Journal of Social Sciences Review (JSSR) DOI: https://doi.org/10.54183/jssr.v3i2.316

How to Cite This Article: Tariq, Iqbal, J., & -Haq, Z.-U. (2023). Farmer Response to Change in Irrigation Water Pricing in Khyber Pakhtunkhwa: A Multinomial Logistic Regression Analysis. *Journal of Social Sciences Review*, 3(2), 792-806. https://doi.org/10.54183/jssr.v3i2.316

Farmer Response to Change in Irrigation Water Pricing in Khyber Pakhtunkhwa: A Multinomial Logistic Regression Analysis

Tariq	PhD Scholar, Department of Economics, Abdul Wali Khan University, Mardan, KP, Pakistan.
Javid Iqbal	Associate Professor, Department of Economics, Abdul Wali Khan University, Mardan, KP, Pakistan.
Zahoor-Ul-Haq	Professor, Department of Economics, Abdul Wali Khan University, Mardan, KP, Pakistan.

Vol. 3, No. 2 (Spring 2023)

Pages: 792 – 806

ISSN (Print): 2789-441X

ISSN (Online): 2789-4428

Key Words

Irrigation Water, Water Pricing, Formers Response, Multinomial Logistic Regression, Khyber Pakhtunkhwa, Swat

Corresponding Author:

Tariq
Email: tariqslz41@gmail.com

Abstract: *The River Swat is one of Pakistan's interior rivers, lying in the Khyber Pakhtunkhwa province. Despite being semi-dry, the area is a significant grain and fruit-producing area. However, persistent drought in recent years, along with excessive water extraction, has resulted in a constant decline of water pouring into the Swat River's mainstream, resulting in serious deterioration of ecosystems along the river's lower reaches. Water pricing is the best tool to control the misuse of water resources and will lead to the optimum use of this very precious resource. 300 farmers were chosen randomly and a preliminary test of the quantitative questionnaire was conducted before data collection to ensure clarity. To analyze the quantitative dataset Multinomial Logistic Regression, a version of ordinary regression was used. Farmers in the study area who face a 100% rise in water prices were polled to gauge their reactions. The results reveal that factors that are "total land area", "age", "total farm income", "slight water shortage", & "presence of fruit plants" are statistically significant. According to the finding, many farmers reacted to the rise in irrigation water prices and they were ready to use irrigation water more efficiently. This study also observed and concluded that just raising the irrigation water price is not a realistic and permanent solution.*

Introduction

The truth is that one of the largest consumers of water resources is agriculture, making for more than seventy percent (70%) of global freshwater consumption. It contributes significantly to global food security by feeding the lower classes at low cost while also giving employment possibilities in rural areas (Tiwari and Dinar, 2002; Reddy, 2008). However, expansion in population as well as in economic growth has boosted demand for water (Tsure, 2005), and feel that water is a precious resource in many parts of the globe.

As the scarcity of water becomes increasingly apparent, it is critical to distribute using this vital resource as effectively as possible. Previous policies for water resources in several nations have encouraged the improvement of water use as irrigation facilities in many dry parts of the world while seeking to ensure the availability of water for domestic purposes (Aishan *et* al, 2015; Chen *et* al, 2015 Ortega *et* al, 1998). The growth of water resources was predicated on the ongoing expansion of supplies. Because this was often linked with a large monetary and ecological cost, the emphasis turned to the demand water management derives. In contrast to the theory of continuous supply growth, Winpenny (2005) correctly summarised this new approach as "doing better with what we have."

The River Swat is Pakistan's interior river, lying in the Khyber Pakhtunkhwa region. Despite being semi-dry, the area is a significant grain and fruit-producing area. However, persistent drought in recent years, along with excessive water extraction, has resulted in a constant decline of water pouring into the Swat River's mainstream, resulting in serious deterioration of ecosystems along the river's lower reaches. Furthermore, water shortage is regarded as a serious impediment to the region's ecological, social, and economic growth. Along with the Swat River, it is understood that the logical allocation and proper management of water resources are the keys to long-term growth. From the literature, it is observed that water pricing is the best tool to control the misuse of water resources and will lead to the optimum use of a very precious resource. It is not only used as a cost recovery for water users but also helps to enhance water allocation, conservation and also to motivate the water user to use water efficiently. Some of them as narrated here for evidence that is; accordingly to Dinar and Subramanian (1998), water pricing motivates consumers to use water resources efficiently by providing info to them based on economic and scarcity. Similarly, Abu-Zeid (2001), investigated that water pricing is not only used as a cost recovery tool but also generates revenue to help in water distribution to the consumers for the concerned authority. Water price is indeed an essential socioeconomic instrument and experts believe it is the most successful strategy to enhance water allocation and conservation (Tsur and Dinar, 1997). According to Schoengold *et* al, (2006) investigation that even a small change in the prices of water may lead to compelling the agricultural water user to induce a cropping pattern shift. In contrast, the benefits of rising water prices may have no negative effect also on the consumption of water for different purposes. Some of them were discussed by different economists for different regions of the world.

Molle (2008), on the other hand, contended that in reality, the effect of price increase is the verse that of projected. Only a significant rise in water pricing rates produced the intended results in an Indian case study (Singhi,i2007). Several research groups have described the disadvantages of such stated significant rises in water pricing, that rising water prices would not only reduce agricultural productivity but rural poverty should be also worsened (Tardieu and Prefol 2002; Liao et al. 2007).

To establish an efficient water price structure, all needs concerning the authorized also governing structure, working standards plus cost factors must be met (Perry, 2001). Yuling and Lein (2010) conducted qualitative research in the iKaidui-iKongquei River Area, a sub-basin of the Tarim Basin in the People's Republic of China, and concluded that only administration activeness works rather than rising water prices.

Research Question

This study attempts to answer the question that whether increased water pricing leads to the sensible practice of limited assets of water via agriculturalists of the selected region of Khyber Pakhtunkhwa, Pakistan.

Significance of the Study

Water price is an essential socioeconomic strategy that has been identified as the most effective method of advancing water allocation and conservation. On one side, the institutions that govern the allocation, distribution, and management of irrigation water resources, and on the other, the growers who stand up for their rights to use these resources, have been the focal point of national discussion. It has been proposed in this context that demand-side water-saving programs can improve the efficiency of irrigation water consumption in various institutional settings (Cummings and Nercissiantz, 1992). In various countries where water scarcity is a concern, one of the primary policy instruments studied in the literature is the setting of water pricing to identify patterns of response in the use of water for agricultural purposes (Wilchens, 1991; Cummings and Nercissiantz, 1992; Rosegranti et al, 1995).

Universe and Scope of the Study

This study has been conducted for the Khyber Pakhtunkhwa provinces of Pakistan. The selection is made due to easy and low costly accessibility to data. The study will be looking at the effect of water pricing on the wiser use of water.

Objectives of the Study

The primary goal of this research is to determine if a rise in water prices leads to efficient and vice use of such a precious resource by farmers. The further specific objective of the study is as;

1. Determine farmers' reactions to a rise in water prices.
2. Determine elements that influence farmers' responses to a price rise for water.

The Hypotheses of the Study

This study has the following hypotheses based on the above objectives,
that is:

1. Farmer has a positive and effective response to an increase in water price.
2. Different factors can influence the former's response toward an increase in water price.

Review of Literature

The significance of a review of literature stems from the fact that it highlights the key findings of previous research projects done by scholars. The following are some studies that are related to the current topic.

Aidam, P. W. (2015) examined the influence of water price policies on farmers' demand for water resources in Ghana The data utilized in this article were gathered from farmers using a standardized sampling strategy. To achieve the aims, the research employed a programming model known as iMATA a multi-analysis tool for the agriculture sector. According to the findings, Ghana's water-pricing regime reduces the demand for water resources. However, this effect occurs only when water prices are dramatically raised. Water prices, on the other hand, have an adverse influence on farming activities, such that their income level, and employment of farmers.

As a result, the research advises that to minimize the agricultural-water loss some specific price of water would be offered to make farmers aware of the shortage of water resources and urge farmers to implement saving water methods not hurt crop production. The study also stressed to keep in mind that this is not the only way suggested way to water-saving initiatives, for the best effect other conjunction methods should also have to be applied. It means that there are a lot of other methods to capture the issue of the overuse of agricultural water.

Frija, A. Wossink, J. Buysse, S. Speelman, and G. Van Huylenbroeck (2011) investigated irrigation pricing regulations and their influence on agricultural input demand in Tunisia using a DEA-based technique. Between March and May 2007, primary data were obtained from 62 landowners from iCapi iBoni , iFondoki iJedid, and iLebnai iBarragei regions. They evaluated irrigation water demand functions using Data Envelopment Analysis (DEA) methods and the information concealed in individual farmers' technological efficiency. The empirical results for Tunisia suggest that more technically efficient farmers have less elastic irrigation water demand functions; these farmers would only change demand to a limited amount and can pay the water price. Water price, on the other hand, has a considerable impact on those who are less efficient. When the price of water rises, these farmers move to a different farming pattern that requires much less water and more area. As a result, increased water prices would endanger this category's livelihood if efficiency was not improved. However, if these farmers' technological efficiency improves, it would be increasingly difficult to meet water-saving targets since their demand will become more inelastic. The findings have significant consequences since the objectives of Tunisia's water policy include complete cost recovery, the continuation of irrigation activities, and national water conservation.

S. Speelman, J. Buysse, S. Farolfi, A. Frija, M. D'Haese, & L. D'Haese. (2009). The consequences of water prices on smallholder irrigation water in North West Province, South Africa, were estimated. Primary data were acquired from farmers using surveys using random sampling. To assess efficiency, they employed the data envelopment analysis (DEA) method. The study's findings reveal that water demand is extremely responsive to even little changes in water prices. Furthermore, the imposition of a water price reduces agricultural profit greatly. This appears to be mostly a concern for the poorest farmers. According to the study's findings, farmers in South Africa are quite sensitive to even little fluctuations in water prices. This substantial reaction can be attributed to the huge potential for improvement in water usage efficiency given the existing low levels. Farmers are encouraged to use less water as a result of the pricing. Another important conclusion, which has been documented in previous research, is the size of the negative impact on agricultural profitability. From a development standpoint, it is concerning since the smaller farms in terms of output (mostly the poorest farmers) are the most affected and, with rising water prices, are no longer profitable and may even cease production. Further study might concentrate on modifying the model to allow for the usage of production frontiers on crops rather than farms. It would also be able to forecast cropping pattern alterations induced by the implementation of water prices in such a model.

Gómez-Limón, J. A., & Riesgo, L. (2004) investigated Irrigation water pricing: unequal implications on irrigated farms. They employed mathematical programming methods based on Multi-Attribute Utility Theory (MAUT). The data required to feed the models came from public records and a farming survey. The approach is being tested in a typical section of Spain's Duero Valley. The study's findings demonstrate the use of differential analysis in assessing the impact of a water price strategy. This enables significant differences in the evolution of agricultural incomes, as well as the State's recovery of costs, demand for agricultural employment, and pesticide and fertilizer consumption as a consequence of rising irrigation water rates in various farming households within a given irrigated lands, to be observed. Based on these findings, we may infer that the examination of water pricing policy effects indicates that farmers engage in a variety of water-related behavior patterns. The diverse forms of the demand curves for each of the clusters analyzed demonstrate this variety. As a result, the consequences of irrigation water prices differ greatly depending on the group of farmers evaluated.

Doppler, W., Salman, A. Z., Al-Karablieh, E. K., & Wolff, H. P. (2002) used secondary data to investigate the influence of water price schemes on irrigation water allocation in Jordan. The linear programming approach was utilized to find a solution that optimizes gross margins while minimizing possible fluctuation in these margins. According to the study's findings, optimizing cropping patterns and irrigation water allocation still has a significant potential to increase the financial return from agriculture optimizing solution that takes into account risk from differing gross margins react indeed very elastically in terms of market value for irrigation water to increase water prices. This introduces the concept of shifting market supply into any debate about regulating water usage across sectors of society through price mechanisms. It is argued that agricultural water demand reacts to rising water costs in an inelastic manner over a long period as long as cropping pattern planning is based only on the assumption of average performance.

Berbel, J., & Gómez-Limón, J. A. (2000) used secondary data to study the influence of water price policies in Spain: an examination of three irrigated districts. The linear programming (LP) method was utilized. To emphasize the issue, this research reflects that water price as a single weapon is not a viable strategy for considerably lowering agricultural water usage. According to the study's findings, if water pricing is used as a policy instrument, among the repercussions for the agricultural sector would be a 40% fall in farm revenue before water consumption decreases sufficiently. As a result, they concluded that to make water pricing function efficiently in Spain, revenues should be performed by "Comunidades de Regantes" for investment in environmental and water-saving actions, while revenues that are not adequately made investments should be transmitted to the Regional Water Department.

Varela-Ortega, C., Sumpsi, J. M., Garrido, A., Blanco, M., & Iglesias, E. (1998) used primary data to investigate water price regulations, public decision making, and farmers' responses: implications for water policy. To conduct this study, a dynamic Mathematical Programming Model (MPM) that mimics farmers' behavior and responses to various water pricing circumstances was developed. The study's findings reveal that the impacts of various irrigation water pricing policies were substantially influenced by regional, structural, and institutional factors and that altering policies have varied repercussions even within the same region and water district. As a result, identical water charges would have a wide-ranging impact on water savings, agricultural income, and collected government income across areas of the region.

Methodological Framework

This article is farm household-based primary-level data and was collected through a questionnaire survey. It was carried out in areas where agricultural output is entirely dependent on groundwater supplies. Respondents were chosen randomly and a preliminary test of the quantitative questionnaire was conducted before data collection to ensure clarity. We performed exploratory research to investigate the impact of a significant rise in water price on-form water management. Farmers in the study area who face a 100% rise in water prices will be polled to gauge their reactions. Farmers will be given five potential responses to the question, "What would you do if water prices increased by 100 percent?" These are as follows: (i) "drill a tube well", (ii) "do nothing and just pay higher water prices", (iii) "shift crop pattern", (iv) "improve on-farm management practices", and (v) "adopt improved irrigation technology". Detailed descriptions are given in the following table 1.

Table 1

A detailed description of five possibilities for responding hundred percent rise in irrigation water price.

Option to formers	Explanation of farmers options
1) Drill a tube well	The farm household Drill tube well for groundwater as an auxiliary irrigation water supply.
2) Nothing to do, just pay the high price	A grower simply considers the higher prices of water and resumes crop cultivation, farming methods, and water resource utilization as usual.
3) Shift crop pattern	Farmer changes agricultural plan to crops with better water production; that is, crops that yield a larger rate of return of water consumed.
4) optimize on-farm management	Farmer enhances farming methods to close the existing productivity gap and reduce water losses.

5) Adopt improved irrigation technology	Growers are shifting to modern irrigation techniques; the lowest is flood irrigation, followed by sprinkler and drip irrigation,

Statistical Analysis

In addition to descriptive statistics, "Multinomial Logistic Regression", one of the versions of ordinary regression and analyzed the quantitative dataset. It's particularly well suited to study issues with two or more category-dependent variables and multiple categorical and continuous explanatory factors. It is a tried-and-true methodology that is commonly used in agriculture, forestry, and irrigation studies (e.g., Bakopouloui et al. 2010; Christopoulou and Minetos 2009; Demeke et al. 2011).

Table 2

Different variables used in the analysis are described in detail.

Variables (Dependent & Independent)		Type of variable
Indep-Variables		
iXi_1i	Farmer-Age	Contt
iXi_2ii	Farm-Area	Contt
Xi_3ii	Farm-Income	Contt
iXi_5ii	Literacy-Level	Catag
iXi_6ii	Farm-Location	Catag
iXi_7ii	No of Crops	Catag
iXi_8ii	Main-Crops	Catag
iXi_9ii	Fruit-Plants	Catag
$iXi_{10}ii$	Shortage of Irrig-Water	Catag
$iXi_{11}i$	Irrig-technique	Catag
$iXi_{12}i$	Tube well existence	Catag
Dep-Variables		
iYi1	Drill a tube well	Multivariate
iYi2	Do nothing, just pay high prices	Multivariate
iYi3	Improve crop production	Multivariate
iYi4	Adopt improved irrigation technology	Multivariate

In this multinomial logistic regression model, the dependent variable will be various answers to the question "What would you do if water prices increased by 100%?". Multinomial logistic regression is a commonly used model which compares each category of the dependent variable to a reference category through a statistical way and their probability will be provided.

Like all other studies, there is a limitation which has been sought out in a proper way and it is that Because of the low response rate of the research region farm households, the two categories "improve on-form management practices" plus "shift crop pattern" has been combined and generate a new one category called "improve crop production." It is a commonly used practice used in this type of situation where the researchers generate such a type of new category. It does not affect the results and we can capture our objective easily. So, in this analysis, the dependent variable is divided into four groups, as shown in the above table 2.

The reference category has selected the Y_1 category which is "drill a tube well". Suppose there are "z" independent variables $(X_1, X_2 \dots X_z)$ and k^{th} responses categories $(Y_1, Y_2 \dots \dots Y_k)$ then the "logistic model" is as;

$$\boldsymbol{ln}\left(\frac{\boldsymbol{P_{i-category}}}{\boldsymbol{P_{j-category}}}\right) = \boldsymbol{\alpha} + \boldsymbol{b_{i1}x_1} + \boldsymbol{b_{i2}x_2} + \cdots + \boldsymbol{b_{iz}x_z} + \boldsymbol{\varepsilon_i} \quad (1)$$

'$P_{i\text{-}category}$' represents the likelihood of the dependent variable being in 'i-category', while '$P_{j\text{-}category}$' represents the likelihood of the dependent variable being in the j-category (the reference category). 'α' indicates the intercept of the regression curve, 'b' the coefficient of each predictor, and 'ε' represents the error term.

In this case, the four logits can be written as follows:

$$\boldsymbol{Y_2} = \boldsymbol{ln}\left(\frac{\boldsymbol{P_{Y_2}}}{\boldsymbol{P_{Y_1}}}\right) = \boldsymbol{\alpha} + \boldsymbol{b_{Y_21}X_1} + \boldsymbol{b_{Y_22}X_2} + \cdots + \boldsymbol{b_{Y_2z}X_z} + \boldsymbol{\varepsilon_{Y_2}} \quad (2)$$

$$\boldsymbol{Y_3} = \boldsymbol{ln}\left(\frac{\boldsymbol{P_{Y_3}}}{\boldsymbol{P_{Y_1}}}\right) = \boldsymbol{\alpha} + \boldsymbol{b_{Y_31}X_1} + \boldsymbol{b_{Y_32}X_2} + \cdots + \boldsymbol{b_{Y_3Z}X_z} + \boldsymbol{\varepsilon_{Y_3}} \quad (3)$$

$$\boldsymbol{Y_4} = \boldsymbol{ln}\left(\frac{\boldsymbol{P_{Y_4}}}{\boldsymbol{P_{Y_1}}}\right) = \boldsymbol{\alpha} + \boldsymbol{b_{Y_41}X_1} + \boldsymbol{b_{Y_42}X_2} + \cdots + \boldsymbol{b_{Y_4Z}X_z} + \boldsymbol{\varepsilon_{Y_4}} \quad (4)$$

The left-hand side of the above equations represents the multivariate dependent variables that are Y_2, Y_3, and Y_4 which is equal to the log of the probability- ratio of farmers, who decides to "adopt improved irrigation technology", "improve crop production" as well as "do nothing and just pay higher water price" was evaluated with the likelihood a farmer compare to a reference category that is to "drill a tube well" if the price of water doubled.

Explanation of Result

This section describes the results and discussion of the study, which has been obtained using the aforementioned methodology. This section comprises subsections that are descriptive statistics and also the different graphs and statistical representations of the former's responses toward an increase in water prices.

Descriptive Statistics

Descriptive statistics of variables used in the multinomial logistic regression are given in Table 3. Continues variables used in the analysis are formers age, former income, and farmer's land area used for the crop. Similarly, the categorical variables in Table 3 are; the farmer's level of education, the farmer's location, the number of crops that a former grows, formers growing the main crop, farmers growing fruit, method of irrigation, shortage of water existence, and formers existing tube well. The results shown in Table 3 illustrate that the average age of farmers who have been surveyed is 45 years and forms that holding maximum land is 16.268 hectares but on average, the maximum land used for forming is 6.958 hectares which reveals the total land area standard deviation is 3.536 hectares. The mean cash income of surveyed farmers that has been calculated from their total yield, prices of crops sold, and crop production area are 174950.30 PKR, with a standard deviation of farm household income is 88400.67 PKR. Huge differences have been seen in the form of household education level that is mostly they are illiterate or have primary education or even middle school

graduates. The farmers having high school education are one-fourth of the sample size

25.67% and few but satisfactorily 12.67 % of farm households have a university level of education. It is also been observed that fruit-producing farmers are 30% while most

of the farmers do not. It is also been observed that the majority of the study farmers had different degrees of high and slight shortages of water during the last few sessions. From the table, it is also clear that 86.67% of farmers used the flood irrigation method in the study area.

Table 3

Descriptive statistics of the independent variables

Continues variable	*N*	Mean	SD	Min	Max
Age (year)	300	45.693	9.954	25	70
Total land area (ha)	300	6.958	3.536	1.359	16.268
Total income (PKR)	300	173950.3	88400.67	33993.65	406709.7
Categorical Variable	**N**	**Percent (%)**	**Description**		
Education					
Illiterate	59	19.67	Illiterate = 1, Other = 0		
Primary Education	56	18.67	Primary Education = 1, Other = 0		
Middle Education	70	23.33	Middle Education = 1, Other = 0		
High Education	77	25.67	High Education = 1, Other = 0		
University Education	38	12.67	University Education = 1, Other = 0		
Location					
Upper Dir	74	24.67	Upper Swat = 1, Other = 0		
Lower Dir	128	42.67	Lower Swat = 1, Other = 0		
Upper Swat	43	14.33	Upper Swat = 1, Other = 0		
Lower Swat	55	18.33	Lower Swat = 1, Other = 0		
Maincrop					
Wheat	243	81.00	wheat = 1, Other = 0		
Rice	46	15.33	Rice = 1, Other = 0		
Other crops	11	3.67	Other crops (Tomato)=1, Other= 0		
Number of crops					
One crop	271	90.33	One- crop = 1, Other= 0		
Multiple crops	29	9.67	Multi-crops = 1, Other= 0		
Water Shortage					
High	193	64.33	High = 1, Other= 0		
Slight	80	26.67	Slight =1, Other=0		
No	27	9.00	No =1, Other=0		
Fruits					
Yes	90	30	Yes =1, Other=0		
No	210	70	No =1, Other=0		
Existence of Tube well					
Yes	171	57	Yes =1, Other=0		
No	129	43	No =1, Other=0		
Irrigation method					
Flood irrigation	260	86.67	Yes =1, Other=0		
Drip irrigation	40	13.33	No =1, Other=0		

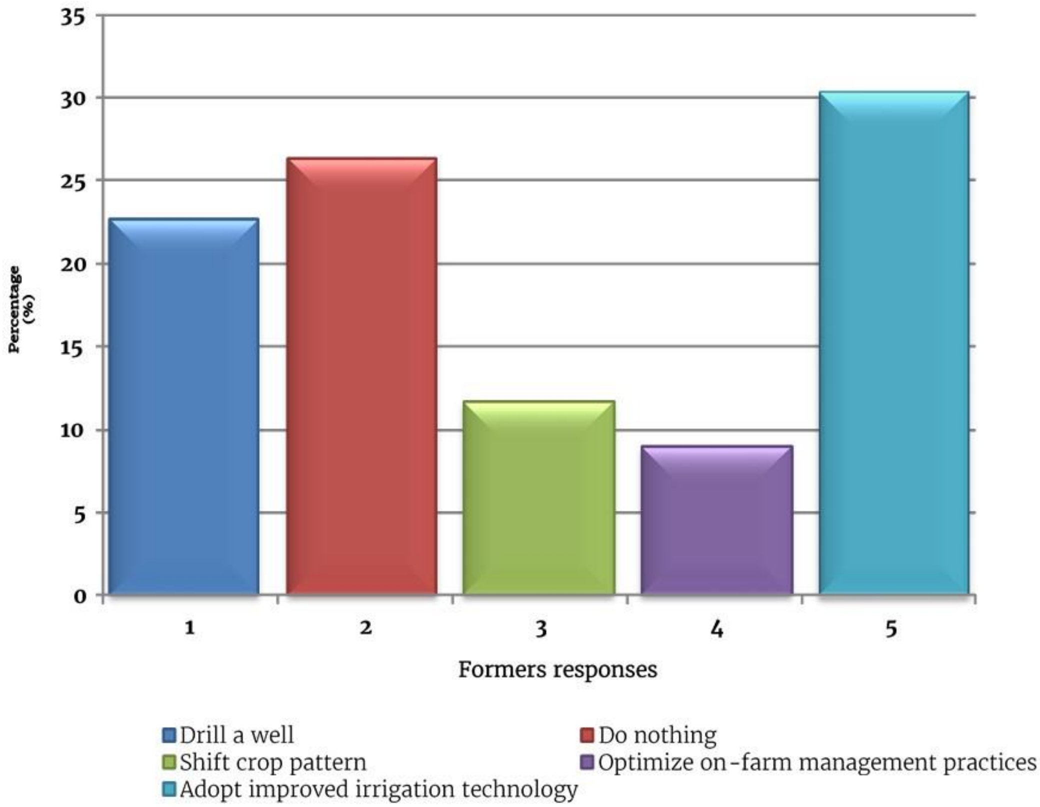
Source: Estimated from survey data.

Farmers' Response towards Increased Water Price

Different formers' responses have been observed while asking for a 100% increase in the prices of irrigation water. In figure (1) it is shown that most of the farmers that are round about one-third of the sample formers responded they have selected the "improved irrigation technology" similarly around one-fourth of the formers have selected the response to "drill a tube well.

Figure 1

Depicts the whole sample of farmers' reactions to a rise in water prices.

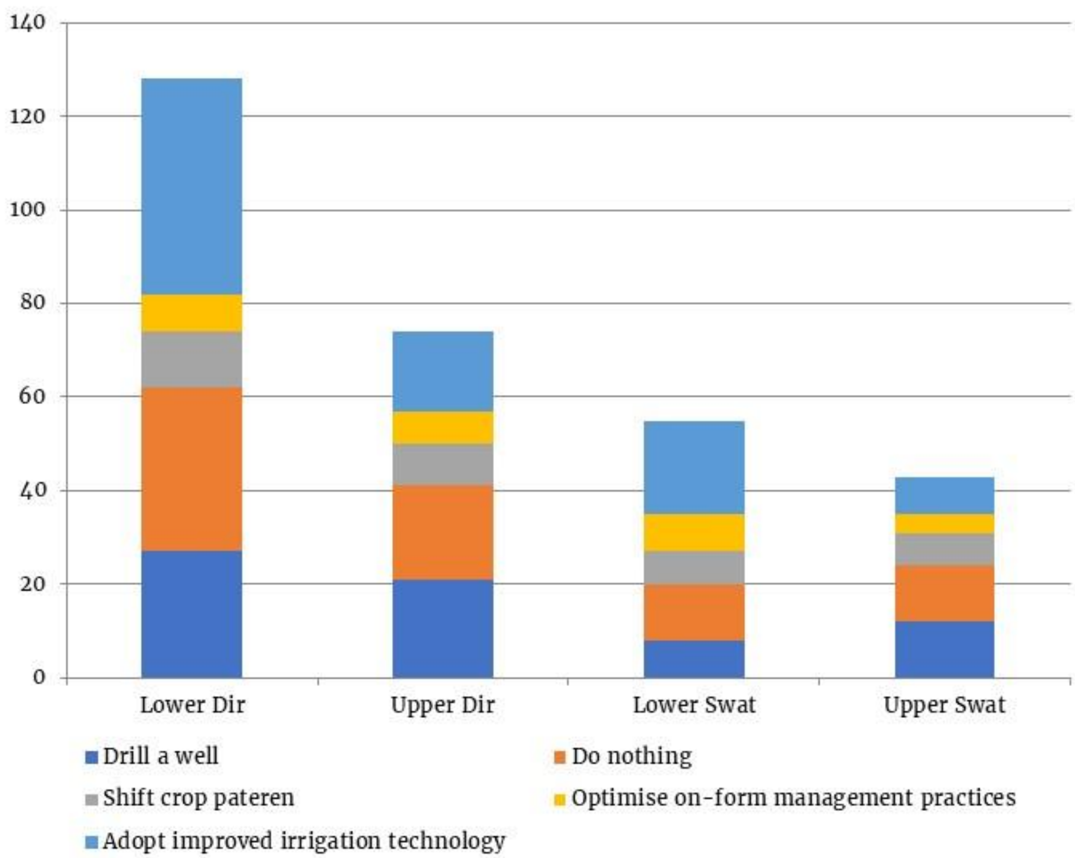


Option do nothing just pay high price" was selected by roundabout one-fourth of the sampled formers and very few formers optioned to "shift crop pattern" and "improve on-farm management practices". Due to the increase in irrigation water prices, the most desirable reaction of the sampled formers was 'drill a well, it is because of high water scarcity, drought, and increasing exploitation of groundwater. From the literature, it is observed that extreme rise in water prices lead to expansion in groundwater misuse which has been recognized in arid American states and China (Schucki & Greeni, 2003; Liao et al., 2008). About 79 surveyed farmer out of 300 farmers responded 'do nothing' option and was willing to pay high prices if the irrigation water prices were increased. Maybe It is because the sampled formers' irrigation water use cannot improve and also maybe an increase in irrigation water prices may have a marginal effect on their budget.

Out of the 300 farm households studied, 79 of them were willing to "do nothing and simply accept higher water prices", they choose this option because of some recessions; one of them was that they believe that the irrigation water-related techniques they already using in their agricultural form are of advanced level and they are unable to improve furthermore as soon as possible. Some of them also were thinking that this increasing price of water makes a marginal effect on their income level which is affordable. About Eleven percent of the farmers were asked the same question and the answer of them was that they will prefer to "shift crop pattern" rather than all other options which were given to the farmers to choose if the price of irrigation water were to increase. They believe that if the irrigation water increases they will shift from water-intensive crops and will manage the price rise. A similar situation was seen by about nine percent of the farmers who prefer to "enhance the on-farm management" rather than other preferences of farmers if the irrigation water price will increase. These farmers had to focus on the management side to reduce excessive loss of water and will bear the rise in irrigation water prices. Besides all other agricultural farmers, a large number that is about Thirty percent of the farmers chose "adopt improved irrigation technology" of all other options given to them. These agriculture formers demonstrate that using modern technology such as sprinkler irrigation technology and drip irrigation methods will control the loose face in flood irrigation techniques and will manage such tight irrigation water prices.

Figure 2

Distinguishing between the four surveys sites of "farmers' response towards the increase in water price".



When comparing farmers' reactions to each of the four research sites, there is just a tiny difference between them (Fig. 3). In any event, Lower Swat and Upper Swat have a slower rate of "drilling a well" than the other two sites. Furthermore, farmers in Lower Dir "shift crop pattern" and "adapt improved irrigation technology" substantially more frequently than farmers in the other three locations, indicating a potential for increasing water prices. It indicates that just increasing the price of irrigation water has little chance of achieving large increases in water usage productivity. The main finding of the studied agriculture farmers was in the support of effective water used for irrigation might result in a genuine improvement in water use efficiency. Most farmers would choose either "do nothing, just pay a high price" or the considerably worse option of "Drill a tube well" which would exacerbate the water scarcity problem.

Table 4

Results of the multinomial regression analysis

Farmers' response	B	SE	Sig	E(B)	95 % Confidence interval for E(B)	
					L-bound	U-bound
Do nothing						
Age	0.045	0.025	0.059*	1.046	0.999	1.096
Total farmland area	0.022	0.011	0.034*	1.022	1.003	1.043
Total farm income	0.001	0.001	0.044*	1.001	1.001	1.001
Location Lower Dir	0.254	0.504	0.614	1.289	-0.733	1.242
Location Upper Dir	-0.249	0.416	0.550	0.780	-1.064	0.566
Location Lower Swat	0.192	0.536	0.719	1.212	-0.859	1.245
Location Upper Swat	-0.284	0.503	0.572	0.753	-1.270	0.701
Education- Low	-0.490	0.792	0.537	0.613	-2.044	1.063
Education –High	0.279	2.893	0.923	1.322	-5.392	5.951
Slight-water shortage	1.977	0.721	0.007*	7.221	1.761	28.998
No tube-well	-0.221	0.349	0.526	0.802	-0.906	0.463
No Fruits	2.082	1.102	0.058*	8.020	0.927	69.380
Improve crop production						
Age	0.032	0.055	0.558	1.033	-0.076	0.141
Total farmland area	0.033	0.015	0.029*	1.034	1.004	1.063
Total farm income	0.001	0.001	0.040*	1.001	1.001	1.001
Location Lower Dir	-0.174	0.537	0.745	0.840	-1.229	0.879
Location Upper Dir	6.770	3.530	0.050*	871.312	0.875	889.976
Location Lower Swat	1.016	0.549	0.065	2.762	-0.061	2.093
Location Upper Swat	0.163	0.537	0.761	1.177	-0.890	1.217
Education- Low	0.958	1.109	0.347	2.606	-1.040	2.957
Education –High	3.914	3.245	0.228	50.099	-2.445	10.274
Slight -water shortage	1.619	0.860	0.058*	5.048	0.940	28.001
No tube-well	-0.484	0.372	0.149	0.616	-1.214	0.246
No Fruits	2.710	1.191	0.023*	15.029	1.480	152.001
Adopt improved irrigation technology						
Age	0.053	0.045	0.237	1.054	-0.035	0.143
Total farmland area	0.019	0.100	0.058*	1.019	0.999	1.069
Total farm income	5.530	1.240	0.655	252.244	-1.870	2.980
Location Lower Dir	1.009	0.540	0.062	2.743	-0.050	2.069
Location Upper Dir	-0.761	0.420	0.070	0.467	-1.584	0.062
Location Lower Swat	0.288	0.499	0.564	1.334	-0.690	1.266
Location Upper Swat	-1.017	0.541	0.060	0.362	-2.077	0.043
Education- Low	0.214	0.775	0.783	1.239	-1.306	1.734
Education –High	3.952	2.766	0.153	52.039	-1.469	9.374
Slight -water shortage	1.901	0.699	0.010*	6.693	1.700	25.998
No tube-well	0.056	0.346	0.870	1.058	-0.622	0.735
No fruits	3.180	1.202	0.020*	24.047	2.199	265.989

Source: estimate from survey data.

Influencing factors of the response of farmers

In above table, the outcome of the "multinomial logistic regression" is given as having chi_square 46.32 and p-valve less than 0.05, which is evidence of the statistical significance of the model. In this analysis, all the dependent variables were regressed against the independent variable "total land area," "age," "total farm income," "water Shortage", "education level," "location," "the existence of fruit production," and "the existence of well." Because of a significant correlation with other factors and back-to-back overt repetitiveness, several of the independent variables were excluded from the regression. In this analysis, the reference category "Drill a tube well" was used. According to the manageability viewpoint, it is the most unwelcome response by farmers to increases in water prices. Along these lines contrasting, with the other alternative answers aids in the development of recommendations for more cost-effective water usage. When comparing the likelihood of farmers responding to "Drill a tube well" and "Do nothing, simply pay a high price".Factors that are "total land area", "age", "total farm income", "slight water shortage", & "presence of fruit plants" had significant influence. The results reveal that those formers, who have more agricultural land and whose incomes are satisfactory high, will shift to "drill a tube well" a reference to "do nothing, just pay a high price". It means that a former having high yield from agriculture farm and high income will prefer to "drill a tube well" for their use of irrigation purposes and will bear the pressure of rising water prices. On the other hand, for the farmers who are aged, the effect of increasing water prices shifts his response to do nothing and pay a high price because of approaching retirement he is not willing to invest more (Potter and Lobley , 1992). The former who is facing a "slight water shortage" was also chosen "do nothing, just pay a high price" as compared to the reference category because the former prefers to pay a high price because it was less expensive as compared to "drill a well". The same situation was seen for the farmers who have no fruit plants are more likely to "do nothing and pay a high price" than "Drill a tube well". it is because farmers who have no fruit orchards do not have any severe need instead of farmers having fruit orchids plane for a long time.

In addition, the model assessed five variables to be crucial when linking the choice to "improve crop production" and "drill a tube well." The results show that farmers with more acreage and more wealth were more likely to choose "improve crop production" understatements of increasing water expenses. This conclusion is supported by the idea that larger landowners, with more capital capacity, may tolerate more risk, for example, by switching crops, than farmers with small landholdings (iNorrisi and iBatiei i1987i). Furthermore, farmers having fruit orchards will be supposed to make an alternate that will choose the reference category. It is because farmers who cultivate fruits on their farms are losing money compared to farmers who plant sessional crops owing to altering crop patterns. Furthermore, farmers' selections were influenced by modest water scarcity and location. The comparison of the options "adopt improved irrigation technology" and "drill a tube well" reveals that three factors were significant statistically: "total land area," "slight water shortage," and "no fruits." Farmers with a higher total land area were shown to respond to enhanced irrigation technologies first and foremost. Nonetheless, the degree of relevance was far smaller than the influence of land size in the other two situations discussed above. Furthermore, farmers that encountered minor water constraints were forced to acquire superior irrigation systems, increasing underwater prices.

It is clear from the result given in the above table that those formers who suffer from the "slight water shortage" preferred to select the option of "adopt improved irrigation technology" as compared to the reference category. The literature also supports the aforementioned situation of the farmer with a rise in water prices.

According to Li et al. 2008, if there is a high as well as no shortage of water the price of water leads to no effect to adopt improved technology. It looks to be a potential alternative for mitigating minor water shortages by effectively distributing limited water assets throughout the whole total cropped area of farms. Adoption of improved irrigation technology, however, is just a minor part of the solution in the case of acute water scarcity and accompanying seasons of complete lack of water. Finally, because of higher water costs, farmers who did not have fruit were forced to "adopt improved irrigation technology." The likelihood of selecting "adopt improved irrigation technology" for farm households that did not have fruit trees was nearly three times that of farmers who did have fruit trees. This, on the other hand, suggests that farmers with fruit trees were more hesitant to use advanced irrigation technologies. Some research supports the hypothesis that adopting enhanced irrigation technology can greatly improve fruit tree water usage proficiency, Cu et al. 2008; Du et al. 2008; Yang et al. 2013).

Conclusion and Policy Recommendations

Farmers and their families were interviewed to learn about their reactions to a significant increase in water costs in Khyber Pakhtunkhwa. Our findings demonstrate that rising irrigation water costs motivate most of the farmers polled to use water most effectively, either by adopting improved irrigation technology, shifting to crops that use less water, or further refining farm management to achieve higher yields with less water. On the other hand, some of the farmers would either make no adjustments to their farming management practices or, even worse, will be urged to drill a tube well and construct their wellspring of groundwater. As a result, the rise in water prices may encourage the overuse of groundwater resources.

Using multinomial logistic regression to determine which factors influence farmers' reactions to excessive water costs, the results reveal that growers with greater land areas would often choose alternative options than "dig a tube well." Farmers with smaller farmland, on the other hand, felt more compelled to "dig a tube well" as water prices rose. Furthermore, a small water scarcity reduced the likelihood that farmers would "dig a tube well" which was connected with the likelihood that they would "do nothing, simply pay a high price" or "implement improved irrigation technology". Furthermore, growers involved in long-term fruit production are more likely to "drill a tube well" than the other two options. Farmers who just produce sessional crops, on the other hand, are urged to "do nothing, just pay a high price," "improve crop production," and "adopt improved irrigation technology."

The findings show that only rising water costs at a rapid rate is not a realistic option for further developing freshwater resources used for the review area. To overcome water scarcity and attain more efficient water use, an appropriate methodology must be developed and implemented. First and foremost, it's indeed critical to promote consciousness across all irrigated agriculture clients because such injudicious utilization of freshwater could result in a shortage of water for other growers. Farmers who have experienced a little water constraint appear to be more prepared to make more informed water-use decisions.

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