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Assessing Consumers Satisfaction For Sustainable Drinking Water Resource Management. Indications From Populated Industrial City Faisalabad, Pakistan.

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Abstract:
An advanced water supply system is always required to meet the consumers demands in semi-arid urban areas for a sustainable urban growth. Current research conducted to explores the multiple dimensions of consumer satisfaction with the various available drinking water sources in Faisalabad, a semi-arid city in Pakistan. The study intends to investigate the indicators that influence the consumers perceptions for the available water sources and their overall satisfaction levels towards water service in city. Through a comprehensive analysis of water quality, affordability, accessibility, and reliability, the research aims to provide insights into the factors shaping consumer preferences and contentment regarding drinking water. The data collected through extensive consumer-based questionnaire and evaluated using SPSS. PLS-SEM model applied to investigate linkage between available water sources and consumer satisfaction and influence of different factors. The verdicts of recent study have insinuations for legislators and relevant water management authorities, offering valuable information to improve the quality and convenience of drinkable water resource in Faisalabad and similar urban structures. Water Consumption (WC) also shows substantial internal consistency with values for Cronbach's alpha, rho-A, and CR at 0.936. The loadings for this construct range from 1.585 for WC7 to 4.476 for WC6, suggesting varying degrees of factor loadings associated with different aspects of water consumption. The AVE for WC is 0.278, again below the desired threshold, which might suggest that the items may not be adequately capturing the construct of water consumption.
User Adoption (UA) shows loadings from 1.118 for both UA4 and UA5 to 4.734 for UA1, with a reliability and validity assessment yielding Cronbach's alpha, rho-A, and CR all at 0.915, and an AVE of 0.376. This indicates good internal consistency though the average variance extracted is slightly low, which could affect the construct's ability to fully represent the variance in user adoption measurements. The study highlights that water quality along with other social aspects are significant factors in influencing consumer satisfaction. Policymakers should enforce stringent water quality standards and regular monitoring to ensure the safety and suitability of drinking water

Key Words: Water Management, Water supply, Consumer Satisfaction, Fresh water, Urban growth.

Introduction:
The current phase of climate change has intensely influenced the interconnection between the infrastructure, environment, and people particularly in urban areas. The water resources have become pivotal for climate adaptation, habitability and suitability of future cities. This matter incorporates multiple aspects pledging the natural environment prospers after rainfall, acclimating sustainable water supply system to altering climatic settings and protecting the built environment from unheralded water-based hazards like flooding, and complementing these elements through wellbeing, security, safety, and comfort of urban inhabitants is crucial. The aptitude of urban areas to manage these multifaceted challenges without compromising the

life quality depends upon operative and effective water management. It consists of strategies for handling the issues of water scarcity (for both public consumption and managing urban greenspaces, infrastructure during droughts) and handling water abundance (such as regulating runoff while delivering aesthetic and recreational services) (Sochacka et al., 2024).

Fresh water, as we know is a confined natural resource and an extremely essential public good for healthy life. The availability of innocuous and clean drinking water and sanitation facility is crucial for enjoying the right to life with all other related human rights, including food, health and hygiene. In appreciation to this, the General Assembly of United Nations in 2010 has avowed the right to fresh water and sanitation in the list of human right within the social, economic, and cultural rights framework. Ensuring this right encompasses water availability, accessibility, safety with high-quality, and affordability to sustain the values of dignity, acceptability, and privacy (Antonio et al., 2022). The progressive water resource systems in arid and semi-arid human settlements have equally benefited both public and their economies for centuries (Hussain et al., 2019). A safe and plenteous water resource in populous areas is considered a fundamental human right (Reza et al.,2021; Bao & Fang, 2012). Water uncertainty and urbanization are two interconnecting global phenomena that contain significant impression on people, businesses, and related environment directly (Gómez et al., 2021; Trung et al., 2019).

With climate change and population increase in urban areas water uncertainty has become global issue because it pervaded more risks in developing areas especially those having excessive population growth rate (Ahmed et al., 2020; Hughes et al., 2014). The improper utilization of available fresh water resources has risked the natural sustainable water systems and added enormous pressure on drinking water aquifers both in developed and developing world (WHO,2023; Qureshi, 2020; Vinke et al., 2017). Discrepancies in water availability produced multiple socio-economic and environmental jeopardies to population in many ways (Babuji et al., 2023; Ahmad et al., 2021; Bhuiyan et al., 2013). The advanced nations have found some interim solutions through technical involvements and these water systems have provided multiple services but in other world these systems could not ensure sustainable sanitation and drinking needs (Lai et al., 2020). So, it has become clear that a sustainable water supply system seeks essential components of technology, institutions and people to run viable water supply scheme (Oral et al., 2020).

Drinking water as basic requirement represents as key determinant to achieve sustainable developmental goals in urban environment (Loucks et al., 2017; Loucks & Beek, 2017). Globally different water supplying strategies are adopted to achieve uninterrupted water supply system in which around one billion population worldwide receives water from piped network (Taylor et al., 2019; Berg and Phillips, 2017). The immense increase in water consumption during past century resulted threats of water shortage and water quality deterioration (Gowela et al 2017). The urban agglomeration and advancement in economic activities have imposed extreme pressure on water ecosystem (Mishra et al., 2021). In recent era of pollution intimidations from insecticides, landfill leachate, fertilizers and human-animal waste, water quality and quantity maintenance has become weird challenge (Oliver et al., 2019). A comprehensive approach solely for sustainable water management requires along balanced cost affective health and safety structure to cover millennium goals (Mukarram et al., 2023; Ferrero et al., 2019). Determination of public satisfaction and gratification with urban water milieu management often cruces on the cumulative impact of detailed long-term practices. Satisfaction or dissatisfaction is usually measured by comparing the public expectations and prospects with their perceptions towards water management conclusions. As direct recipients of community-driven ecological facilities, the public thoroughly gauges these municipal services through attitudes, quantity, quality, smoothness and service levels. Thus, the government administration should seriously consider public satisfaction a crucial and critical metric in weighing the performance of overall water supply structure. Now the emphasis is growing on recognizing the aspects that stimulates the public satisfaction towards urban water supply networks (LI et al., 2020). Along with all other challenges, long-term ability to provide adequate, incessant water service according to consumers demand always remained perplexing for governments, stakeholders and related authorities (Xiang et al., 2021). In existing state of water ecosystem, natural imbalance of water availability can only be tackled through comprehensive management according to community requirements (Thacker et al., 2019). Water management entails resource steadiness along with organizational structure, technological innovation, governance, administration and social acceptance (Verdhen, 2022; Mishra, 2023).

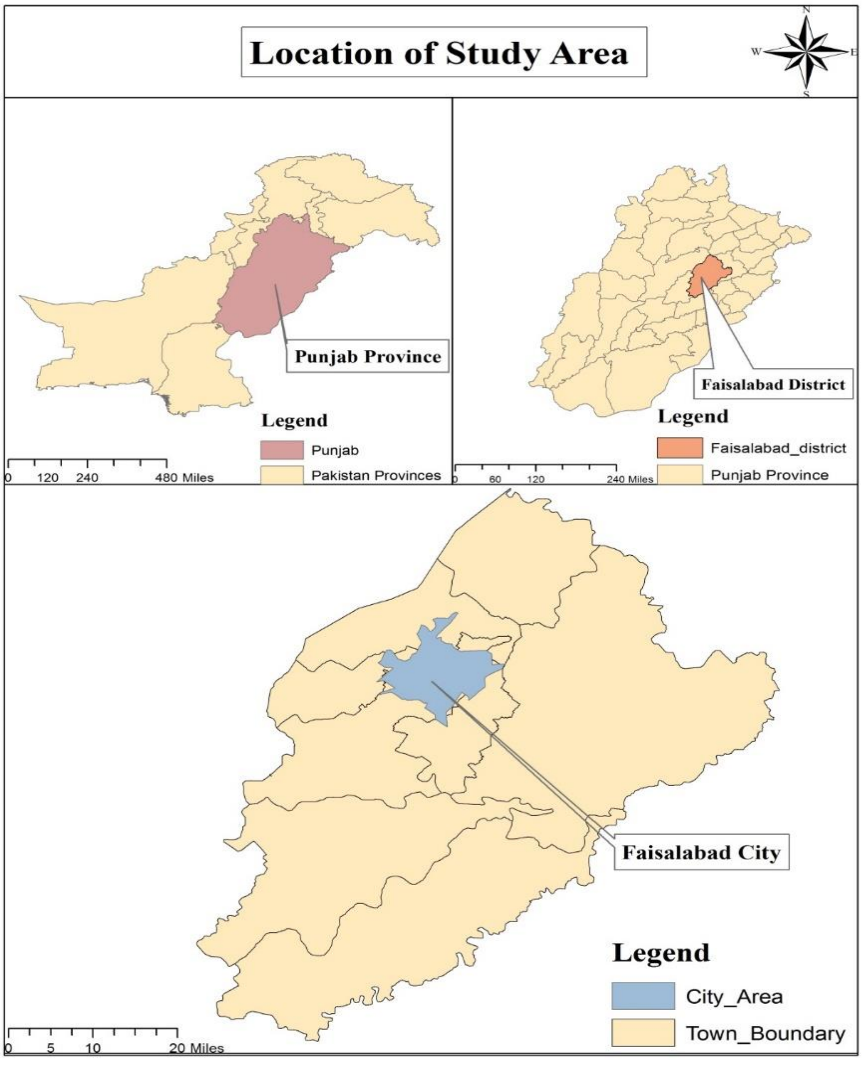
Pakistan has been categorized a scarce country for fresh water since 2005 but has immense water consumption in its rural and urban communities due to demographic upsurge. Less endorsed water plans, deferred execution tactics and destitute hygiene persuaded intimidations to excellence and amount of surface and ground water systems (Akbar et al., 2021; Jafri, 2022). Water supply facilities improved in last thirty years quantitatively with service quality continued abridged because extra attention is paid towards maximum water provision to growing population (Caldera et al., 2021). In developing country Pakistan, conserving and safeguarding the sustainability of drinking water supply systems has become a significant challenge for government authorities. In order to achieve the objectives of Sustainable Development Goal 6 proposed for providing the clean water to public worldwide, assuring the customer perceptions and satisfaction is decisive factor (Mustafa et al., 2022; Beshir et al., 2024).

The outmoded communal water supply infrastructure in urban centers, poor pipeline network, non-functional storage tanks, old pumping stations, and exhausted groundwater wells facilitated public-private water selling business to flourish and safeguard incessant water provisions. The water supply structure of all urban units does not contain even edifice, some city areas mainly depends on surface water bases and some use inland water depending upon consumers socio-economic priorities (Ahmad et al., 2022). Maladministration of water resources by government, minimal public participation and lesser revenue collection halted the municipal administrative system to formulate, fund and maintain sustainable water supply structure (Jafri, 2022).

With increasing population, consumers preference and perception towards better water source has changed the supply system in urban areas. It also influenced the water consumption patterns and approaching trends for different water sources in every community (Sajjadi et al., 2016). Consumers satisfaction provides support to enhance water-based activities and maintain durable association between supplier and receiver (Tijjang et al., 2019). In socially diverse communities of Pakistan, water demand and supply system should be investigated through consumers satisfaction towards water sources based on water quality, availability, accessibility, affordability and quantity (Delpla et al., 2020). The perception and contribution of local population for improved water system has gained strong attention in last few decades to instigate large scale and lasting management plans in urban areas (López-Ruiz et al., 2023; Maruapula et al., 2023).

The topographically plain city Faisalabad, located in Rachna doab of Punjab Province contains abstemiously ancient and sophisticated alluvium transferred by Chenab and Ravi rivers in past centuries from mountainous north after erosion (Ogata et al., 2021). Faisalabad established in British era by Sir James Lyall progressed rapidly as main textile industrial centre after independence. The city contains semi-arid Kopen-Geiger climate of BWh type which is characterized as hot, desert type climate and the mean yearly temperature lies within 17^{o}C to 32^{o}C and mean annual rainfall range of 375mm. December has mean low temperature of 6^{o}C highest 22^{o}C so it is coldest month whereas June, the hottest month contains mean maximum 40^{o}C and lowest temperature of 27^{o}C. The city experiences rainfall in monsoon season during July and August (Ahmad, 2012; Khaliq et al., 2021).

Faisalabad with brackish water zone, supports multiple formal and informal water supply sources. Water and Sanitation Agency, a communal body is responsible for maintaining urban demand of water and supply system consequently settled a massive water supply pipeline network for providing water at the doorsteps of urban residents (Rasheed et al., 2021). The maladministered municipal water supply empowered the private suppliers to contribute and overcome the water shortage with variant fare structure. The informal sources of drinking water supply facilitate the residential areas, services sectors and commercial canters but the handlers of these supply systems differ as per social-economic deviation in the community (Aziz, 2007). The difference of price range, source location, service excellence, consumer satisfaction, supply amenities, resource availability and social reception may ratify diverge communal arrangement of water usage from handy sources (Ahmad et al., 2017).



Source: Compiled by Author.

Figure. 1: location of Study Area.

The municipal underprovided water prescribed local consumers to rely on private or self-providing consumable water resources whether trustable or not. Within the urban boundaries of Faisalabad city, various water supply patterns are being followed as in some areas people utilize community water supply source for drinking and other domestic activities (Kumar et al., 2023; Rasheed, 2021). They also buy water from private street vendors, water purification plants installed by individuals and organizations and packed mineral water available in shopping malls. Private vendors deliver inexpensive and cost-effective water at door steps using rickshaws, donkey carts, and carry vans. Public from lower to middle class of community is forced to avail drinking water facility from these cheap suppliers without considering mental satisfaction and water excellence (Khaliq et al., 2021; Nadeem et al., 2018; Bhalli et al., 2012).

Literature Review:

The community-based administrative systems with active public involvement help to establish dynamic, efficient and improved drinking water quality schemes. The governance policies considering many social aspects along with economic and environmental factors can satisfy all stakeholders through interdisciplinary political approach (Pahl-Wostl et al., 2020) (Li et al., 2020) (Li & Wu 2019) (Enqvist & Ziervogel 2019) (Romano et al., 2017). Management and good governance accelerate the augmentation of commercial approaches for drinking water provision in populated areas (Pahl-Wostl, 2019).

In current modern times, the needs of citizens have become more intricate and nuanced, accentuating the inevitability of executing policies, strategies, plans and services that can achieve and enhance citizens satisfaction. The consumer satisfaction can be defined as the general judgment conceded by citizens about the local government performance in providing basic urban services with quality (Oppio et al., 2021) (Zerva et al., 2018). Thus, citizens satisfaction assists for a critical criterion in identifying key indicators. Considering this, public satisfaction for potential community services and institutions is a crucial aspect while searching for improved urban management goals, because it surely imitates a government's strategies, policies and action plans (Gearin & Hurt., 2024; Foroughi et al., 2023). The urban appearance with advanced approach of community consideration stands out as a striking indicator of urban administration quality. It considers the importance of appraising citizens satisfaction, so they perceive it as influence on their well-being, personality and overall quality of life (Corrente et al., 2023) (Chen et al., 2022).

Consumers satisfaction scale with available fresh water and provision quality varies with different service providers. The receiver's perception and providers services fairly interact and backs in framing general satisfaction (Romano and Masserini, 2020). García-Rubio et al. (2016) and Romano and Masserini (2020) shared that the category of water supplier (public, private or concession) also directs the user insight towards the service quality. Also, this feature indicates the trust level consumers contain on the water provider, and it directly effects the users' assumed service quality (Doria et al., 2009).

In case of public water supply structure, it is estimated that in developing countries, more than 20% of community drinking water supply sources are non-operational due to breakdown and skimpy management. Most of discrepancies occur during first 2 to 4 years after initiation of water schemes (Foster, T et al., 2020). Importance to consumer satisfaction has considered challenging in developing areas due to less allocation of budget towards water resource maintenance by respective governments, ageing and frequently broken pipes, less infrastructure investments, unmotivated staff, often power breakdown, haphazard urbanization, corruption, poor revenue generation and politicized tariff setting regime (Denantes and Donoso, 2021).

Li et al., 2020 discussed the importance and determining factor of public satisfaction for urban water setting especially in public-private partnership settings. They analyzed six primary factors from about 33 initial indicators impacting public satisfaction structure. They explained that the urban water situation meaningfully shapes the life quality of inhabitants. In populated urban water supply system, public is direct perceiver and their satisfaction towards service quality reflects the degree of water management and treatment.

Mahler et al., 2015 documented the issues and concerns of public about urban drinking water in Pacific Northwest, USA.

They used a questionnaire to measure public satisfaction for urban water supplies with three intervals of five years in 2002, 2007 and 2012. They concluded that public satisfaction level towards outer urban water resources declined with increasing time. They added that till 2015, use of in-home water treatment and filtration plants has significantly increased.

Pedro-Monzonís et al., 2015; Bhandari & Grant, 2007 noted that insufficient water source that cause scarcity in urban areas effects the consumers satisfaction because it diverts the supplying organizations to control and manage adequate water supply that mostly compromises the quality. The environmental, economic and social satisfaction is related to well managed water supply system with long-term sufficient water availability. Loon and Lanen (2013) observed that misuse of available water resources and overexploitation cause interruption in water supply system that consequently influence water quality and customer satisfaction. Ananga et al., 2020 examined the community participation in water resource management and beneficiary satisfaction and found that participation of consumers in water resource management increases satisfaction level towards available water resources and enhances water conservation as well.

Methodological Framework:

The current research is based on descriptive and systematic investigative approaches to examine the extent of consumers satisfaction towards drinkable water supply structure in Faisalabad city. In the era of water scarcity this third most populous industrialized urban center is under huge pressure to maintain uninterrupted sustainable water supply for community. The city area contains various social classes so the consumers satisfaction criterion towards available water resources may also vary as per their socio-economic condition. Eight major housing colonies were principally selected for data collection from different directions of the city ensuring the representation of different social classes in the Faisalabad city.

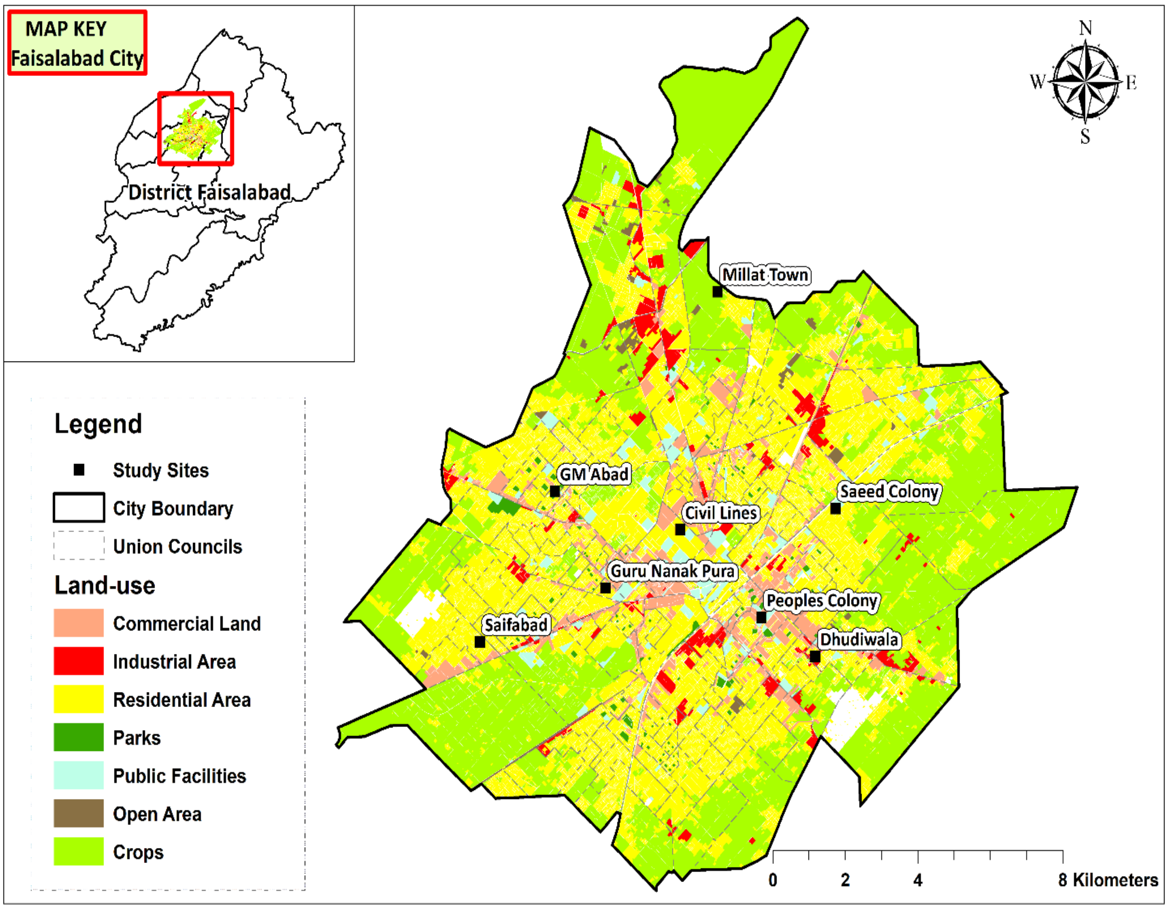


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Figure 2: Residential sites selected for data collection.

Data acquisition and analysis:

The data for completing this task was gathered through primary as well as secondary data sources. Evidences linked to population satisfaction towards available water resources were collected using both types of data (Obosi, 2011; Green & Smith, 2006). Primary raw data was collected using instrument probe survey through reliable questionnaire from all selected housing colonies. Stratified random sampling method was used for data collection from family patriarch (collector of water from source), the domestic receiver of available drinking water. Overall four hundred samples were obtained from study area (fifty from each housing colony) indiscriminately.

The secondary data was composed to attain the contextual material of the study area, and also articulate a reference line for additional research activity. The sources to obtain secondary data include libraries, offices of government, semi-government and non-government organizations, research journals, city Statistical section and internet. The secondary data is congregated from Books, newspapers, progress and assessment reports, research articles, maps, satellite images shape files, and diagrams. The data is analysed using correlation and cross tabulation methods to crisscross the measures of association in data. Tabulation along with pie charts are drawn to epitomize data. PLS-SEM method was used to investigate satisfaction among consumers of different water sources in study area (Salangka et al., 2024; Shahangian et al., 2024; Zhalmurziyeva et al 2023).

Results and Discussion:

Consumers satisfaction for water and delivery reputation are not constantly in line with monitored water and better service structure. Alignment between the customer perceptions and veracities needs proper understanding of how the perceptions are molded according to the forming factors and their influence on community. Developed countries have reached these factors and maintained their system accordingly. The current study analyzes the factors explaining customer satisfaction level with available drinking water and its service quality by discussing the factors that interacts with consumer satisfaction in developing regions context (Fulazzaky et al., 2023; Gunnarsdottir et al., 2023; Denantes and Donoso, 2021; Putera et al., 2020).

To understand the discernment of community users about existing water supplying classification of city, the communal satisfaction level about capability and aptitude of supply structure and other facets together with water quantity, quality, availability, distance from collection point, cost, waiting time, consumer dependability on water source and reliability on sustainable supply structure was computed applying a Likert scale on data of field survey. Similar method was used by Schubert et al., 2024; Salem &Ertz, 2023; Ichoroh et al., 2023; Cardoso et al., 2023 Yang et al., 2022 in their studies. The classified classes of items were analyzed to measure the level of satisfaction of consumers (Shuai et al., 2023).

Competency of Water supplying organization/ Person		
	Frequency	**Percent**
Very Satisfied	63	15.75
Satisfied	197	49.25
Don't Know	72	18
Dissatisfied	52	13
Very Dissatisfied	16	4.0
Total	400	100.0

Table 1: Aptitude of drinking water supplier

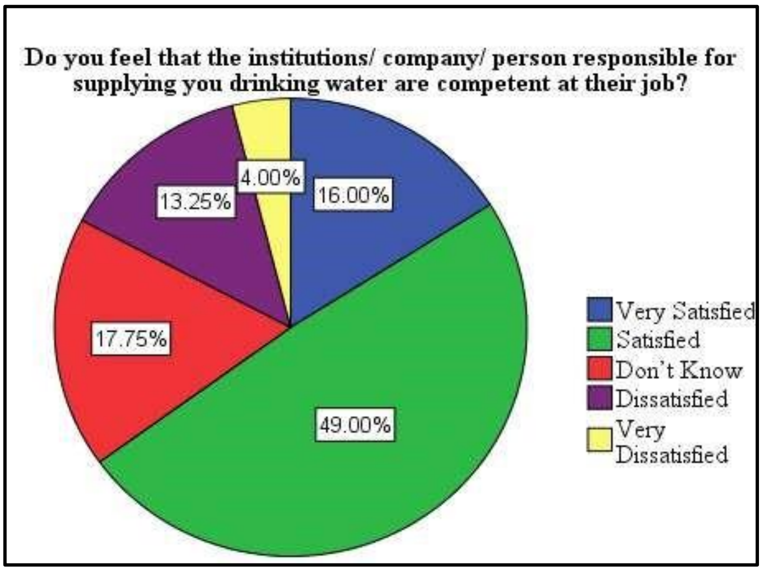

Figure 3: Aptitude of drinking water supplier

The results of table 1 and figure 3 expresses that 16% water receivers have revealed more gratification towards the capability of water supplying strategy of the available fresh water in city. On the other side 49% consumers are overall satisfied from the structure of supplying agency. The results are someway similar to Ong et al., 2023 who mentioned consumers satisfaction for water supplying company with efficient and well-organized system. Around 18% consumers are not aware of the capability of their water supplier. Only 17 % receivers exhibited dissatisfactory response for expertise of supplier network of drinking water resource in use.

Degree of satisfaction (drinking water source in use)						
Aspect	**Very satisfied**	**Satisfied**	**Don't Know**	**Dis Satisfied**	**Very Dissatisfied**	**Total**
Water quality	22.5%	45.8%	9.3%	18%	4.5%	100%
Quantity	28.8%	49.8%	6.0%	14.0%	1.5%	100%
Distance	24.8%	49.5%	4.5%	17%	4.3%	100%
Waiting time	21.3%	53.8%	6.5%	14%	4.5%	100%
Cost of water	17.8%	43.3%	4.0%	25.3%	9.8%	100%
Reliability of Water Source	14.5%	48%	21.5%	12%	4.0%	100%
Reliability on Supply system	16%	46.8%	20.8%	14%	2.5%	100%

Table 2: Satisfaction of users for in use water source.

The water consumers were provided a Likert scale in the survey to grade the level of satisfaction against the available features for domestic water supplier relied for drinking. The table 2 demonstrates that most of users gave acceptable reply against all aspects for available in-use domestic water supplying source. For overall water quality, the 22.5% people are very satisfied and 46% are somehow contented, in water amount availability around 29% users are very satisfied whereas 50% are satisfied. On the other hand, in overall water source distance 25% are very satisfied, 49.5% are satisfied while in waiting time for water collection 21.3% are very satisfied and 54% are satisfied. Corrente et al., 2023 and Alatas et al., 2023 have shared similar results of their findings. little variation is found in economic matters in terms of water cost as nearly 18% are very satisfied, 43.3% customers are satisfied. Here a considerable 25.3% users are not satisfied from overall charges of their drinking water, and in trustworthiness on source again around 48% consumers feel satisfaction whereas for reliability of overall supply system 47% have chosen satisfactory option about their specific water source.
The price of water remained highest dissatisfied element on Likert scale for community following water quality by 18% value and then distance of drinking water source from household with 17% response. overall result indicates that around half of the inhabitants of study area are satisfied and pleased from their own water source.

Consumer satisfaction for quality (WASA drinking water supply)		
	Frequency	**Percent**
Very Satisfied	28	7.0
Satisfied	104	26
Don’t Know	84	21.0
Dissatisfied	138	35
Very Dissatisfied	46	11.5
Total	400	100.0

Table 3: Consumer satisfaction for WASA water quality.

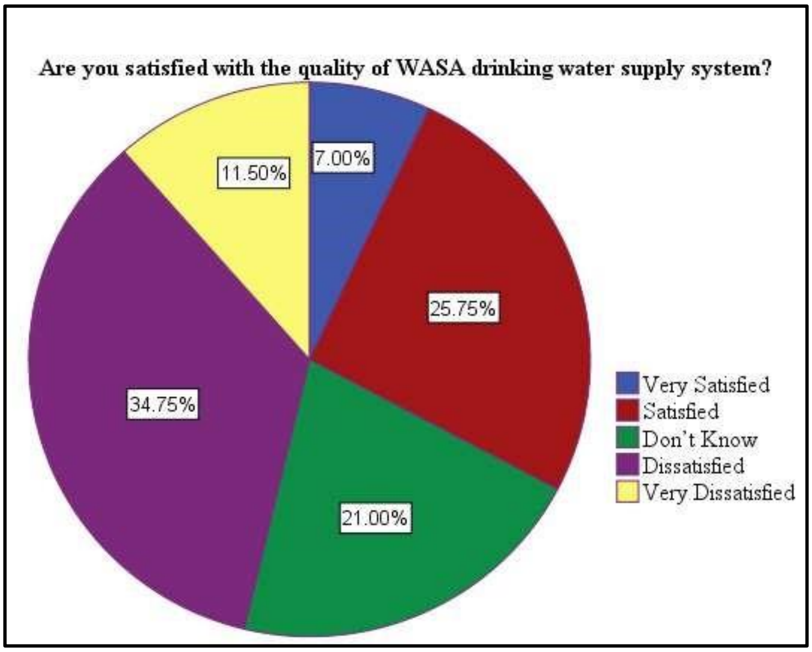

Figure 4: level of Satisfaction about WASA water quality.

The respondents showed their satisfaction for available government water supply schemes managed by WASA. The data mentioned in table 3/figure 4 specifies that 33% users are satisfied from WASA water quality and almost 46% are completely disgruntled from quality maintenance structure of same source whereas 21% are unaware of the quality of WASA water network.

Household perception regarding water quality (all sources)					
Safety Level/Source	**Ground water**	**WASA water supply**	**Donkey cart/ Van water supply**	**NGOs/ Foundation**	**Packaged Bottled Water**
Not safe at all	35%	21.0%	15%	8.0%	9%
Not so safe	33%	21.5%	21%	20%	10%
Somewhat safe	17%	22%	28%	20%	15.0%

Quite safe	7%	21.0%	19%	31%	18.0%
Very safe	6.0%	13%	15%	17%	41.0%
Cannot say	2%	2.0%	2 %	5 %	7%

Table 4: Observation regarding water quality of entire supply network.

The outcome of rating scale (table 4) shows that perception level of respondents towards water quality of wholly existing sources in city differs heavily (Tian et al., 2023; Anoche et al., 2023). In case of underlying aquifer, people have well defined contrary stance as 35% consideres it unsafe for drinking, 33% took it as not much safe while just 6% marked it safe for drinking purposes. The values related to packed bottled water gives positive perception of community for safety standards as 41% respondents marked it very safe source plus 18% categorized it quite safe to consume commonly.

On the other hand, only 19% population perceived it as not safe for drinking. In case of NGOs water supply 31% population consider it quite safe, 17% very safe and 8% as not safe at all, 20% takes it not so safe and equal 20% feel it slightly safe. However varied perception approach for donkey cart and van water venders and WASA water quality was detected where little variation in values of safety level was found.

In city area, considerable numbers in public rely on WASA supply and donkey cart water vendors to obtain water for drinking purposes as only or several water sources. Above 63% users notice their own water source as safe for drinking. On the other hand, around 43% respondents categorized WASA supply and 35% selected donkey cart or van water as unsecure drinkable water source. Community responses for rating the all available water sources on quality index shows that most of the users consider other water sources better in quality and taste than their own source but cannot adopt these sources because of numerous socio-economic reasons (Nouri-Khajebelagh et al., 2023; Singh et al., 2023; Weisner et al., 2023).

Water Quality Index of Supply System		
	Frequency	**Percent**
Very Poor	53	13
Poor	143	35
Good	88	22
Fair	87	22
Excellent	31	8
Total	400	100.0

Table 5: Rating about quality of overall urban drinkable water system.

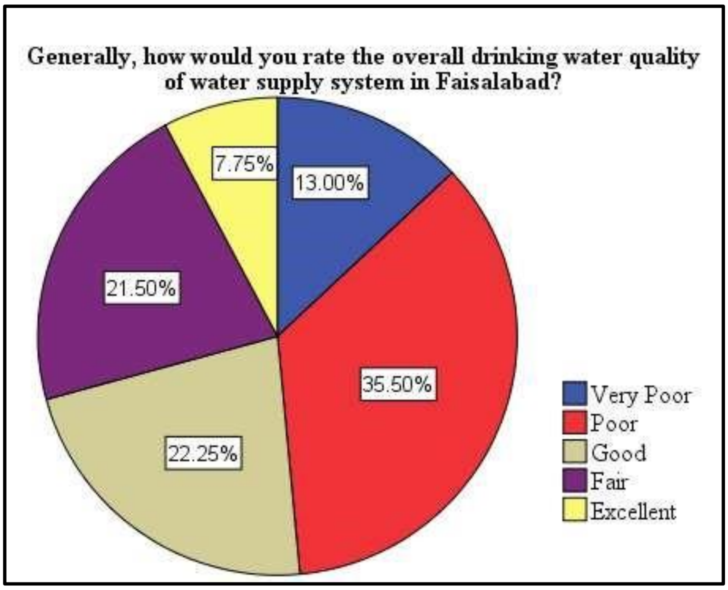

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Figure 5: Rating of entire drinkable water system.

The users were inquired for their insight about general quality of all available fresh water sources of city. The figure and table 5 show that 13% users marked it very poor and 35% consider it poor quality for direct use and only 8% consumers anticipated it excellent. On the other hand, 22% evaluated it good and 22% feels it fair to use.

The base level results collected using the infield questionnaire showed better satisfaction level of costumers about their own drinking water source about the aspects including quality, distance from source, waiting time, reliability of source, quantity, and water supply system (Mengstie et al., 2023; Thakur et al., 2023). The respondents were enquired for rating the overall water supply arrangement for which 49% people consider it unclean. The overall satisfaction towards public owned WASA drinking supply setup remained low and only 33% defendants have given appropriate satisfactory consent about it.

Total effects of user satisfaction:

	Actual Sample (O)	Mean of Sample (M)	Standard Deviation (STDEV)	TStatistics (|O/STDEV|)	P Values
PHRW -> US	0.528	0.5	0.148	3.58	0
UA -> US	-0.306	-0.308	0.093	3.295	0.001
WC -> US	0.168	0.188	0.09	1.873	0.062

Table 6: Standard deviation of samples.

As shown in table 6, the US is impacted by three predictors including PHRW, UA, and WC. In the original sample column (O), are presented the estimated predictors' coefficients pointing out the way they affect the response. Sample Mean, column M represents the average of coefficients obtained in varied samples. STDEV is the standard deviation column that highlights variations in the coefficients in different samples. O/STDEW is the t statistic column and it measures how big the effect is by comparing the original coefficients with the standard deviations. For each of the three co-efficient, I obtained the p value for each; this column denotes the probability of obtaining a coefficient as extreme as the original one by chance if the null hypothesis of 'no effect' was true. The value of p is lower, the better the evidence against the null hypothesis.

Regression analysis:

	R Square	R Square Adjusted
US	0.596	0.586

Table 7: R square value.

Regression analysis of US for PHRW, UA, and WC is presented in Table 7. The values of R square column indicate what percent of total variance in the response variable is determined by the predictors. Higher r-square demonstrates a good match of the model. R square adjusted column illustrates the value of the revamped R square that considers the number of predictors in every respective model. It is always smaller than R Square, enabling comparison of model-fit between different models.
Based on these tables, we can conclude that:
PHRW has a good coefficient that is 0.528 and p-value at 0 on us as an example country. Such infers that a single unit rise in the measure of PHRW causes a 0.528-unit change in US, which most probably has no relation with randomness.

Bootstrapping:

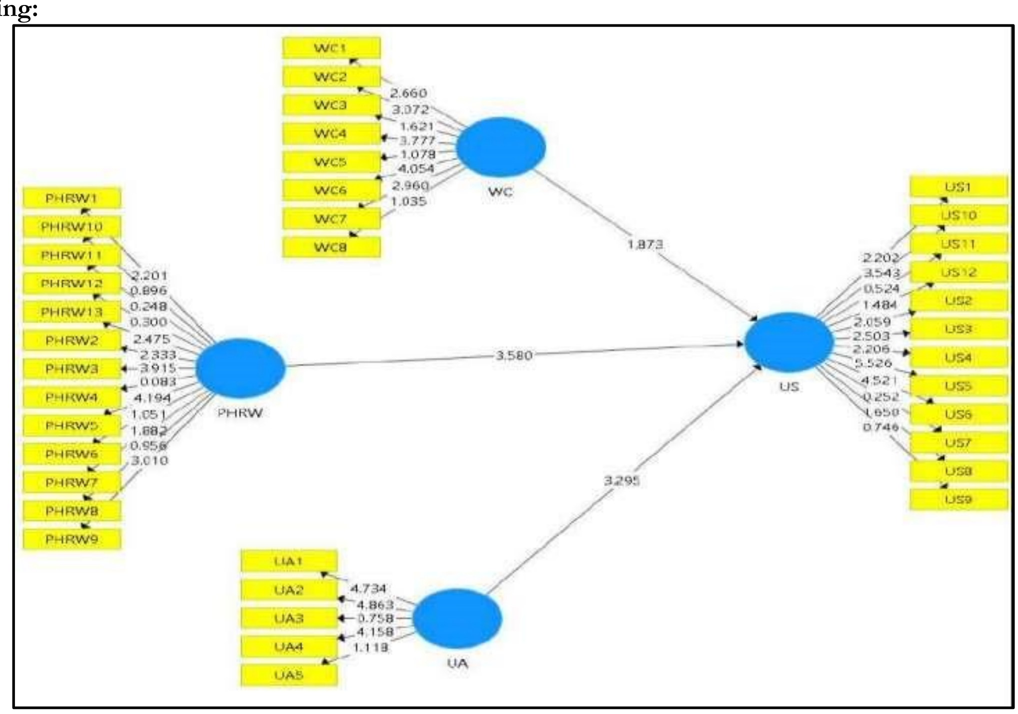

Figure 6: Bootstrapping of US, UA, WC and PHRW.

Assessment of the Measurement Model:

Constructs/Measurement Items	Loading	Cronbach-α	ϱ-A	CR	AVE
PHRW		0.951	0.951	0.951	0.295
PHRW1	2.031				
PHRW10	2.801				
PHRW2	2.063				
PHRW3	2.420				
PHRW4	2.858				
PHRW5	2.433				
PHRW6	1.891				
PHRW7	1.951				
PHRW8	1.761				
PHRW9	2.109				
WC (Working Capital)		0.936	0.936	0.936	0.278
WC1	2.267				
WC2	3.326				
WC3	2.567				
WC4	1.757				
WC5	2.094				
WC6	4.476				
WC7	1.585				
WC8	2.315				
UA (User Adoption)		0.915	0.915	0.915	0.376
UA1	4.734				
UA2	1.752				
UA3	4.258				
UA4	1.118				
UA5	1.118				
US (User Satisfaction)		0.934	0.934	0.934	0.268
US1	2.250				
US2	2.544				
US3	4.288				
US4	3.586				
US5	5.289				
US6	3.528				
US7	4.251				
US8	4.520				
US9	3.461				
US10	0.765				
US11	0.754				

Table 8: Assessment of the measurement model.

The table 8 presents an assessment of the measurement model for various constructs including Perceived Health Risk in Water (PHRW), Working Capital (WC, interpreted here as Water Consumption), User Adoption (UA), and User Satisfaction (US), as part of a PLS-SEM analysis. Each construct is evaluated for reliability and validity through measures like Cronbach's alpha (α), rho-A (ϱ-A), composite reliability (CR), and average variance extracted (AVE).

The construct PHRW, with loadings ranging from 1.761 for PHRW8 to 2.858 for PHRW4, demonstrates a high level of internal consistency with a Cronbach's alpha, rho-A, and CR all at 0.951. The AVE for PHRW is 0.295, which is slightly below the commonly recommended threshold of 0.5, indicating potential issues in explaining the variance in the observed variables by the construct. Water Consumption (WC), also shows substantial internal consistency with values for Cronbach's alpha, rho-A, and CR at 0.936. The loadings for this construct range from 1.585 for WC7 to 4.476 for WC6, suggesting varying degrees of factor loadings associated with different aspects of water consumption. The AVE for WC is 0.278, again below the desired threshold, which might suggest that the items may not be adequately capturing the construct of water consumption.

User Adoption (UA) shows loadings from 1.118 for both UA4 and UA5 to 4.734 for UA1, with a reliability and validity assessment yielding Cronbach's alpha, rho-A, and CR all at 0.915, and an AVE of 0.376. This indicates good internal

consistency though the average variance extracted is slightly low, which could affect the construct's ability to fully represent the variance in user adoption measurements.
Finally, User Satisfaction (US) with loadings from 0.754 for US11 to 5.289 for US5, displays Cronbach's alpha, rho-A, and CR at 0.934, and an AVE of 0.268. This low AVE value suggests that while the items are consistent, they might not be adequately capturing all the variance in the user satisfaction construct.
Overall, while the constructs exhibit high internal consistency as indicated by the values of Cronbach's alpha, rho-A, and CR, the AVE values are below the ideal threshold of 0.5 in all cases. This might indicate that the constructs do not adequately capture the variance of the indicators, potentially requiring a reassessment of the measurement items or additional items that might better represent each construct's latent variables.

PLs algorithm:

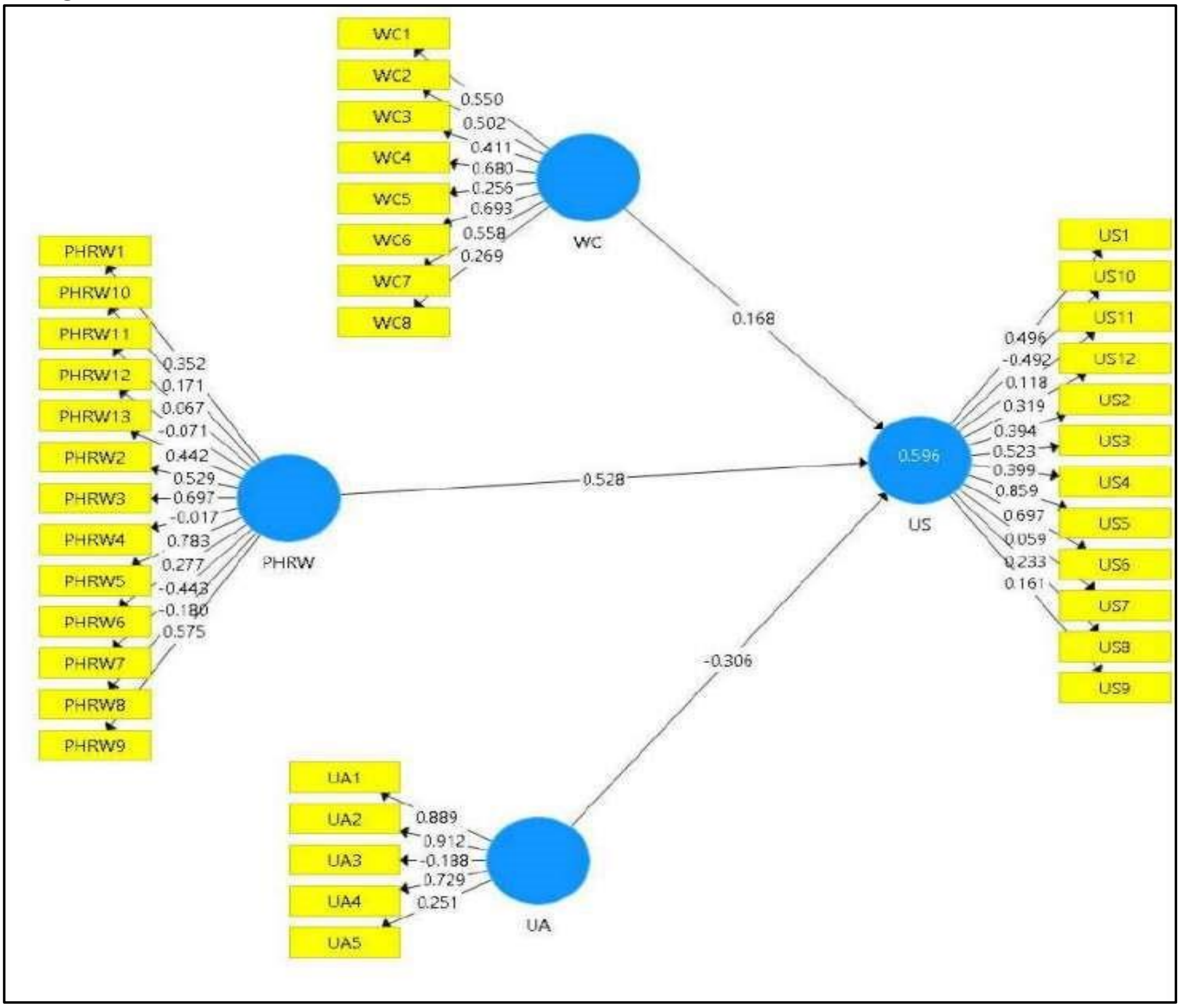

Figure 7: PLs algorithm of US, UA, WC and PHRW.

UA results in a negative and significant influence upon US; with coefficient being -0.306, and p-value is 0.001. Thus, an increase in one unit of UA will be associated with a decrease of 0.306 units on US and this effect is unlikely to be random. The coefficient is 0.168 while the p value is 0.062 leading us to infer that WC is positively affecting US. In other words, a one unit rise in WC leads to 0.168 units increment in US though this effect is insignificant at the alpha=0.05 level. As such, the model accounts for approximately 59.6% of the variance in US and represents a fairly good fit. Adjusted r squared is 58.6%. This means that adding additional predictors in the model may hardly increase the fit of the new adjustments.

Discussion:

The study's findings on customer satisfaction with water supply in a semi-arid urban environment provide useful insights for improving water management and policy development. The research examines various factors, including water quality, availability, accessibility, cost, and reliability, to reveal a comprehensive understanding of customer views and satisfaction levels in Faisalabad. the findings suggest that consumers have varying levels of satisfaction. A considerable proportion of the participants expressed contentment with the quality and accessibility of water. However, apprehensions regarding the expense and dependability persist as noteworthy issues. The significant level of discontent regarding water expenses indicates a pressing requirement to reassess pricing tactics to strike a balance between the financial constraints of consumers and the operational requirements of water supply systems. This underscores a possible discrepancy between the pricing models employed by water suppliers and the perceived value or affordability of the water supplied, indicating either excessively high-water prices or inadequate communication regarding the process of determining and allocating water rates for system upkeep.

Differences in satisfaction ratings among several characteristics of the water supply, such as the distance from the source and the amount of water, indicate that although physical access to water is typically satisfactory, its economic and qualitative aspects need more focus. Furthermore, close to 50% of the participants in the study expressed only moderate satisfaction or indifference towards these issues, suggesting a considerable need for enhancing the universality of water access to ensure greater overall satisfaction. The economic issues are of great importance, as a significant proportion of users express dissatisfaction with the overall fees for water, indicating a discrepancy between pricing strategies and consumer anticipations. This could indicate either exorbitant water costs or insufficient dissemination of information on the calculation of rates and water consumption. The importance of water safety and reliability in the source also became evident as significant elements. A portion of consumers have confidence in their main water source, whereas a notable proportion view their water supply as undependable or lacking credibility. This perception may arise from sporadic service, perceived concerns of contamination, or past problems with water providers. These findings suggest that implementing numerous policy changes could be advantageous. Prioritizing the improvement of both the tangible and perceived characteristics of water, as well as establishing consumer confidence through reliable service and open communication, is essential. Implementing regular evaluations and releasing transparent public reports on water quality has the potential to enhance customer confidence. Furthermore, doing a thorough evaluation and making necessary modifications to pricing systems could effectively tackle economic discontentment. Introducing tiered pricing models that modify rates according to levels of usage could achieve a compromise between the economic viability of water systems and the principles of fairness and affordability.

Enhancing the dependability of water supply and improving communication with clients regarding service interruptions and repair schedules could further decrease unhappiness. Investments in infrastructure aimed at minimizing leaks, preventing pollution, and guaranteeing a reliable supply are essential and can be facilitated by a blend of government funding, international assistance, and collaborations between the public and private sectors. Ultimately, by actively interacting with communities, we can gain a comprehensive understanding of their distinct requirements and preferences. This enables us to customize services in a more efficient manner, ensuring that enhancements in water service provision are in line with community expectations and demands. In summary, the study highlights the importance of specific policy interventions that not only seek to increase the efficiency and efficacy of water service delivery, but also guarantee that these improvements are in line with the requirements and expectations of the community. To cultivate a water management system that is adaptable and sensitive to customer needs, planners should consider the various dimensions of water supply satisfaction.

Conclusion:

The outcomes of current study articulate robust interaction of multiple social behaviors, customers' contented satisfaction purely links to particular acceptance. As the preliminary study investigating the consumers approach for domestic drinking water structure and complex supplying system in the Pakistan, it provides a strong conceptual foundation to develop effective plans and public policies to improve water service and delivery system to the population as discussed by Ong et al., 2023. In assessing the results of data, customer satisfaction about in-use water source in all aspects found significant. It indicates that reliability is associated with consumer satisfaction for water source selection. Moreover, sustainable and efficient performance of service provider in terms of quality water provision with accurate bills and timely delivery also documented the satisfaction of consumers as mentioned by Agyapong et al., 2017.The clear variation is detected in the observing the satisfaction state of community for water source in-use and all other accessible sources. Variations in the results about water quality observation of all water sources shows that many people believe packed mineral water is safe and finest for drinking purposes but cannot consume it due to availability, collection distance and affordability issues. The results show that consumers satisfaction is linked with other variables including affordability, accessibility and overall appearance of water source. Social behaviors influence the selection of drinking water source in any area.

Policy implication: The consideration of consumers satisfaction towards drinking water resources can enhance the supply system and reduce demand and supply difference. Current research will definitely support policy makers and stakeholders to better comprehend the social behaviors of community and water needs of urban areas. It will further enhance the water supply patterns and enable relevant water providing agencies to improve water quality using different measures.

The research examining consumer satisfaction with various drinking water sources in Faisalabad, a semi-arid city in Pakistan, offers several pertinent policy implications that could guide local authorities, policymakers, and water management bodies toward improved water supply systems. Here is the key policy recommendations derived from the study's findings:

Enhance Water Quality Control: The study highlights the importance of water quality as a significant factor influencing consumer satisfaction. Policymakers should enforce stringent water quality standards and regular monitoring to ensure the safety and suitability of drinking water. This could involve updating and enforcing local water quality regulations and investing in modern water treatment facilities that can effectively remove contaminants and ensure the safety of the water supply.

Improve Accessibility: Accessibility to safe drinking water is another critical factor. Policies should aim to expand the water distribution infrastructure to underserved areas, reducing disparities in water access across different regions of the city. This might include building additional water dispensing units, extending pipelines to remote areas, and ensuring that water supply points are adequately maintained.

Invest in Reliable Water Supply Systems: Reliability of the water supply was identified as a crucial determinant of consumer satisfaction. Ensuring a continuous and consistent water supply can significantly enhance user satisfaction levels. Investment in resilient water supply infrastructure, capable of withstanding environmental and operational stresses, should be prioritized. This may include upgrading old pipes, implementing advanced leak detection technologies, and using smart water management systems to predict and manage demand more effectively. Ensure Affordability: Affordability is a significant concern, particularly in semi-arid regions where water scarcity can drive up costs.

Subsidy programs or tiered pricing models could be introduced to make water more affordable for lower-income households. Policymakers might also consider public-private partnerships to leverage funding for infrastructure improvements without placing undue financial burdens on consumers. Consumer Education and Engagement: Educating consumers about water conservation techniques and the importance of sustainable water use can also improve satisfaction by making consumers more knowledgeable and engaged stewards of their water resources. This could involve community outreach programs, educational campaigns, and regular feedback solicitation to adjust services in line with consumer needs and preferences.

Regular Assessments and Responsive Management: Continuous assessment of consumer satisfaction and the factors influencing it should be institutionalized within water management practices. This would involve regular surveys and the use of analytical tools like SPSS and PLS-SEM to understand and respond to changing consumer needs and environmental conditions promptly. Adaptation to Climate Change: Given the semi-arid context, Faisalabad's water management strategies should also incorporate long-term climate adaptation measures. This could include investing in alternative water sources such as rainwater harvesting and recycled water, and enhancing the resilience of water infrastructure against climate-induced stressors such as droughts and heatwaves. By implementing these policies, Faisalabad and similar urban areas can enhance the sustainability and resilience of their water supply systems, improving consumer satisfaction and supporting sustainable urban growth.

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