Advance Journal of Econometrics and Finance
Vol-4, Issue-1, 2026

Advance Journal of Econometrics and Finance

Online ISSN
2959-8990
Print ISSN
2959-8982
https://ajeaf.com/index.php/Journal/About

Name of Publisher: SCHOLAR CRAFT EDUCATION & RESEARCH HUB
Review Type: Double Blind Peer Review
Journal Frequency: Quarterly Research Journal (4- Issue)

MONETARY CONTRIBUTION FOR CONTROLLING WATER SHORTAGE: A CASE STUDY OF DISTRICT PESHAWAR, KHYBER PAKHTUNKHWA PAKISTAN

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Abstract

Groundwater is a vital resource that supports agriculture, industry, and domestic needs in many regions of the world. The level of ground water is continuously declining in different part of the world which has significant impacts on the economy, environment, and public health. Water shortage can affect productivity of crops and industrial. In the current stress condition of water resources, has drawn the attention of researcher. The significance of groundwater issue in the global development agenda and highlights the need for proactive management. Worldwide more than two billion people depend on groundwater for their daily usage. The continuous mismanagement in extraction of groundwater has causes depletion in ground water, as a result the surface level is declining on daily bases might be results in serious water shortage in future. This study explores and analyzes the willingness to pay for controlling water shortage and improve water quality through which over usage can be reduce in district Peshawar. The study focuses on the current water situation in Peshawar, considering its importance for sustainable development and the well-being of the residents. The sample size of 281 respondents was selected. The household willingness to pay per month is dependent variable. While household head age, education, family size, income, water quality, gender and dummy of tube well water supply and water from filtration plant for household were among explanatory variables. The results shows that household education level, age, income, dummy for tube well and filtration plant are significant and have positive relationship with willingness to pay. However, household family size, gender and water quality are insignificant. Household age is positively in relationship with willingness to pay. Proper monitoring and evaluation is need for the supply of safe and clean water supply. There are people who do not trust local bodies or government department.

Introduction

The water that is kept below in aquifers beneath the surface of the Earth is referred to as groundwater. It is an important source of water for various purposes including household usage (M.Sulaiman 2020). Groundwater is a vital resource that supports agriculture, industry, and domestic needs in many regions of the world. The level of ground water is continuously declining in different part of the world which has significant impacts on the economy, environment, and public health. Water shortage can affect productivity of crops and industrial. The current situation is alarming for future economies of both developed and developing. Different studies provide a thorough review of groundwater management, including concerns such as pollution, groundwater shortage, and the need for creative and diverse management strategies (Karin E. Kemper 2004). In the current stress condition of water resources, has drawn the attention of researcher. The significance of groundwater issue in the global development agenda and highlights the need for proactive management. Worldwide more than two billion people depend on groundwater for their daily usage. The continuous mismanagement in extraction of groundwater has causes depletion in ground water, as a result the surface level is declining on daily bases might be results in serious water shortage in future. A worldwide hydrological model is used to predict groundwater recharge, and the estimated amount of groundwater abstraction is subtracted (Wada et al, 2010). To address groundwater shortage, several measures must be undertaken by Implementing regulations and water-use rights, like licenses, entitlements, and permits, to establish privileges, restrictions, and obligations for groundwater users. Adopting community-based or collective action management strategies for groundwater resources while taking into account how difficult it is to keep out potential users and how resource use affects other people's access to it. Investigating instrumental strategies to control groundwater use and avoid overexploitation, such as the assignment of rules and rights. Recognizing that the most effective solutions might lie outside the conventional groundwater management framework, indirect approaches should be taken that concentrate on larger resource systems rather than just the groundwater sector. Encouraging adaption solutions that take into consideration the unique qualities of each location and aquifer to overcome the problems related with groundwater exploitation (M. Giordano, 2009).

The study investigates the willingness to pay (WTP) for improved water access among the residents of Peshawar. By employing contingent valuation techniques and conducting surveys, the researchers measure the economic value people place on reliable water supply. This assessment of WTP provides insights into the affordability of water services and the community's capacity to contribute financially towards sustainable solutions.

Groundwater is one of the most important natural resource of Pakistan. Round about 90% or more rural population is depend on groundwater they use groundwater to fulfill their daily requirement because of insufficient private water supplier or the city water department (Hamilton and Helsel 1995). Like rural areas many urban centers also depend on groundwater due to water shortage to fulfill the daily requirements. Around 42% of groundwater is also used for irrigation purpose also. So, withdrawal of groundwater increases day by day because of the rapid increase in population and limited surface water reservoirs (Qureshi et al, 2010). Water scarcity is the main issue of the world and effect more on poor class, so effective policies should be form by policy makers that would be essential for to manage the scarce water resources which would be helpful in addressing the water challenges. However ground realities are totally different from imperfect water policy, water shortage becomes a huge challenge and calls for sudden policy actions in the country (Watkins 2007). In many areas water pipes are old and outdated. That forced the households to buy water from private water suppliers due to water depletion. Inadequate and unsafe water supply switches the consumer to most reliable substitutes (Mohod and Dhote 2013). As population is rapidly increasing all over the world during day by day so water resource risk is also increasing. As the demand for water is more and supply of water is limited. There is a serious need of water resources management to minimize the global water risk (Collick, 2008).

The examination of willingness to pay helps in arrangement of the advantages in financial terms from improvement in admittance to safe water. This data is valuable for strategy creators in making venture choices in view of advantages and expenses of progress of water administrations. Plus, in emerging nations, strategy producers by and large don't concentrate on venture for the arrangement of further developed water supply plans as they accept that people in general is hesitant in paying a higher tax and the expense of the venture will fall onto the generally intensely troubled public exchequer with the exception of a giver or loaning organization proposes to finance the help arrangement. Inability to planning appropriate valuing strategy for water administrations in the past has brought about under-venture, unfortunate upkeep, slow advancement in spreading inclusion, and wastage of water. Hence, assessment of the ability to pay is very useful for strategy producers for fostering an effective venture choice as well as in planning valuing strategies for reasonable administration and office of water administrations that will work on the government assistance of the general public.

To estimate the willingness to pay for water services gives monetary value for improved water services. This would help policy makers in cost and benefit analyses and they can take effective investment decision regarding improved water management. In developing countries policy makers would not take proper decisions regarding investment for

providing improved water supply schemes. Because policy makers think that public is not willing to pay higher water prices due to higher tariff. Therefore the burden of cost falls on the national exchequer except if a donor or a lending agency offer funding' the provision of the service (Hutton et al., 2004).

This study explores the economic implications of groundwater shortages and analyzes the willingness of the community in Peshawar, to pay for improved water access. The study focuses on the current water situation in Peshawar, considering its importance for sustainable development and the well-being of the residents. The case study of Peshawar reveals a pressing need to understand the economic implications of groundwater shortages and the willingness of the community to pay for improved water access. Despite the importance of sustainable water management for the well-being of residents, there is limited research on the economic burden and the factors influencing willingness to pay in Peshawar. Therefore, there is a critical knowledge gap that needs to be addressed to develop effective strategies for mitigating the economic burden of groundwater shortages and ensuring sustainable water access in Peshawar. In developing countries like Pakistan government is continuously trying to invest in improved water service and sanitation services but due to funds shortage, the supply of these services is always inadequate (Ahmed 2016).

Objectives

The research aims to achieve the following objective:

- To find the impact of different determinants of willingness to pay for ground water access.

Hypothesis

- There is a significant relation between social economic factors and willingness to pay for groundwater access.

Significance of the Study:

The research is essential for government and policy makers. This study targeted the ongoing water crisis issue in our country and discusses there consumption and usage. This study highlighted the problem of water scarcity and investigates about whether the people are willing to pay for groundwater service, if providing to them or not. Therefore the study helps the policy makers to take effective decisions regarding investment in improved water services, pricing policies and management which is beneficial for welfare of the society.

METHODOLOGY

Data Collection:

Survey Questionnaires:

Design and distribute questionnaires to the residents of Peshawar, gathering information on water usage, alternative water sources, expenditure on water-related activities, and willingness to pay for improved water access.

Interviews:

Conduct semi-structured interviews with key stakeholders, such as local authorities, community leaders, and water service providers, to gain in-depth insights into the economic burden and water management practices.

Secondary Data:

Collect relevant secondary data from government reports, academic papers, and existing databases to supplement the primary data and provide a broader context.

Sample Size and Sample Technique:

The size of sample for this study would be 281. The size of the sample has been derived by using the sampling formula for the unknown population which is

$$n = z^2 p\,(1 - p) / c^2$$

Whereas

Z, the standard normal deviation set at 95% confidence level

P is the %

C is the confidence interval

In order to understand the demand for the provision of groundwater service a sample size of 281 was determine using a confidence level of 95%. Data is collected through questionnaires and interviews; a simple random sampling technique is used for data collection purpose. Snowball random sampling is used which is an important technique for

the sample selection and indicates the true representation of the sample. This technique gives equal chance to every household in the study area to be selected. Total 9 interviews were conducted for qualitative side from different stakeholders who were working and providing tube well water services in the study area. For this study data was collected from Hayatabad.

To find the determinants of willingness to pay for groundwater access, the following model will be estimated.

$$WTP = \beta0 + \beta1\ (HHH\ age) + \beta2\ (HHH\ Edu) + \beta3\ (Family\ size) + \beta4\ (HH\ Inc./m) + \beta5\ (HHH\ Gender) + \beta6\ (water\ quality) + \beta7\ (dummy\ filter) + \beta8\ (dummy\ tube\ well) + \mu i \quad \ldots\ldots\ldots\ldots 03$$

Where:

WTP = Willingness to pay

HHH age = Household head age

HHH Edu = Household head education

Family size = Number of family members

Total HH Inc./m = Total household Income

Gender HHH = Household head gender

Water Quality = Current water quality

Dummy Filters = Dummy for filter water users who uses filter water it will be = 1, otherwise = 0. Due to the poor quality of tube wells and the lack of groundwater, filter water also uses in Peshawar, that's why a dummy for filter was introduced. Dummy tube well = Dummy for tube well water users who uses tube well water it will be = 1, Residents of Peshawar are using tube wells water as a result of the lack of ground water, that's why a dummy for a tube wells was introduced.

The objective was achieved through answered the research question, that to collect information regarding factors that influence the willingness to pay of households. To investigates the willingness to pay (WTP) for improved water access among the residents of Peshawar contingent valuation techniques was employed. Contingent valuation is a survey based method that is used to determine the economic value of nonmarket goods. Willingness to pay (WTP) is the amount that the consumer is willing to pay for groundwater out of his/her income to maximize his/her utility with respect to particular good and services. For to study the factors that influence the willingness to pay (WTP) of households for groundwater, linear regression model is used. This model was chosen because our dependent variable is a continuous variable and model has a well- established theoretical background Omondi et al., (2014).

RESULTS AND DISCUSSIONS

The current section consists of study that reveals different results which were collected from field survey and secondary sources. The current information was collected through quantitative methods to fulfill the main objective of the study.

Willingness to Pay for Groundwater Access

In the next part of dissertation research try to applied a linear regression model for the investigation of willingness to pay for access to safe and clean groundwater services. The study also investigates the determinants for maximum willingness to pay. The household willingness to pay per month is dependent variable. While household head age, education, family size, income, water quality, gender and dummy of tube well water supply and water from filtration plant for household were among explanatory variables.

The results shows that household education level, age, income, dummy for tube well and filtration plant are significant and have positive relationship with willingness to pay. However, household family size, gender and water quality are insignificant. Household age is positively in relationship with willingness to pay. This shows that with one year increase in age of the respondents. However, the willingness to pay increases up to Rs. 2.68 per month. This result shows that with increase in age of respondents, people get more curious and sensitive about quality water supply and safe services. The result further explain that education is highly significant with willingness to pay, with one unit increase in education of household head, people contribute Rs.16.32 while keeping the other factors constant. It was understand that improvement in education level of household head motivate them for the improvement in maintaining quality of water. Beside that education motivate them about the issue of water shortage in the study area. Hence a person is highly motivated toward the issue of water crisis in the study area and every person want to access save water supply as compare to own bore. People contribution level is high and they are willing to pay more as compare to those whose level of education low. Furthermore, with the increase in level of education, the income level of the respondents also

improves. Education helps them to earn more as compare to those who are low in education. This is the only reason as household whose income is high is willing to pay more as compare to those whose income is low. Result further shows that person whose income increases by one unit contributed about Rs. 23.63 per month in willing to pay for clean and safe water supply as compare to own bore. Quality of water varies with the amount of willingness to pay. However quality of water was scale on with different numbers i.e. 1 for good quality, 2 for medium quality and 3 for low quality. But the results shows that as quality of water are worse people start decreasing willingness to pay for it. Therefore, quality of water is negatively insignificant.

The dummy coefficient for bore is positively significant which have positive relationship with willingness to pay for safe and clean water supply. The empirical evidence clearly shows that people who used to extract water from own bore are willing to pay Rs. 53.86 per month more for tap supply of water with good quality. The main reason of people who used bore water is because of electricity charges which they pay for water extraction. As the energy tariff charges are increase on continuous bases people who used bore water are now willing to pay for supply of tap water. The motive behind that is to save money in monetary term and to control water shortage in future. Another factor through which household were motivated was that of low rate of water supply as compare to that of self-extraction through using water pumps by using electricity. Beside that the coefficient of dummy used for water filtration plant was also positively significant. The respondents are willing to pay more for safe and clean supply of water to their houses. The household who used water from filtration plant are willing to pay Rs. 75.87 per month more supply of tap water to their houses as compare to those who are not using filtration plant water. The main reason of extra payment for safe access to tap water is because of different reason which involve the time they spear to collect water from the filtration plant and the amount of energy they wasted to collect water from the point. There are respondents who used their own vehicle to collect water from filtration point, so fuel cost is also one of the reason due to which they are highly willing to pay as compare to other people in the study area. The household who are used to with water of filtration plant are very concern about the quality of water. They use filtration plant to get good quality of water, which clearly show their concern related to health. Majority of the respondents are highly concerned about the quality of water which they receive from supplier through tap. Respondents agree to pay more for quality water supply at door step as compare to their own bore water, tube well and filtration plant water. However, the respondents think that current water supply system is not up to the mark and people who used water are always have health issues as compare to those who do not used water local water supply system. The above results depict that people are willing to pay for quality water supply to their houses. However, the respondents were also agree for water meter installation, but people do not trust the current water supply services. Therefore, during the survey majority of respondents wants a new infrastructure for clean and safe water supply without any stoppage.

Table 01: ***Results of the Model for Determinants of Willingness to Pay***

Variables	**Coefficient**	**Std. Err.**	**T**	**P>t**
Education of HHH	16.32*	1.78	1.92	0.10
Age of HHH	2.68***	0.89	1.84	0.10
Family size	0.81	5.92	0.23	0.94
Income of HH	23.63*	5.77	3.00	0.03
Water Quantity/m	-26.34	20.00	-1.92	0.30
Gender	5.89	18.56	0.31	0.83
Dummy for Bore	53.86***	23.54	2.89	0.05
Dummy for Filter	75.87***	34.75	3.23	0.07
Observations	281			
R^2	0.69			
MSE	81.23			

*Significant at 1%, **Significant at 5% and ***Significant at 10% confidence interval

It was also important to know the perception of household about their willingness to pay for properly manages and clean water supply system. The results were quite interested about 89 percent of respondents were in the favor of safe and clean infrastructure of water supply system, while 11 percent respondents were not in favor. Majority of respondents who agree upon water supply system shows that people want to save money, time as well as control water stress situation in the study area.

Table 02: ***Percentage of Household Willingness to Pay for safe and clean supply system***

Yes	89
No	11

Survey result 2023

Furthermore, the respondents who are willing to pay for safe and clean water system was about the amount of money they wants to contribute. The above table shows that about 89 percent people are willing to pay for safe and clean water supply. After that respondents who agree to monetary contribution were asked about the amount of money they wants to contribute. 43 percent of the respondents were willing to pay in the range of one thousand to two thousand. While 21 percent of respondents were willing to pay from 2000 to 3000. 19 percent of respondents were willing to pay from 3000 to 4000 and 12 percent respondents agree upon the amount ranges from 4000 to 5000. However, there were 5 percent of respondents who were willing to pay more than 5000 for clean and safe water supply system.

Table 03: ***Monetary Contribution for safe and clean water supply system***

1000 - 2000	43
2000 – 3000	21
3000 – 4000	19
4000 – 5000	12
More then 5000	05

Survey result 2023

Conclusion

The study concluded the determinants for maximum willingness to pay. The household willingness to pay per month is dependent variable. While household head age, education, family size, income, water quality, gender and dummy of tube well water supply and water from filtration plant for household were among explanatory variables. The results shows that household education level, age, income, dummy for tube well and filtration plant are significant and have positive relationship with willingness to pay. However, household family size, gender and water quality are insignificant. Household age is positively in relationship with willingness to pay. It was understand that improvement in education level of household head motivate them for the improvement in maintaining quality of water. Beside that education motivate them about the issue of water shortage in the study area. Hence a person is highly motivated toward the issue of water crisis in the study area and every person want to access save water supply as compare to own bore. People contribution level is high and they are willing to pay more as compare to those whose level of education low. Furthermore, with the increase in level of education, the income level of the respondents also improves. Education helps them to earn more as compare to those who are low in education. This is the only reason as household whose income is high is willing to pay more as compare to those whose income is low. The results shows that as quality of water are worse people start decreasing willingness to pay. Therefore, quality of water is negatively insignificant. There are respondents who used their own vehicle to collect water from filtration point, so fuel cost is also one of the reason due to which they are highly willing to pay as compare to other people in the study area. The household who are used to with water of filtration plant are very concern about the quality of water. They use filtration plant to get good quality of water, which clearly show their concern related to health. Majority of the respondents are highly concerned about the quality of water which they receive from supplier through tap. Respondents agree to pay more for quality water supply at door step as compare to their own bore water, tube well and filtration plant water. However, the respondents think that current water supply system is not up to the mark and people who used water are always have health issues as compare to those who do not used water local water supply system. The above results depict that people are willing to pay for quality water supply to their houses. However, the respondents were also agree for water meter installation, but people do not trust the current water supply services. About 89 percent of the people in the study area are willing to pay for the supply of clean and safe water. This clearly shows that people are serious about the water services.

Recommendations

There are household, whose income level is very low therefore they are not willing to pay as compare to people with high income who are willing to pay for supply of safe and clean water. The people who are not willing to pay for safe and clean water supply is due to the reason that they are living below poverty line and their cost of living is high on other goods and services, beside water.

Water stress is the most serious issue in the study area. Results shows that education level increases household willingness to pay as well as it help in controlling water shortage. Therefore, awareness of community about continuous water shortage and discouraging self-ground water extraction in the form of bore. Beside that people whose family size is small are consuming less water as compare to large families. So educating people about small family size is also important to reduce water stress in the study area.

The organization such as local government and rural urban development shall take all the responsibility for maintaining quality. Proper monitoring and evaluation is need for the supply of safe and clean water supply. There are people who do not trust local bodies or government department. Government authorities need to restructure already existence department for avoiding unhygienic and unsanitary conditions in water supply services.

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Advance Journal of Econometrics and Finance
Vol-4, Issue-1, 2026