To Assess Challenges and Opportunities in Enhancing Access to Adequate, Safe and Affordable Watsan Services in District Peshawar: The Role of Local Government

Usman Farooq[a*], Prof. Dr. Inayatullah Jan[b]

[a]Ph.D scholar, Institute of Development Studies, Faculty of Rural Social Sciences, The University of Agriculture, Peshawar-Pakistan. [b]Director, Institute of Development Studies, Faculty of Rural Social Sciences, The University of Agriculture, Peshawar-Pakistan

[*]**Email:** farooqps2003@yahoo.com

Abstract: The aim of this study was to assess the challenges and opportunities in access to improved water and sanitation (WatSan) services, the effects of unsafe WatSan services on the health of the population (adult and children under-five), and the prospects of revenue generation from improved WatSan services in Pakistan. The study is based on novel data collected from 278 households - selected using proportionate random sampling technique - across three village councils (VC), namely Arbaban, Nothia Qadeem-I and Achar-II, of district Peshawar, Khyber Pakhtunkhwa Province (KP) of Pakistan. Data were collected from households and government officials using two separate questionnaires. The descriptive analysis shows that people in the research area used various sources of potable water such as government sponsored water supply and sanitation programme (WSSP) (76.7%), bore-sourced drinking water (12.5%), and public health department services (10.8%). As many as 91.7% respondents reported occurrence of water-borne diseases in their households in the last six months and 12.5% reported under-five mortality in their households. Furthermore, the respondents in the research area were aware about the importance of safe sanitation However, the health effects of unsafe WatSan services were separately determined for adult population as well as children under-five by using chi-square tests of independence. The study also concludes that despite the existence of a number of issues in access to improved WatSan services, consumers were willing to pay for improved services. The policy implications of the study is that In order to close the communication gap between consumers and policymakers, this study advises practitioners in the local government department and WSSP should develop programs and strategies for provision of safe WatSan services in the study area**.**

Keywords: Watsan Services, WSSP, SDG's, Water born diseases

1. Introduction
1.1 Background of the study
The availability, use and access to clean water for everyone as well as concerns like water storage and how to deal with water scarcity, are all on the global agendas of all international forums and organizations. The seventeen Sustainable Development Goals (SDGs), which the United Nations launched in September 2015, highlighted the most significant global issues and challenges. Clean water and sanitation are listed as the sixth most urgent global issue, demonstrating the significance of the water issue on a global scale (UN, 2015).

Practically life is impossible without water. Water is vital for all living organisms in one way or another. More than a billion people, according to estimates, lack access to safe water. One of the reasons that clean water resources have declined, mainly in densely populated areas of the world, is the rise in population (Rashid et al., 2015). Water supplies have been contaminated by bacteria throughout history. Providing users with safe, clean water that is free of germs is one of the main responsibilities of water quality management. The efforts made to safeguard water sources and treat water have significantly decreased the occurrence of diseases in developed countries. Water must therefore be tested for quality before being given to customers, especially in locations without access to water management services. Because contaminated water has the potential to spread dangerous diseases, testing the water is essential. To stop disease outbreaks, drinking water should be examined often. Around 800 million people live in Asia and Africa without access to safe water (Ali et al., 2014).

1.2 Importance of Water

Water is essential for all living things, including plants, animals, microbes, and humans, as was previously mentioned. Two hydrogen atoms bound to one oxygen atom make up the molecule of water. About 70% of the earth's surface is covered by water, which is primarily found in the seas, rivers, lakes, and glaciers. Water is scarce in a lot of countries, though. In order to increase people's quality of life and promote personal fulfillment, financial stability, economic growth, and sustainable development, good quality water is a necessity. In both urban and rural areas, access to clean water is a critical issue. Various diseases have been discovered in many populations as a result of inadequate access to clean water. Having access to water resources can reduce poverty and boost the economy while preserving the environment (Lenntech, 2017).

Pakistan's drinking water quality is rapidly declining as a result of the country's surprising population growth and accelerating industrialization. In Pakistan, only around 20% of the total population has access to clean drinking water. Because there are few sources of clean and healthy drinking water, the remaining 80% of the population is compelled to utilize contaminated water. waste from sewers, which is frequently dumped into drinking water systems, is the main source of pollution. The release of pesticides, fertilizers, and hazardous chemicals from industrial effluents into water bodies is a secondary cause of pollution. Thirty-three percent of fatalities and almost 80% of all illnesses are waterborne, a result of anthropogenic activity. This assessment focuses on the causes of pollution, the state of sanitation, the consequences of contaminated drinking water on humans, and the quality of drinking water. Protective measures and treatment technologies must be implemented immediately to improve the unsanitary state of drinking water sources in various parts of Pakistan (Daud et al., 2017).

1.3 Effects of Water-borne Diseases

In developing countries, waterborne diseases are particularly prevalent. The sources of water contamination include industries, population increase, radioactive waste, chemical waste, and excessive pesticide and fertilizer use, all of which worsen health and spread disease. Typhoid, hepatitis, polio, skin conditions, stomach and bowel issues, and typhoid fever are the main ailments brought on by contaminated water. Water quality should be examined often in order to prevent and detect such disorders (Haseena, 2017). Around 80% of diseases in the world are caused by water-related problems. Unsuitable water storage systems, a lack of or insufficient sewage systems, population growth, and improper fertilizer use are all causes of water pollution, which has a negative impact on the quality of life. Pesticides and fertilizers of various kinds play a major part in water pollution. Other health problems (such as constipation, sore throat, nausea, parasite, cholera, and skin infection) are transferred by water and are caused by bacteria that cause diarrhea and viruses that cause hepatitis (Haseena, 2017). Five million children in poor nations lost their lives as a result of tainted drinking water. Since there is inadequate control of water quality as a result of rapid population expansion, this scenario is getting worse every day. The rapid population increase is making matters worse by the day since it leads to inadequate control of the water quality. Poor water quality is thought to be the cause of 40% of all fatalities and 30% of all illnesses in Pakistan. According to reports, waterborne diseases like diarrhea are the main cause of mortality for young children in Pakistan, where one in five people also have illnesses brought on by contaminated water (Kahlown et al., 2006).

1.4.1 Quality of Drinking Water in Pakistan

Due to population growth, Pakistan is facing a severe water shortage and a sharp decline in the amount of water available per person. The Council of Research and Water Resources in Pakistan has launched a national initiative to track water quality by taking samples from all the main cities. These samples have undergone physical, chemical, and biological examinations. All provinces have bacteria in the water, according to the samples. In samples from Punjab, nitrate, iron, and Khyber Pakhtunkhwa (KP) as well as samples from Baluchistan and Sindh, arsenic was discovered. This information prompted the authorities to examine the water's quality and recommend the implementation of strategies to enhance it (Soomro, 2018).

In Pakistan, 7% of the population lives in rural areas and relies on rivers, wells, and hand pumps. Of all the provinces, Punjab has the best supply system for waiters. In Sindh, 24% of the population uses unclean water sources. Baluchistan and Khyber Pakhtunkhwa (KP) utilize water from wells and the surface at rates of roughly 72% and 46%, respectively (Daud, 2017).

1.4.2   SDG-6: Clean Water and Sanitation for all

SDG-6 "Clean water and sanitation for all". It is one of the 17 SDGs that the UN General Assembly set in 2015. "Ensure availability and sustainable management of water and sanitation for all," reads the goal's official statement. To reach the target by 2030, eight milestones must be attained. To monitor progress towards the targets, eleven indicators are used. The six "outcome-oriented targets" of SDG-6 mentioned below:

6.1. Ensuring access to safe and affordable drinking water;

6.2. Putting an end to open defecation;

6.3. Assuring access to hygienic facilities;

6.4. Improving water quality, wastewater treatment, and safe reuse;

6.5. Increasing water use efficiency and securing freshwater supplies;

6.6. Putting integrated water resource management (IWRM) into practice; and protecting and reviving ecosystems that are connected to water.

1.5 Objective of the study

a) To assess challenges and opportunities in enhancing access to adequate, safe and affordable WatSan services in the research area.

b) To give policy recommendation based on the study

1.6 Hypotheses of the Study

H_0: There are no health effects of unsafe WatSan services on adult population in the research area.

2. Literature Review

According to a study by Ganter (2019) the demand for fresh water is getting more intense because of factors such as climate change, population growth, urbanism, and agricultural production. The sector is also essential in the fight against the nation's high child mortality rate, hunger, malnutrition, and poverty. Due to rapid change in global climate change and pollution in oceans and no proper storage of water and accessibility makes the situation worse.

Blackburn (2019) investigated in his research on WatSan services and found that several instances of sewage leaks that entered people's homes have occurred. According to Blackburn's research, a lot of homes lack acceptable sanitation and water supplies, which shows that the government hasn't done enough to meet the basic necessities of the neighborhood. As a result, the goal of this study also includes using the research objectives as a road map to continue moving in that direction. Analyzing the characteristics of the water and sanitation sector, the political, economic, and social issues that affect it, as well as the remedies and policies put in place, are among these aims.

Muhammad et al., (2020) found in the research that the dilemma of access to clean drinking water is a problem in practically every developing country. However, in the process of fast urbanization and urban

expansion, scholars have focused solely on the physical infrastructure of city development and completely disregarded the significance of evidence based on planning. Using the Contingent Valuation (CV) survey Method, data from 45 urban councils were gathered for this study. The findings indicate that 96.8% of households receive municipal services, 89.8% are served by WSSP, 7% are served by the Cantonment Board, and 3% have their own arrangements. The mainstream is dissatisfied and is WTP for QDWS at PKR 278 per month.

Anh et al., (2022) explored in the research that how increased cleanliness and access to clean water affected children's deaths. Only behind Sub-Saharan Africa does South Asia have the second-highest number of public health emergencies related to the use of unsafe water and sanitation. According to logistic regression models, access to better water and sanitation, particularly in the post-neonatal era, is strongly linked to a decreased likelihood of child death. The risk of child mortality is decreased by higher parental educational attainment and household wealth, however the combined household wealth and place of residence variable showed that children living in urban regions had a higher mortality risk than those living in rural areas. These findings highlight the significance of better sanitation and access to clean water in lowering the number of children dying from illnesses associated with water. Additionally, they advocate for more study into how access to clean water and better sanitation help the world reduce child mortality, particularly in light of the SDGs of the UN.

3. Research Methodology

The universe of this study was district Peshawar. District Peshawar consists of both urban and rural areas; and ranked topped to be the most populated district of KP. The district is divided in 357 village councils and neighborhood councils (VCs/NCs). The recent census determined that the total population of district Peshawar is 4.26 million, furthermore it also shows the population of rural areas is 2.29 million, and urban area is 1.96 million and the average household size is 8.37 (GoP, 2017). Peshawar city is the most congested city of KP having major institutions of health, education and government. The city is divided into seven towns and one city metropolitan area. To provide facilities of WatSan, the GoKP established WatSan cell and WSSP. The WSSP further established its offices in all seven towns and is planning to extend the facilities to remote areas of the city. To improve the WatSan services, the GoKP, through the funding of USAID, completed the Municipal Services Program, through which the major sanitation structures were developed (GoP, 2017). The GoKP along with many donors and organizations run many projects to developed and update the infrastructure in accordance with latest technology. The GoKP recently initiated a project under Asian Development Bank funding titled "Khyber Pakhtunkhwa Cities improvement Program-KPCIP" under the supervision of LGE&RDD which aims to update the WatSan infrastructure in Peshawar, Swat, Abbottabad, Mardan and Kohat. The Project Management Unit has been established in Peshawar and main focus in Peshawar to update the infrastructure for the provision of safe and clean WatSan services. Thus district Peshawar constitutes the universe of the study.

3.1 Analytical Technique

The study assesses several objectives, therefore, different analytical techniques were used to assess the objectives of the study. The study used both quantitative as well as qualitative analytical techniques. The objective wise details of each analytical technique to be used as given as follows.

To find out the association between unsafe WatSan services and their effects on adult population, Chi-squared analysis will be conducted because these variables are in categorical form (Muhammad et al., 2018).

Occurrence of diseases was measured as categorical variable with value 1 if major water-borne diseases occurred during the last six months and 0 if otherwise. The other variable will be measured as categorical variable with value 1 if a household is having access to improved WatSan services and 0 if otherwise. The following Chi-squared test was used.

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij}-E_{ij})^2}{E_{ij}} \quad ……………………….. \ 3.2$$

4. Results and Discussion

4.1 Drinking water sources

A body of water that naturally occurs and provides water for both private wells and public drinking sources (such as a stream, river, reservoir, lake, body of ground water or spring). Sources is referred to as a source of water. The drinking water source is the intake of drinking water used for human use from the groundwater or surface water. The average usage of drinking water by household needs a source and it should be on daily basis as without water not even human can survive neither they can't clean all their daily routine needs like (bathing, washing clothes, dishes and houses, water need for irrigation and even to use the water for cooling the vehicles engine.

Table 1: Sources of drinking water in study area

	Frequency	**Percent**
Bore	36	12.5
Public Health	31	10.8
WSSP	220	76.7
Total	287	100

Source: Field Survey, 2023

Table reveals that 12.5% of households utilize bores to get their drinking water, 10.8% use public health water sources, and 76.7% use water from WSSP. An earlier investigation of the quality of the drinking water in the rural Tank district found a variety of issues, including a low water table and erratic water supply. In the communities that were studied, 40% of families used hand pumps to get their drinking water, 25% used communal tube wells, 16% used wells, 13% used pressure pumps at home, and 6% used rainfall (Cooper, 2018).

Table 2: Satisfaction with Water Quality in the study area

	Frequency	**Percent**
Yes	236	82.2
No	51	17.8
Total	287	100

Source: Field Survey, 2023

Table shows that 82.2% of households were happy with the quality of their drinking water, while 17.8% of households were not. Previous research shows that in Khyber Pakhtunkhwa (KP), more than 80% of the population uses safe drinking water that is obtained from surface and ground sources. While the surface water in KP is pure and safe to drink, the ground water in the south is a dark, almost black color. Deep water can also be discovered to be clean. However, groundwater is readily available throughout KP and is routinely pumped out using tube wells. Surface water and springs make up the majority of the water resources in KP's northern region. The quantity and quality of drinking water are particularly poor in urban areas due to insufficient water treatment of deteriorating water and antiquated sanitation facilities (Daud et al., 2017).

Table 3: Availability of Water Quality Testing Services in the study Area

	Frequency	Percent
Yes	201	70
No	86	30
Total	287	100

Source: Field survey, 2023

Table shows that whereas 30.0% (86) of households have no water testing facility, 70.0% (201) of households in the study region have a water testing facility. According to previous research drinking water quality is a significant environmental health factor. Physical, chemical, and microbiological qualities are the three main areas taken into account when determining the quality of water. Heavy metals are present when certain organic molecules, total suspended solids, and turbidity are present, according to physical and chemical characteristics. Coliform bacteria, E. coli, certain pathogenic bacterial species (such the cholera-causing Vibrio cholerae), viruses, and protozoan parasites are examples of microbiological criteria. Although some elements, such as nitrates/nitrites and arsenic, may have a more immediate effect, chemical characteristics frequently result in a chronic health risk due to the gradual and continuous buildup of heavy metals. On the other hand, Physical elements may affect the look and taste of drinking water as well as making it more difficult to eradicate microbiological organisms. It's crucial to consider disadvantaged populations who are more likely to be exposed when discussing drinking water quality, such as children, elderly people, and those with compromised immune systems. For instance, enteroviruses are very dangerous for newborns (Abzug et al., 1995).

4.1 Alternate source of drinking water used by the respondents
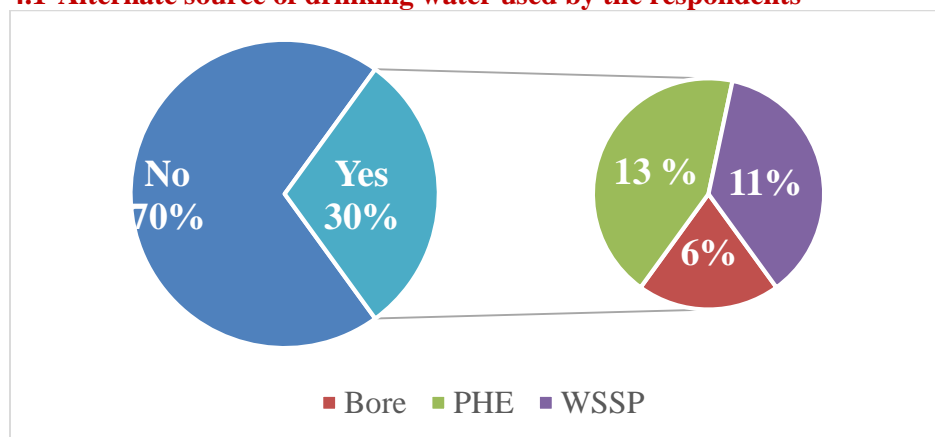
Source: Field Survey, 2023

Figure 4.1 reveals that 30 % of families have a backup supply of drinking water and have alternate source of water supply, compared to 70 % who do not have any other source of water supply. Previous studies conducted on the sources of the water by the researcher shows that the water used for drinking water from different sources are not fully usable. Due to financial constraints and availability of resources people has access only to one source. However the people having more income can afford other sources of water supply and storage. The other reason of the other source is having own house people residing in rented house has to use only one option provided by the owner of the house. Moreover, water samples were taken from several sources in three districts of the province of Khyber Pakhtunkhwa, and was discovered that the water from every source contained parasite eggs, cysts or oocysts (Ayaz et al., 2011).

The figure further shows that the 13 % of people get their water from Public Health tube wells. The 6% of households have bores for the use of water for everyday use and drinking, while 11 % have WSSP as an additional source of water.

4.2 Health Effects of Unsafe WatSan Services

Viruses, bacteria, and other tiny organisms can cause diseases called "waterborne diseases" when they are absorbed through polluted water or by coming into touch with human or animal excrement. If everyone on the planet could practice appropriate sanitation and hygiene habits and had access to clean water, these diseases wouldn't exist (lifewater.org). The primary cause of illnesses in underdeveloped nations, according to researchers and health professionals, is a lack of access to clean, safe drinking water. According to a report by the United Nations Commission on Sustainable Development about 2.3 billion people in developing nations suffered from illnesses that were caused by inadequate access to and poor quality of water (CDS, 2015).

Table 4: Occurrence of water-borne diseases in the last six months

	Frequency	Percent
Cholera	35	12.2
Diarrhea	143	49.8
Dysentery	26	9.1
Hepatitis	34	11.8
No disease	49	17.1
Total	287	100

Field Survey, 2023

Table shows that as a result of water-borne infections, statistics reveal that 12.2% of households were afflicted by cholera, 49.8% by diarrhea, 10.7% by dysentery, and 11.8% by hepatitis. The 17.1% of the respondents replied with no and have no water-borne disease in last six months.

4.2   Diseases Caused by the Unsafe Sanitation Identified by the Respondents
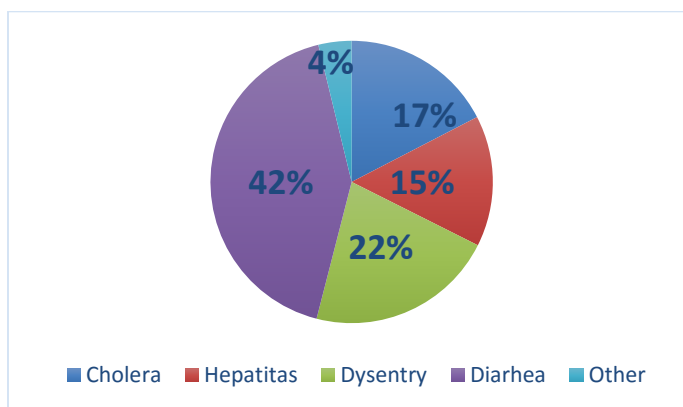
Source: Field Survey, 2023

Figure 4.2 is about how well-informed the respondents are about the diseases that can be brought on by poor sanitation and improper waste and trash disposal. According to the research, 17.4% of households were aware

of cholera, 42.2% were aware of diarrhea, 21.6% were aware of dysentery, 15.0% were aware that hepatitis may be brought on by poor sanitation, and 3% were discussing other illnesses.

4.3 Mortality of children under-five due to water-borne diseases

The children are the most vulnerable and most effected ones due to every exposure and mostly contaminated water. The children should be given boiled safe and pure water as to reduce their water-borne diseases due to which many children die every year. While public infrastructure is generally better in metropolitan areas, just 13.5% of children in rural regions have access to pipe-borne water; by contrast, 55% of children in urban areas have. In Khyber Pakhtunkhwa (KP) and Balochistan, where 31.4% and 41.9% of children, respectively, have access to dangerous (high risk) water, the situation regarding the water source appears to be the worse. Despite having the largest percentage of children, Sindh and Punjab have the lowest percentage of kids (4.7% and 9.9%, respectively) who are exposed to hazardous (high risk) water sources. The majority of youngsters in Punjab and Sindh, or 77.2% and 60.6%, respectively, were also exposed to relatively less hazardous water sources. Notably, KP seems to have the most percentage of kids (37.3%) who drink from low-risk water sources, followed by Balochistan (31.9%). Despite being the most populous province and receiving the greatest portion of the national budget, Punjab has the least amount of access to tap water (low risk); just 18.1% of children in Punjab seem to have access to tap water (Fowad et al., 2021).

Table 5: Children Under-Five Mortality due to Water Borne-Disease in the Last Six Months

	Frequency	Percent
Yes	36	12.5
No	251	87.5
Total	287	100

Source: Field Survey, 2023

Table shows the results about the mortality of children under-five in which 12.5% of people said there had been children under-five who had died from water-borne infections due to unsafe drinking water, while the majority, 87.5%, said there had been no such fatalities. Previous studies shows some communities have been plagued with water- borne disease outbreaks, resulting in deaths (Dore, 2015). Most underdeveloped countries are said to be extremely concerned about access to safe drinking water. People require access to basic amenities like a clean water supply and improved sanitation. Around 7000 million people in Asia lack access to a proper water delivery system, especially in rural areas. In Pakistan, 70% of the population relies on groundwater, and rapid development is causing the water table to drop. Sewerage and contemporary effluents, surface run-off, and a number of human activities that change the physical (variety, taste, and smell) and chemical characteristics of water all contribute to water pollution. Polluted and contaminated water can cause waterborne illnesses such dysentery, cholera, hepatitis A, diarrhea, and hepatitis. 5 million people worldwide every year pass away as a result of illnesses connected to water. Diseases and fatalities in underdeveloped countries are caused by a lack of adequate and safe water supply and sanitary infrastructure. 250 million people are contaminated by water-borne microorganisms annually, resulting in 10–20 million fatalities. It has been noted that in underdeveloped countries, poor water and sanitation contribute to a large number of illnesses and about 4 billion deaths of children under the age of five. Every year, almost 250,000 children under the age of five in Pakistan pass away from diarrhea (Malik et al., 2012).

Table 4.6: Association between Unsafe Drinking Water and Children Under-Five Mortality

Category	Yes	No	Total	χ2	Sig.
				2.281	.048
Yes	26 (29.6)	210 (206.4)	236 (236.0)		
No	10 (6.4)	41 (44.6)	51 (51.0)		
Total	36 (36.0)	251 (251.0)	287 (287.0)		

Source: Field Survey, 2023

Table 4.6 shows the association between two variables and majority (251) of respondents answered "No" as compared to their fellow respondents (36) that answered "Yes". The chi-squared statistic value is 2.281, while the p-value at 0.048 which is less than 0.05, this outcome indicates that there is significant association between the given variables.

Previous studies show that any illness epidemic with a water source should be reported right once to medical authorities. Regular reporting requirements, sub-typing of bacterial isolates, laboratory molecular analysis, customer complaints, and organized monitoring systems should all be used for detection. Calling possibly exposed groups, sending alarms, seeking laboratory samples, or releasing a media notice are all possible steps in the protocol. It is important to record any water-related disorders linked to dangerous substances like algal blooms. It is essential to note that epidemiological research should be conducted to determine reasons and implement preventative strategies. In order to confirm an etiologic agent, if required, and to put public health measures in place to stop further spread, samples should be delivered to public health laboratories (Pal, 2014). In conclusion, the data from the table underline the importance of addressing the challenges in water and sanitation services to mitigate the prevalence of waterborne diseases and its impact on child health in the research area. The findings can serve as a basis for formulating effective policies and practices to enhance access to safe and affordable WatSan services and improve the overall well-being of the community.

Table 4.7: Association between Quality of Drinking Water and Sickness of the Respondents in Last Six Months

Category	Yes	No	Total	χ^2	Sig.
Yes	187 (86.7)	49 (49.3)	236 (236)	0.898	.039
No	40 (40.3)	11 (10.7)	51 (51.0)		
Total	227 (227.0)	60 (60.0)	287 (287.0)		

Source: Field Survey, 2023

The above table 4.7 is about the association between two variables and results shows that majority (227) of respondents answered "Yes" as compared to their fellow respondents (60) that answered "No". The chi-squared statistic value is 0.898, while the p-value at 0.039 which is less than 0.05, this outcome indicates that there is significant association between the given variables.

5. Conclusion

The study's primary objectives were to determine how households felt about WatSan services, how unsafe water and sanitation affected the population's health, particularly that of children under the age of five, how aware people were of their personal hygiene and health, and how willing they were to pay for better water and sanitation services. According to the survey, households in pakka houses make more money than those in kacha houses. The majority of the respondents were literate. The study found that regardless of the water quality, the majority of families were utilizing WSSP for drinking water. Higher income respondents had higher WTP. The elderly family head will probably spend less for drinking water. Furthermore, it is determined that respondents with higher levels of education had higher WTP. The survey also found that the majority of respondents were knowledgeable about water-borne illnesses. The majority of respondents obtain their clean drinking water from bores.

5.1 Recommendations of the study

a) The study provides the following recommendations.
b) Enhance water and sanitation infrastructure by implementing national policies at the provincial level and encouraging private sector participation.
c) Develop and enforce policies to clear public sewage lines and prevent future encroachments.
d) Promote affordable household water treatment solutions and reduce water waste.
e) Implement long-term wastewater management plans to address the lack of treatment systems in Peshawar.
f) Clean and repair blocked drains, upgrade unlined drains to durable materials, and increase public awareness of waterborne diseases and hygiene.

References

Anh M. Ly et al., (2022) Revisiting the Impact of Clean Water and Improved Sanitation on Child Mortality: Implications for Sustainable Development Goals

Ayaz S., Sanaullah K., Shahid N.K., Farzana B., Sumaira S., and Masood A., (2011). Prevalence of Zoonotic Parasites in Drinking Water of three Districts of Khyber Pakhtunkhwa Province, Pakistan. Pakistan, *Journal of Life and Social Science*, 9(1), pp 67-69.

Ayub A (2022). Household perceptions of water and sanitation quality and their willingness-to-pay for improved water and sanitation services in district Peshawar.

Abzug MJ, Keyserling HL, Lee ML, Levin MJ, Rotbart HA, et al. (1995) Neonatal enterovirus infection: virology, serology, and effects of intravenous immune globulin. *Clin Infect Dis* 20: 1201-1206.

Agriculture Department. https://agriculture.kp.gov.pk/#sthash.PbR0fFNS.dpuf

Aguilar-Barajas, I., Mahlknecht, J., Kaledin, J., Kjellén, M., Mejía-Betancourt, A. (eds) (2015). Water and Cities in Latin America: Challenges for Sustainable Development. Routledge, Abingdon.

Blackburn, k. (2019). PICS: Big stink as raw sewage leak flows into Shallcross family's home. www.iol.co.za/dailynews/news/kwazulu-natal/pics-big-stink-as-raw-sewage-leak-flows-into-shallcross-familys-home-27006685

CSD – United Nations Commission on Sustainable Development, (2015), Comprehensive Assessment of the Freshwater Resources of the World. Report of the Secretary General, New York. pp 39.

Cooper, R. (2018). Water, sanitation and hygiene services in Pakistan.

Cooper. R. 2018.Water, sanitation and hygiene services in Pakistan.2018. Helpdesk   Report.

Dore MHI (2015). Water Policy in Canada: Problems and Solutions. Switzerland: Springer International Publishing.

Department of Health and Bureau of Statistics, Planning and Development Department Government of Khyber Pakhtunkhwa. (2017). Khyber Pakhtunkhwa Health Survey (2017)

Dwight RH, Fernandez LM, Baker DB, Semenza JC, Olson BH, et al. (2005) Estimating the economic burden from illnesses associated with recreational coastal water pollution—a case study in Orange county, California. J Environ Manage 76: 95-103.

Fowad Murtaza et al., (2021) Water and Sanitation risk exposure in children under-five in Pakistan. 10.4103/jfcm.jfcm_149_21

GIS Hub-Planning and Development Department GoKP, 2023

Malik, A., A.Yasar,AB.Tabinda and M.Abubakar.2012. Water-Borne Diseases, Cost of Illness and Willingness to Pay for Diseases Interventions in Rural Communities of Developing Countries. *Iran J Public Health*. 41(6): 39–49.

M. A. Kahlown, M. A. Tahir, H. Rasheed, and K. P. Bhatti (2006). Water quality status, national water quality monitoring programme, *Fourth Technical Report* PCRWR 5, 2006.

Muhammad et al., 2014. Assessing Household Willingness to Pay for Quality Sanitation Services in Urban Areas of Pakistan/ University of swat

M. K. Daud et al., 2017. Drinking Water Quality Status and Contamination in Pakistan.

NASA, 2010. "What Is the Water Cycle?". https://climatekids.nasa.gov/water-cycle/..

Pakistan Demographic and Health Survey (2012-13) https://dhsprogram.com/pubs/pdf/fr290/fr290.pdf

Schlein, L. (2017). Report: Billions of People Lack Safe Water, Sanitationhttps://www .voanews .com/science -health/report-billions-people-lack-safe-water-sanitation.

Schlein, L. (2017).Report: Billions of People Lack Safe Water, Sanitation". https://www.voanews .com /science-health/report-billions-people-lack-safe-water-sanitation.

UNICEF. (2015). *Progress Report 2013-2015. Improve Access to Sanitation.* Islamabad: UNICEF Pakistan. Retrieved from https://www.unicef.org/pakistan/Improve_Access_to_Sanitation.pdf

UNICEF. 2019. "Water, Sanitation and Hygiene". https://www.unicef.org/wash/.