ACCESSIBILITY ASSESSMENT TO POTABLE WATER SOURCES IN FAISALABAD CITY; USING GEOSPATIAL TECHNIQUES

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ABSTRACT: Approach to potable water under satisfactory, assessable, and economically affordable price is one of the major issues in Faisalabad city. This study aims to find accessibility to drinking water sources in Faisalabad city. A structured questionnaire was designed to collect primary data whereas secondary data was collected from the Water and Sanitation Agency water supply (WASA) and the Municipal Corporation of Faisalabad city. Geospatial techniques were used for the spatial coverage of water schemes. We used buffer analysis, and near-distance analysis to find accessibility to portable water in Faisalabad, and kriging analysis was applied to draw the pattern of accessibility to potable water in Faisalabad city. Our findings reveal that the main potable water sources in the study area are borehole water, filtration plants, bottled water, WASA, and canal water. 51.6% of people rely on filtration plants for drinking water. Most filtration plants are in the center of Faisalabad city. Residents are living in remote areas of Faisalabad city cover the maximum distance to collect the potable water. People living in the center of the city cover about 0.03km-3.3km distance to collect potable water. On the other hand, People living in remote areas of Faisalabad city cover about 26.4km-29.7km distance to collect potable water.

Keywords: Buffer Analysis, Kriging, Potable Water, Accessibility, Faisalabad.

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INTRODUCTION

Water is an important element for human existence and material development, and lack of access to water affects human health and economic progress (Hutton & Haller, 2004). According to the World Health Organization fact sheet 2018, 844 million people have not access to basic potable water services. In the overall world, 159 million populations are relying on surface water. In less-income countries, 38% of health care opportunities are absence of clean water. In world at least 2 billion population use a potable water source polluted with excrement. Polluted water is causing many illnesses like diarrhea, cholera, dysentery, typhoid, polio, & hepatitis.

Globally, every year polluted potable water causes 502,000 diarrheal deaths (WHO, 2018). As per records, one in four people don't use safe drinking water till 2020 (Ritchie, 2021)The lack of supply of clean potable water is the main cause of diseases in developing countries (Shah et al., 2016). According to the 2015 report of Millennium Development Goals, globally 663 million population still do not have clean potable water and among them mostly people belong to rural areas (WHO/UNICEF, 2015). Access to clean potable water is an essential human right but most people of the world lack access to it. Approximately one in five health care facilities lack basic water services which affects 1.7 billion people, comprising 857 million people globally who access health care facilities with no water at all (WHO & UNICEF, 2024). In developing countries demand for clean drinking water has become more serious due to the increasing population (Cohen, 2006).In every five people almost out of three lack access to clean drinking water in developing countries (Garg et al., 2005).

According to the associated press of Pakistan in 2025, the worldwide population will face a severe shortage of drinking water and in Pakistan, 180 million residents have not access to drinking water (Dawn, 2011).The World Health Organization stated that in Pakistan only 36% of People have access to unpolluted drinking water (WHO, 2017). The report of Daily Times claims that Pakistan is one of the top countries where people have the lowest approach to clean potable water. Almost 21 million populations do not have access to safe drinking water. In Pakistan rich population has access to clean drinking water near their home as compared to the poor people (kunbhar, 2018). In Faisalabad city, in 2015, the water supply provided was about 501,000 m3/day (110 MGD) to the city which only fulfilled 77 percent of the total water demand of 650,000 m3/day (142 MGD), causing a shortfall of 149,000 m3/day (32 MGD)(Jamal, 2019). Only 60 percent of households in the city have access to municipal water supply (WASA, 2017).

Ahmad (2016) found that in urban areas of Faisalabad majority of people were not access to filtered water. People relied on canal water. Inequalities in income are the main hindrance to getting clean potable water. Most of the population has an income of less than 30,000 PKR. That's why they have no approach to clean water and cannot afford bottled water due to its high cost. Low-income people live away from the potable water source. Many of people reported water-related diseases due to unclean potable water.

Abbas and Cheema (2015) described that mostly people were access to potable water with the depth range from 50-200ft in area under study. Hand pumps and domestic motor pumps were the main sources of potable water. High arsenic concentration was found in hand pumps than the motor pumps. The natural and anthropogenic activities were the cause of high arsenic concentration levels in groundwater. The quality of potable water in the study area was not suitable and it caused problems for human health.

Batool et al. (2015) described that populations of urban areas of Faisalabad district were highly affected by unclean potable water. Majority of the peoples were used canal bank pumps and WASA supply sources for drinking purposes. WASA supply became polluted after a sewage leak and then this water mixed with drinking water. The increasing population and socioeconomic activities are important causes of water scarcity in various parts of the city. The drinking water supplies are inadequate in many urban areas. The dust particles are mixed with the potable water. This situation is having a bad impact on human health. For refining the potable water, there is needed to improve the situation of pipeline supplies. A good water administration strategy should remove the barriers for the safety of potable water.

Hisam et al. (2014) found that in Islamabad less than half of the potable water samples of water filtration plant were polluted. And remaining potable water samples of the water filtration plant were not polluted. Maximum total coliform was found about 240MPN per 100ml while the lowest total coliform was found about 2MPN per 100ml. The reason behind the contamination of the water filtration plant was a maintenance issue.

Ahmad (2011) discussed that people faced the problem towards the availability of drinking water in area under study. As a result of population increase, the water scarcity problem was going to increase in Pakistan. With the help of different techniques, the water shortage problem is overcome. Regular maintenance of water schemes, providing another source of water to the animals, construction of new dams, decreasing the population, manage the current population, and awakening the population about water management through the mass media. With these, we can overcome the water shortage problem.

Kausar et al. (2011) discussed that the approach to clean potable water was a basic human right but in Pakistan water and hygiene were ignored department. In Pakistan, many people do not have an approach to clean potable water services causing families to be hurt from waterborne diseases such as diarrhea. Socioeconomic characteristic like education, mothers, family type, and household income is one of the health risk factors for diarrheal illness. Policymakers should create different policies that reduce waterborne diseases. Jabeen et al. (2011) described that water condition in both village and city areas of Abbottabad was poor. But in rural parts, the situation was worse. Most of the population had access to clean potable water in Abbottabad. In urban areas, most people were relying on tap water for drinking purposes. In urban areas, people rely on boreholes for potable purposes. The facilities of potable water were short. The government is unable to provide basic facilities to the population. The reason is the rapid increase in population.

MATERIAL AND METHODS

Faisalabad is the 3rd largest city of Pakistan and 2nd in Punjab province (FDA, 2024). Faisalabad lies between 30°42' and 31°47' north latitudes and 72°40' and 73°40' east Longitudes. Its elevation is 605 feet above ocean level. Ravi River flows about 40 km south-east of Faisalabad city, and in the north-west direction Chenab River meanders about 30 km off the city. The Lower Chenab Canal serves as the major water source for agriculture that drains almost 80 per cent of the total cultivable land of Faisalabad district (PCGIP, 2015).

The city population has increased rapidly since 1947 to present. The quality of ground water of Faisalabad is salty and not suitable for human uses except some areas near Rakh Branch Canal. The city first delivered drinking water in 1903 and the waterworks were increased after many years, counting the provision of clean water in 1939. The research was conducted in Faisalabad city situated in the eastern side of Pakistan.

Our research is based on the primary data collected through the survey method. Structured Questionnaire was designed to assess the accessibility of portable water. The total sample size for the research was 314 households. 157 colonies were selected based on economic class such as Upper class, Middle class: Lower class. 314 questionnaires were equally divided into 157 colonies of Faisalabad city. Two households were selected from each colony to fill out the questionnaire. A convenience sampling technique was used for this research. Using of Google Earth in study area was done to collecting the coordinates of households. Statistical package for social sciences (SPSS) was used for analysis of the data. Buffer analysis & near distance analysis were used to find accessibility to portable water in Faisalabad city.

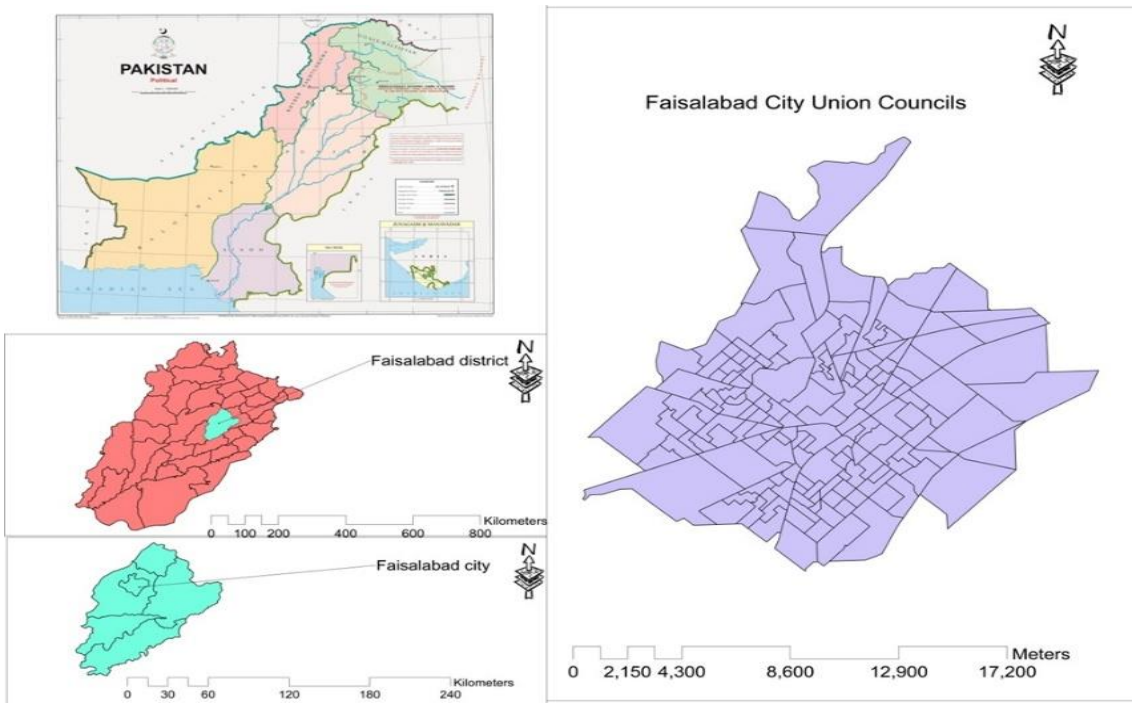

Figure1 Study area-Faisalabad city

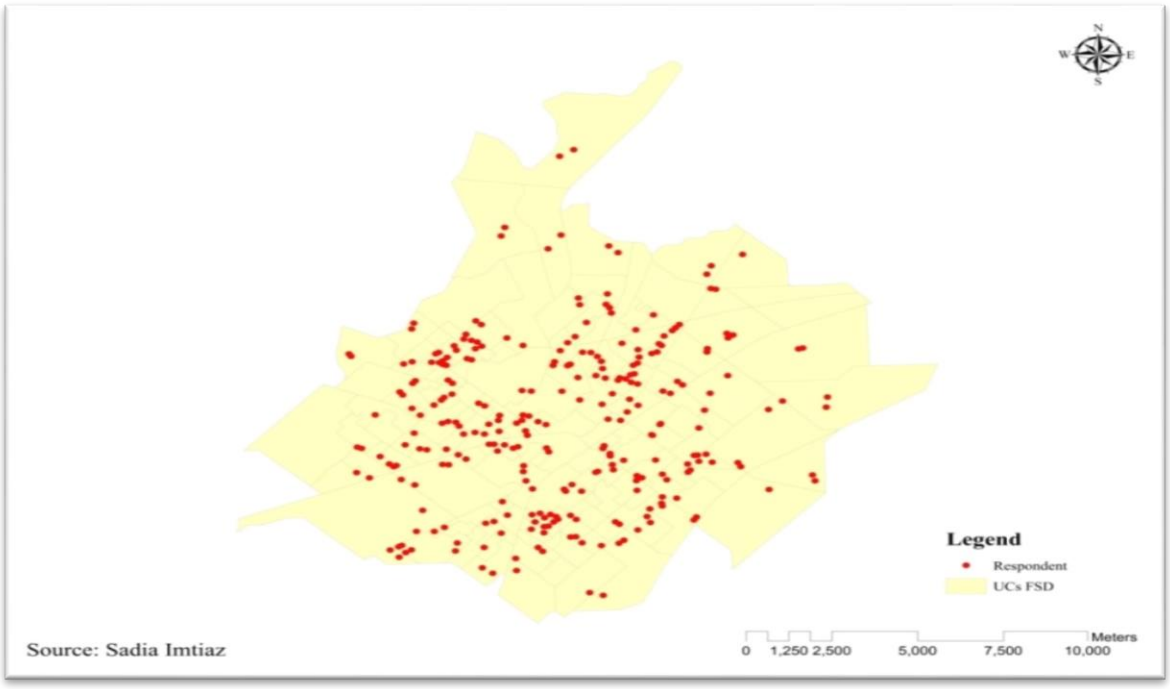

Figure 2 Spatial Distribution of surveyed colonies in Faisalabad city.

Accessibility to the Potable Water Sources; There is no doubt that water sources are sufficient in Faisalabad city, but problems arise in the inappropriate supply and distribution of water sources. The potable water supply and distribution are not uniform in Faisalabad city. Distance from potable water sources is also the most reported problem. Residents of Faisalabad complain to WASA supply and other potable water supplies like filtration plants. People living in remote colonies from the center of the city reported that they travel long distances to reach water sources to collect potable water

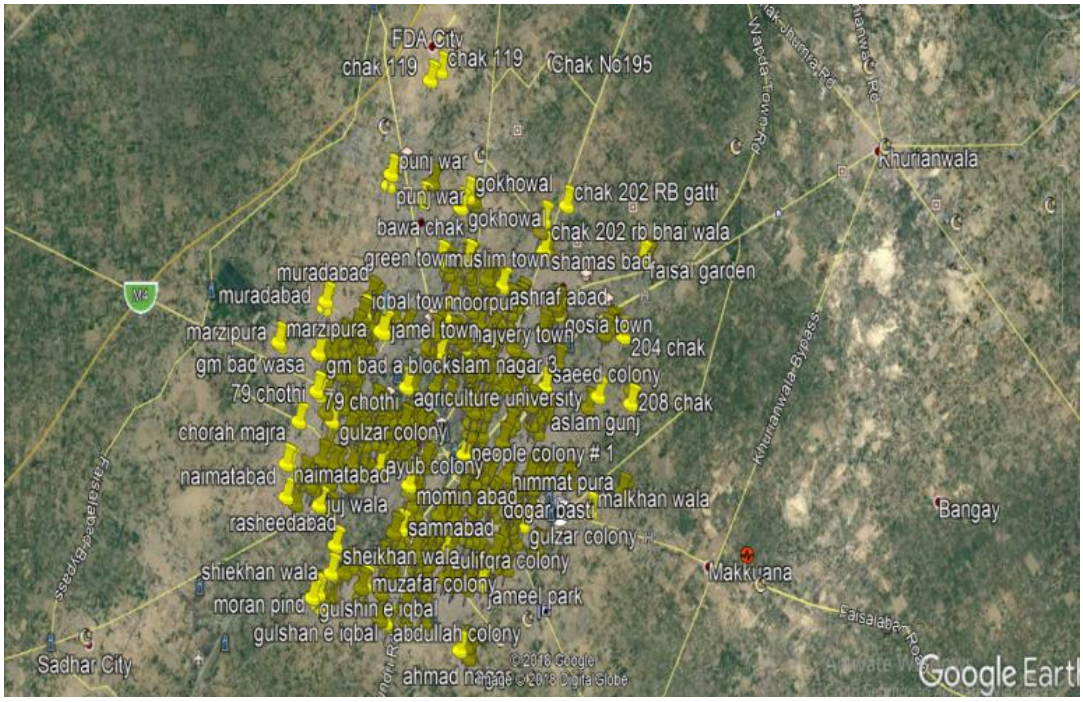

Figure 3 Coordinates of Respondents and Filtration Plants

RESULTS AND DISCUSSION

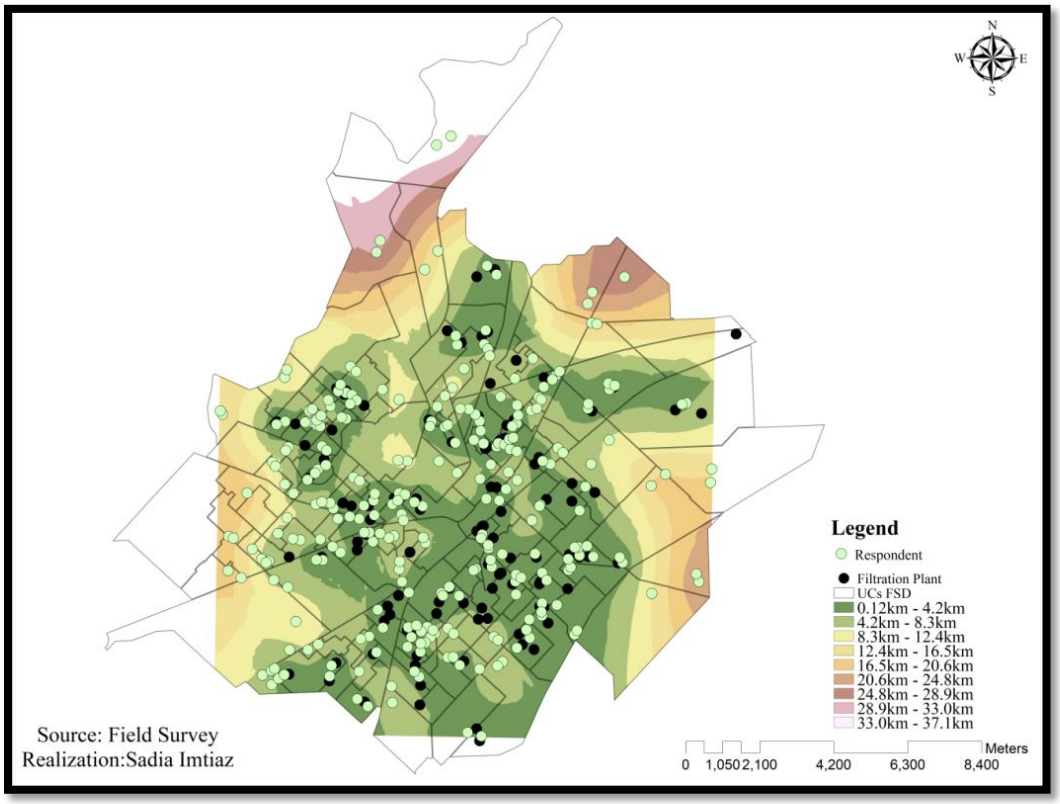

Figure 4 Spatial Pattern for Accessibility of Filtration Plant in Faisalabad city by using Kriging

Figure 4 shows the accessibility of the filtration plant in Faisalabad city through using kriging. 112 filtrations were in the surveyed area. Most of the population relies on these filtration plants for drinking purposes. A large proportion of filtration plants existed in the center of Faisalabad city as shown in Figure 4. Remote areas of Faisalabad city have no filtration plant. The people living in remote areas of Faisalabad city cover the maximum distance to collect the potable water. Many residents of remote areas use dirty water for drinking due to the lack of potable water sources. The residents who are living in the center of the city cover a 0.12km-4.2km distance to access the potable water sources whereas residents who are living in remote areas of Faisalabad city cover a 33.0km-37.1km distance to access the potable water sources. The population influences on filtration plant because filtration plants are less and population of Faisalabad city is increasing day by day.

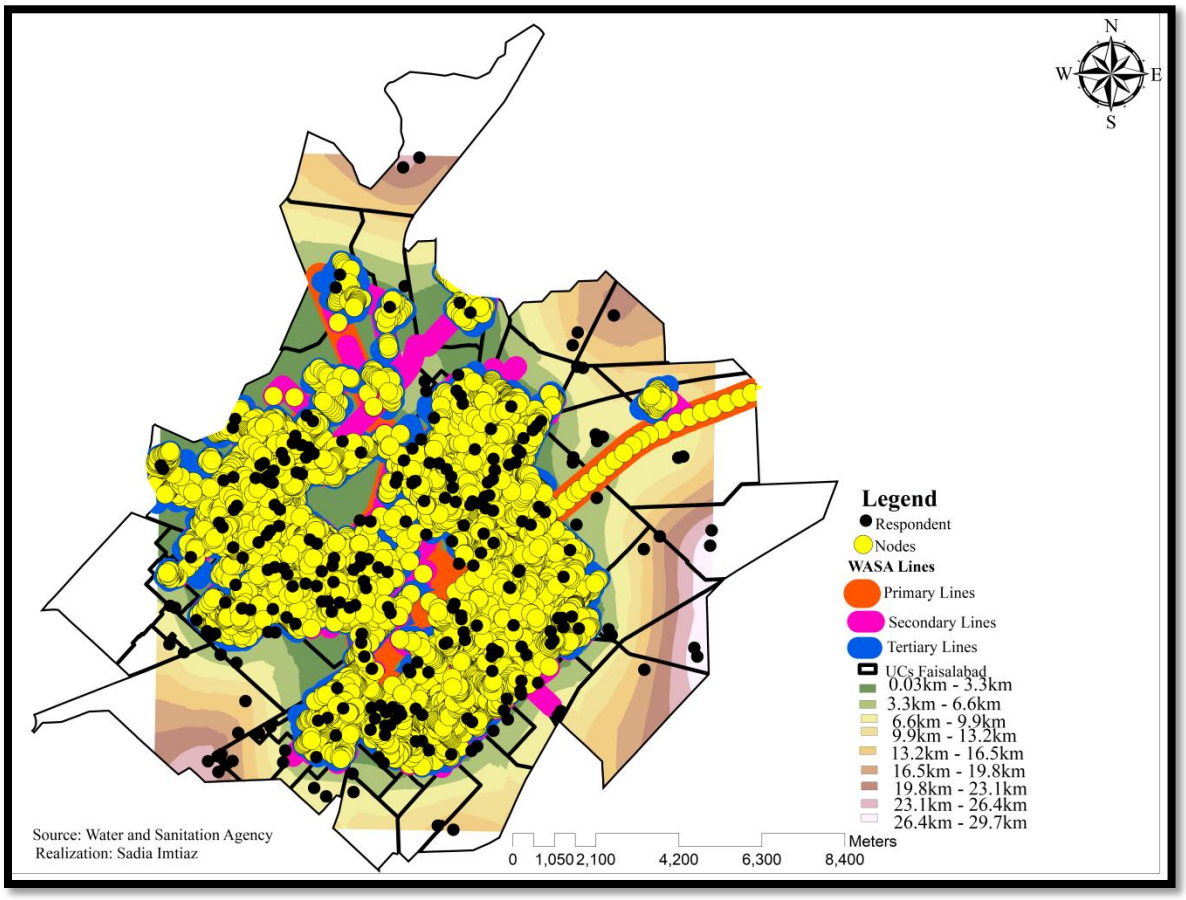

Figure 5 Accessibility of WASA Supply in Faisalabad city through using kriging

Figure 5 shows the spatial pattern for accessibility of the Water and Sanitation Agency water supply (WASA). Majority of the WASA supply nodes and WASA supply lines have existed in the center of the city of Faisalabad. WASA supply nodes and WASA supply lines such as primary lines, secondary lines, and tertiary lines do not exist in the remote areas of Faisalabad city. Residents who are living in remote areas of Faisalabad city have to use dirty for potable purposes. Residents of Centre city cover a 0.03km-3.3km distance to collect the potable water whereas residents of remote areas of Faisalabad city cover a 26.4km-29.7 km distance to collect the potable water.

Conclusion: Most of the residents use filtration plant water for drinking. Number of filtration plants is less in contrast to population in surveyed areas of Faisalabad city. The population pressure affects the performance of filtration plants. Many filtration plants are not properly working due to population pressure. People face accessibility issues in terms of distance and cost in Faisalabad city. Much of the population covers the maximum distance to collect drinking water. In remote area of Faisalabad city, people have no water point sources nearby and they have to travel long distance to collect the drinking water. The cost of drinking water is also high in remote areas in Faisalabad city.

REFERENCES

Abbas, M., & Cheema, K. (2015). Arsenic levels in drinking water and associated health risk in District Sheikhupura, Pakistan. *Journal of Animal and Plant Sciences*, *25*(3), 719-724.

Ahmad, B. (2011). Water Management: A Solution to Water Scarcity in Pakistan. *Journal of Independent Studies and Research*.

Ahmad, S., Mirza.U. (2016). Urban facilities for safe drinking water in Faisalabad: An equity perspective. *International Growth Center*.

Batool, Z., Anjum, F., Faiz, S., Akram, M., & Ibrahim, M. (2015). Household perspectives towards integrated management of drinking water in Faisalabad district, Punjab, Pakistan. *Mediterranean Journal of Social Sciences*, *6*(5), 503.

Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in society*, *28*(1-2), 63-80.

Dawn. (2011). *Dawn*. Retrieved 7 june from https://www.dawn.com/news/683780

FDA. (2024). *About Faisalabad*. https://fda.gov.pk/about-faisalabad

Garg, A. X., Moist, L., Matsell, D., Thiessen-Philbrook, H. R., Haynes, R. B., Suri, R. S., . . . Clark, W. F. (2005). Risk of hypertension and reduced kidney function after acute gastroenteritis from bacteria-contaminated drinking water. *Canadian Medical Association Journal*, *173*(3), 261-268.

Hisam, A., Rahman, M. U., Kadir, E., Tariq, N. A., & Masood, S. (2014). Microbiological contamination in water filtration plants in Islamabad. *Journal of the College of Physiciansand Surgeons Pakistan*, *24*, 345-350.

Hutton, G., & Haller, L. (2004). *Evaluation of the costs and benefits of water and sanitation improvements at the global level*.

Jabeen, S., Mahmood, Q., Tariq, S., Nawab, B., & Elahi, N. (2011). Health impact caused by poor water and sanitation in district Abbottabad. *Journal of Ayub Medical College Abbottabad*, *23*(1), 47-50.

Jamal, S. (2019). Situational Analysis of Water Resources in Faisalabad City (Establishing a Case for Water Stewardship). *WWF Pakistan Report*.

Kausar, S., Asghar, K., Anwar, S. M., Shaukat, F., & Kausar, R. (2011). Factors affecting drinking water quality and human health at household level in Punjab, Pakistan. *Statistics*, *100*(100), 0.

kunbhar, Z. (2018). *Daily Times Report*. Retrieved 23-7-2018 from https://dailytimes.com.pk/218000/21-million-people-in-pakistan-dont-have-access-to-clean-water-report/

PCGIP. (2015). *Faisalabad Peri-Urban Structure Plan (2015-2035), report*. W. B. Government of Punjab.

Ritchie, H. (2021). The world is making progress on clean water and sanitation, but is far behind its target to ensure universal access by 2030" *Published online at OurWorldInData.org*. Retrieved from: 'https://ourworldindata.org/water-sanitation-2020-update' [Online Resource]

Shah, A. A., Khan, M. A., Kanwal, N., & Bernstein, R. (2016). Assessment of safety of drinking water in tank district: an empirical study of water-borne diseases in rural Khyber Pakhtunkhwa, Pakistan. *International Journal of Environmental Sciences*, *6*(4), 418-428.

WASA. (2017). *Water Supply, Sewerage and Drainage Master Plan of Faisalabad,Interim Report*. W. a. S. Agency.

WHO. (2017). *WHO*. Retrieved 7 june from https://www.geo.tv/latest/166322-only-36-pakistanis-have-access-to-safe-drinking-water-who-report

WHO. (2018). *WHO*. Retrieved 7 june from http://www.who.int/news-room/fact-sheets/detail/drinking-water

WHO, & UNICEF. (2024). *Global Framework for Action 2024-2030 : Universal water, sanitation, hygiene, waste and electricity services in health care facilities to achieve quality health services*. World Health Organization and the United Nations Children's Fund (UNICEF).

WHO/UNICEF. (2015). *Progress on sanitation and drinking water: 2015 update and MDG assessment*. World Health Organization.