (Mulk and Mohtadullah, 1991).

Water situation for the upcoming years has been projected at 107.3 and 126.6 MAF (if 3 dams namely Kalabagh, Basha and Dassu are operationalized) in year 2013 and 2025 respectively (Afzal, 1996).

There are several ways of defining water scarcity. The definition here refers to water scarcity as: the condition when aggregate demand by all sectors of economy is not full filled by aggregate supply from all water resources (UN, 2006). Water consumption is rising at very fast rate; more than twice the rate of population increase. By 2025, 1 800 million people will be making their lives in countries with significant water shortage, and two-thirds of the world population would be under severe water crises. Water is essential element for irrigation of agricultural lands that why it is most valuable input for farmers. Irrigation is defined by Galbraith, *et al.* (2005) in discussion paper as irrigation is used because it gives more productivity and output to land by applying water in right time.

Out of 16.23 million hectors land, 11.42 million hectors is irrigated by cannel water and 4.03 by tube well water and remaining 0.78 hectares by miscellaneous sources (WAPDA, 2009).

As per the World Bank and Asian Development Bank of Pakistan it is stated that Pakistan is falling in water stressed nations as compared to its population needs. It will face severe water shortage due to rapid urbanization and increasing population over the next five years. It will result in water crises in all sectors including irrigation, energy, industry, domestic consumption and agriculture. As per Water Board report water position in Pakistan has reduced from 5,000 cubic meters per capita to 1,000 cubic meters in 2010, and is expected to further fall to 800 cubic meters per capita by 2020.

Global population growth is making an increase in the demand for yield like wheat by 1.27% annually between 2000 and 2025 (Rosegrant and Cai, 2000). Agriculture constitutes 70 percent of all water consumption globally and nearly 95 percent in most of the developing countries.

As per the United Nations' "UN World Water Development Report", the aggregate renewable water resources have decreased from 2,961 m^3 per capita in 2000 to 1,420 m^3 per capita in 2005 making alarming picture of recent past years.

After independence in the regime of Field marshal Gen. Ayub Khan, India got the advantage to fully use water of the three eastern rivers; Ravi, Bias and Sutlej, while Pakistan had right to use water of three western rivers; Indus, Chenab and Jhelum according to the Indus Water Treaty (IWT). Many intellectuals and economist claim that, if India continued to build dams on Chenab and Jhelum rivers, then there will be serious effects on Pakistan's agriculture, industry and safety (Sharif, 2010).

The factors playing major role in water shortage are raising population, climatic variations, poor future planning for construction of new dams and reservoirs. Sharif (2010) After introducing tube well technology currently there are near about 300,000 private tube wells in Pakistan that account for 40% need of irrigation to agriculture land in Punjab (Afzal, 1996) Research done on effect of water crises on crops by institute of agriculture extension and rural development UAF in Faisalabad it was observed that farmers community prefers canal water for farming but due to limited supply of canal water they are forced to depend on tube well water which increases their cost of farming due to severe energy crises as well as rising fuel prices Asim, *et al.* 2012.

Since independence Pakistan had only two dams Mangla & Tarbela for meeting agriculture and energy requirements and agriculture needs are fulfilled through natural resources like rivers, lakes, glaciers and rains while artificial sources are dams and reservoirs for excess water storage used for irrigation purposes but due to rapidly rising population and slow development of water resources our per acre water supply is decreasing seriously so we need to construct more small and large dams as well as initiate water saving techniques in our methods of cultivation (Ahmad *et al.*, 2007). Since the scope of this paper is to see the impact of crises of major sources of water on crops and economic life of farmers, major sources of water in agriculture are ground water, canal water and tube well water. We will investigate through this research the impact of water crises of these sources on economic life of farming community and to recommend water saving techniques for sustainable environment friendly water resource management.

Water resource management (adoption of water saving technologies)

As per report of ministry of water and power Pakistan is making work on construction of new dams; Gomal Zam Dam project, Mirani Dam project, Mangla Dam raising project and Sabakzai Dam Project. Moreover small and medium sized Dams and canal projects will be initiated in next five years to fulfill the agriculture and energy needs.

Research was done in china about use of scarce water resources to save their

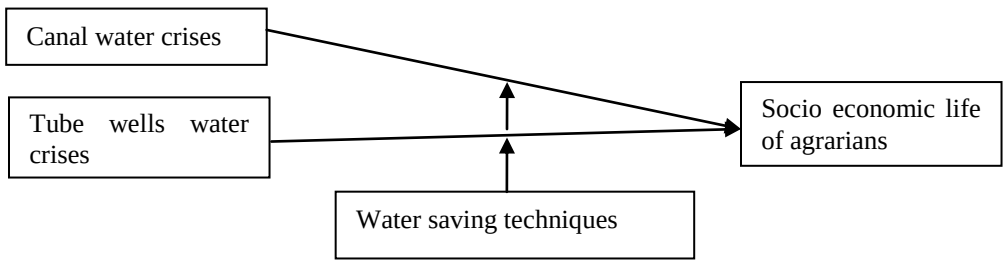
extravagant use and adoption of water saving technology; it was stated that agriculture sector needs are rising from the past decade so lot of research and budget is allocated for discovering and adoption of modern water saving techniques (Blanke *et al.,* 2007). Total annual agriculture yield is about 19.72 million hectares, out of which, 15.3 million hectares are irrigated areas, about 75 % (11.4 mha.) is irrigated through canal water, l9 % (2.9 mha.) through tube well water 2 % (0.3 mha.) through traditional wells and rest 4 %(0.4 mha.) Through small or medium sized tanks and other reservoirs. Mainly crops grown are wheat, rice, cotton, maize and sugarcane in this area of Punjab which make about 63 percent of the total cropped land. Growth of three major crops; rice, cotton and sugarcane and 90 percent of wheat and maize is dependent on irrigated sources. Alam *et al.* (2000) and Blanke *et al.* (2007) surveyed China to determine the water saving behavior of farmer community and he found there is lack of water saving technique due to different reasons like little or no benefit given by state regarding water saving techniques. Wang, *et al.* (2008) concluded in his research on water saving adoption behavior; that socio cultural environment like family demographics make an impact on water saving adoption behavior positively directing them to move for more better irrigation systems.

Pointing out about renewable water resources like fossil water, report by the Geological Survey of Pakistan (GSP) highlight: "Natural resources are limited and they depend upon people how they use them in a wise manner. As per geological survey of Pakistan government tried to work on artificial rain water through combination of some gasses but it did not work practically now so again it had to rely on ground water mainly for agriculture. As Canal water is cheapest source of irrigation so Canal lining is crucial for better canal irrigation and it can be done in seasonal canal closure periods (Afzal, 1996).

Research objective

- To investigate the affect of tube well water and canal water on Socio economic life of farmers
- To devise environmentally sustainable water resource management plan.
- To search out implication of different water saving techniques for farming.

Research model



Research hypothesis

H1: There is significant impact of canal water crises on Socio-economic life of agrarians.

H2: There is significant impact of Tube well water crises on Socio-economic life of agrarians**.**

H3: water saving techniques have moderating relationship between water crises (canal, tube well) and socio economic life of agrarians.

Methodology/research design

The study is descriptive in nature and data was collected from 150 Male farmers of district Okara. Okara is one of the most fertile agriculture districts in Punjab. Its major crops are maize, wheat, potato, and sugur cane. There are three main towns in the district; Okara, Renala Khurd and Dipalpur. Data was collected from three villages of one from each town. Simple random sampling will be used for sampling and structured questionnaire on five point licker scale will be used for data collection. Data will be then analyzed by applying multiple regression analysis and correlation techniques by using SPSS.

Reliability analysis will also be done to find out the validity of instrument.

Data analysis

Results of survey are interpreted in the form of tables drawn in excel attached here with the description of findings are as under.

Table 1: The values in table of reliability analysis show that chron bosh alpha is above 0.6 for all variables. Internal consistency of elements is also good in the scale.

Table 1: Demographics summary

Demography	Count	Proportion
Gender		
Single	60	40%
Married	90	60%
Age		
Below 15 years	02	1.33%
15 years to 30 years	45	30%
31 years to 45 years	79	52.67%
Above 45 years	24	16%
Income		
Below 100,000	12	08%
From 100,000 to 250,000	63	42%
From 251,000 to 400,000	52	35%
Above than 400,000	23	15%
Level of education		
Illiterate	87	58%
Matriculation	47	31%
Graduation	12	08%
Any other	04	03%

Table 2: Correlation

Variable	Cronbach's alpha	No. of questions
Canal water crises	0.730	04
Tube well water crises	0.65	04
Socio Economic life	0.59	03
Water saving techniques	0.71	05

Correlation is a technique which shows the degree of association between two variables the results show there is positive correlation between water crises and socio economic life of agrarians. Moreover high positive correlation exists between canal water crises and socio economic life, and water saving techniques has also significant association with all dependent and independent variables.

Table 3: Multiple regression analysis

Variables	Beta 1	R^2	Adj. R^2	t-value	F-value	p-value
Constant				1.913		0.005
Canal water crises	0.468**	0.434	0.419	2.929	24.43***	0.001
Tube well water crises	0.382			3.431		0.002

Regression measures variation in dependent variable due to change in one or more independent variables in the study The R square is goodness of fit in the model and explains the part of dependent variable constituted by the independent variable. It ranges from 0.0 to 01.00 that socio economic life of farmers is affected by 43.4% due to impact of independent variable. The value of adjusted R square shows that dependent variable is caused by independent variables by 41.9% and remaining portion is affected by other factors held constant. The value of F statistic shows the overall Fitness in model and T value shows test statistic. Value of Beta (Standardized Coefficient) shows water crises especially canal water crises have strong impact on socio economic life of farmers as shown in table The moderating relationship of water saving techniques between water crises (Canal, Tube well) and socio economic life of farmers has been proved significant.

Table 4 shows that the linear model tested is significant (P < 0.05).The regression analysis accounted for 48.9% change is caused by water crises to socio economic life of farmers which is dependent variable. Value of beta also shows the positive rate of change by dependent variables (0.582) with independent variable. Table 5 shows that the linear model tested are significant (P < 0.05). The regression analysis accounted for 58.8% > (48.9% regression result Table 4) change is caused by water crises (canal, tube well) and water saving techniques to socio economic life of farmers which is dependent variable. Value of beta also shows the positive rate of change by dependent variables (0.621 > 0.582 and o.481 regression result Table 4) with independent variable. As the R square value is greater for the canal & Tube well water crises * water saving techniques than only for Canal & tube well water crises (0.494 > 0.434). The water saving techniques is proved as a significant moderating variable.

Table 4: Regression for moderation

Variables	Beta 1	R	R^2	Adj. R^2	t-value	p-value
Constant					3.929	0.002
Canal water crises	0.582	0.671	0.434	0.489	5.431	0.000
Tube well water crises	0.481				0.342	0.000

Predictors: **(**Constant) Canal water crises, Tube well water crises

Table 5: Regression for moderation

Variables	Beta 1	R	R^2	Adj. R^2	t-value	p-value
(Constant)						
Canal water crises, Tube well water crises		0.691	0.494	0.588	17.394	0.004
*water saving techniques	0.621				6.631	0.000

Predictors: (Constant) Canal water crises, Tube well water crises *water saving techniques

Conclusion & recommendations

Water is an important content of nature and essential source for existence of life. The agriculture sector is back bone of our national economy and it accounts more than 70 % of total work force. Canal and tube well water are two major sources for

irrigation in agriculture in districts of Punjab but due to over all water crises and poor future planning for better water resource management farmers are facing severe water shortage which is causing different socio economic problems among them like disputes, over expenditure, low productivity, poor farming and low profitability. The need is to adopt better irrigation and farming techniques, taking advanced agriculture extension trainings, genetic technologies and water saving techniques. Moreover it has huge impact on environment so safe sustainable environmental management plan for water resource management need to be devised in Pakistan.

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Anexture I

Impact of Water Crisis on Socio Economic life of farmer in District Okara

What is your Marital Status?

(i) Single (ii) Married

What is your age?

(i) 15 years but below 30 years (ii) 30 years but below 45 years (iii) 45 years or above

What is your House hold annual income?

Below 100,000 (ii) From 100,000 to 250,000 (iii) From 251,000 to 400,000 (IV) > 400,000

Level of Education?

(i) Illiterate (ii) Matriculation (iii) Graduation (iv) Any Other

SD-Strongly Disagree D- Disagree N-Neutral A-Agree SA-Strongly Agree

	SD	D	N	A	SA
I am satisfied with amount of canal water for my crops					
I am satisfied with the frequency of canal water for my crops in week.					
I am satisfied with the timing of canal water for my land					
Improper Canal lining is causing poor water supply to lands					
Tube well water is essential source for irrigation					
I feel energy shortfall effect supply of tube well water					
Shortage of Tube well water makes irrigation costly for me.					
My per acre cost of production increases due to shortage of tube well water.					
I face different disputes with other farmers due to shortage of water.					
My annual crops yield is decreasing due to shortage of water					
My household annual income is decreasing due to water crises					
I attend agriculture extension training meetings for better farming.					
I use precision land levelling techniques.					
I prefer Water reservoirs for saving water for upcoming need in case of shortfall of water					
I use different water saving techniques for upcoming need fulfilment of irrigation					
I will use all modern techniques for pollution free water resources development					