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Determinants of Community Participation in Sustainable Management of Rural Water Supply System: Evidence from District Lahore, Pakistan

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Abstract: *Sustainable functionality of rural water supply systems is one of the most imperative aspects to ensure the provision of safe drinking water for communities. In recent decades, a number of projects have been initiated by national and international organizations to meet the desired need for safe drinking water and sanitation, but a large proportion of these development projects fail shortly after their execution. The majority of water supply projects fail in rural communities within three years after development due to the least level of community participation regarding decision-making, site identification, planning, execution, monitoring, evaluation and management process and, above all, unawareness, lack of basic technical and management skills. This study presents the most influencing determinants of community participation that are compulsory for the sustainable functionality of rural water supply systems. This study was conducted in the district of Lahore, Pakistan and simple random sampling methods and techniques were applied to draw the sample from the population. A semi-structured questionnaire was used as a tool for data collection. The result of the study indicated that a significant association existed among community participation in planning, execution, operation, maintenance & evaluation processes and sustainability functionality of rural water supply systems.*

Key Words: Determinants Of Community Participation, Community Participation, Sustainability, Functionality, Water Supply System

Introduction

The sustainable functionality of rural water supply systems is one of the most imperative aspects to ensure the provision of safe drinking water for communities. More than half of the world's population, mostly in Asia and Africa, lives in rural areas and has low socio-economic conditions (Ogunbode et al., 2024). The rural population from developing countries of Asia lack access to appropriate basic facilities such as safe drinking water, improved sanitation and hygiene. In recent decades, a number of projects have been initiated by national and international organizations to meet the necessity of safe drinking water and sanitation, but a large proportion of these development projects fail shortly after their execution due to improper management (Gabr, 2023). This situation is particularly so in developing countries like Pakistan, where access to safe drinking water is still a major challenge to numerous rural populations (Vijay, 2021).

Inadequacies and identified problems in rural water supply systems are common, such as increased scarcity of water, reduced human productivity, enhanced socioeconomic issues, and plenty of hardships for people (Gaffan et al., 2023). The World Bank revealed in their report that globally, there are about 663 million people living without access to safe drinking water, and 2.4 billion still do not have access to improved sanitation facilities. Considering the importance of the issue, the United Nations emphasized the global Sustainable Development Goals (SDGs) and tried to ensure the availability, functionality and sustainability of improved water and sanitation for all. The cornerstone of successful development projects

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is strongly associated with active community participation, which initiates a proactive process that enhances the development initiatives and creates ownership rather than receiving its own share of benefits (WHO & UNICEF, 2017).

With the objective to provide safe drinking water and improved sanitation and hygiene conditions, the government of Pakistan and its allies national and international organizations spent a huge amount of funds, time and resources but unfortunately did not achieve the set targets (Arias et al., 2020). The majority of rural communities still face shortages and malfunctions of safe drinking water facilities. Moreover, the spread of waterborne infectious diseases creates an unbearable socio-economic and health burden among community dwellers (Ogunbode et al., 2022). Waterborne diseases stand as the second highest leading cause of morbidity and mortality, especially among children and women. This vicious cycle of interrelated issues is not only due to a shortage of facilities but also due to mismanagement and lack of community participation (Birkinshaw et al., 2021).

Existing empirical evidence (Bayu et al., 2020; Puskás et al., 2021; Widyarani et al., 2022 & Ogunbode et al., 2023) indicated that the majority of water supply projects fail in rural communities within three years after development. These water supply projects fail due to the least interest of community members regarding decision-making, site identification, planning, execution, monitoring, evaluation and management process and, above all, unawareness and lack of basic technical and management skills (Iduseri et al., 2021). The shortage of underground water, contamination, and poor maintenance have caused the malfunctioning of numerous water supply projects in the country. Furthermore, meagre sustainability in water-related development projects becomes the main obstacle to attaining the related improvements in living standards of the rural population in Pakistan (Yasin et al., 2021).

Therefore, this study sought to find out the determinants of community participation in the sustainable functionality of the rural water supply system in Pakistan in order to suggest what can be done to deal with the issue and enhance sustainability in the rural water supply sector. This has further implications for socio-economic and health development among the country's population. For this purpose, research tries to address the gap by establishing the most significant determinants with enhanced community participation and sustainable functionality of services in rural communities.

Objectives of the Study

- To examine the extent to which community participation affects the sustainability of rural water supply systems.
- To identify the performance of management and service delivery of water supply facilities by the water management committee and the challenges they face.

Theoretical Framework for this Study

The users of any service in a community need to be involved in the service, participate in its improvement and oversee its fulfilment (Tarlani et al., 2021). This can be accomplished through community participation, which is characterized as a dynamic procedure affecting the course and execution of a development program with a view to upgrading their prosperity in terms of finance, self-awareness, independence, or the different esteem they value. This infers that the context of participation in the development programme is that the attention is on the participation of users and not that of government officials (El-Rawy et al., 2023). It is a joint or collective and cooperative inclusion of users in groups, which is a sign of community participation. Community participation is likewise characterized as a procedure by which people, families or communities accept accountability for local issues and build up an ability to add to their own community development (Murwendah et al., 2020).

Arnstein's Ladder of Participation

Arnstein's theory has been impugned in the preface that each of the methods addresses an outstandingly expansive and general order. Inside, there is presumably going to be a broad assortment of experiences and encounters (Jepson et al., 2023). With respect to participatory development procedures, people can and ought to have their own perspectives and zones of enthusiasm regarding sustainability. A solitary

programme needs a broad, perfect, and all-around characterized idea of sustainability to be directly executed and filled in as a reason for assessment. The more rural individuals were included in addressing their own particular development, the more certainty and achievement levels related to such a program (Prevost et al., 2020). The local individuals guaranteed non-support, particularly women, in programmes that were implied for their development. The sustainability of the procedure relies upon people and foundations to keep giving those same administrations after the help and dies down of a programme. As a general rule, a programme looks for and expects this sort of sustainability, which relies upon the feasibility of establishments, as well as their ability and potential for survival. Moreover, it relates to the sustainability of assets. This alludes to the degree to which exercises advanced by the programme will protect the asset base for future use (Brazeau et al., 2021).

Carter Model of Sustainability

Carter divided sustainability into different characterizations and depicted the broadness and unpredictability of the issue. These portions are social, finance-related, technical, institutional, and environmental, and they endeavour to examine the linkage among them (Sholihah et al., 2020). Carter built up a reasonable structure which displays how the parts of sustainability relate and interlink. A lack in any one fragment in the chain could wreck sustainability. While the relationship between parts of sustainability is exhibited by the system, not all seem related. It is sketchy whether changes to proceeding with help would unmistakably affect inspiration or whether any acclimation to inspiration. It would show up in view of the effects acquired by transformation cost recuperation and maintenance (Muzioreva et al., 2022). The likelihood of a chain is that all pieces are connected and subordinate to each other. However, the two finishes of the sustainability chain are not attached. A chain is comparably as solid as its weakest affiliation. While the sustainability chain does not remember one section as being more gigantic than the rest, Carter does make specific reference to the importance of community participation and proceeding with help for satisfying reasonable water and sanitation associations (Odagiri et al., 2020).

Research Hypothesis

Normally, Individuals, groups and communities put their best efforts toward the success of development programs in their areas, especially regarding the provision of basic human needs like safe drinking water. However, in reality, the issue revolves around awareness, behaviours and their long-held habits. By retaining the focus on community participation and sustainable functionality of rural water supply systems, the following hypotheses were proposed.

- H_1: The higher the level of community participation in planning, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.
- H_2: The higher the level of community participation in execution, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.
- H_3: The higher the level of community participation in operation and maintenance, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.
- H_4: The Higher the level of community participation in evaluation, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.

Research Methodology

In this study, researchers tried to examine the determinants of community participation in the sustainable functionality of rural water supply systems. The primary data was collected through a survey method to understand underlying factors that contributed to the sustainable functionality of RWSS. A semi-structured questionnaire comprising background and demographic characteristics is used as a tool for data collection. The semi-structured questionnaire incorporates the user's satisfaction regarding decision-making, planning, executing, monitoring, evaluation and management of RWSS in their communities. The data were collected from households who use drinking water provided through rural water supply schemes. The unit of analysis was the head of the household, who lived in their communities for one year.

This primary study applied quantitative methods and techniques to approach the participants. The target population was the water users (heads of households) from functional water supply schemes of district Lahore. There are a total of 45 water supply schemes, including 22 functional and 23 dysfunctional.

Through a simple random sampling method, three (03) water supply schemes from functional were selected: 1) water supply scheme Shamki Bhattian, 2) water supply scheme Sultan Town, and 3) water supply scheme Mall.

For the purpose of sampling, an updated list of water users with their names and home addresses was obtained from a local community-based organization. The sample for this study is determined through the Casely and Kumar (1998) method. If the population is smaller in size, a larger percentage of the population will be drawn for the sample size, and if the population is larger in number, then a smaller percentage will be drawn for the sample size. It has been argued by Casely and Kumar that after a certain sample percentage, usually 20%, the effect of the sample size on research outcome remains constant or normalized. So, by keeping in view these standards, the minimum survey sample recommended for a larger population is 10%.

A semi-structured questionnaire was adopted as the tool of data collection, which was the most appropriate approach for in-depth study; questions can be explained and repeated if the respondent does not understand the nature of the question. To check the validity and reliability of the research tool, the researcher pretested 25 No respondents selected from two water supply schemes other than the target areas of this study. Before the actual data collection, researchers obtain necessary permission from all concerned stakeholders, such as the Public Health Engineering Department (PHED), Community Based Organizations (CBOs) and the participants. The collected data was analyzed using descriptive and inferential statistics and presented through tables, graphs and interpretation.

Results and Major Findings

Descriptive Analysis

Through descriptive analysis, the researcher tries to present the overall geographical and demographic aspects of this study. Descriptive statistics are generally used to present quantitative descriptions, which are basically used to describe the basic features and mostly contain information regarding lists of numbers that describe a population.

Table 1

Distribution of demographic characteristics

Demographic Characteristics	Description of Characteristics	N	%
Gender	Male	204	64.7
	Female	111	35.2
	Total	315	100
Age	20-30	110	34.9
	31-40	160	50.7
	41-50	25	7.9
	51-60	11	3.4
	Above 60	9	2.8
	Total	315	100

Table 1 presents the details regarding participant gender stratification as 35.2% of respondents were female, and more than 64.7% of respondents were male. Findings highlight the age of the respondent. 34.9% of respondents were between 20-30 years, 50.7% were between 31-40 years, 7.9% were between 41-50 years, 3.4% were between 51-60 years, and 2.8% respondents were above 60 years of age.

Table 2

Distribution of demographic characteristics

Demographic Characteristics	Description of characteristics	N	%
Education Level	Primary	42	13.3
	Middle	89	28.2

Demographic Characteristics	Description of characteristics	N	%
	Matric	102	32.3
	Graduate	51	16.1
	Post Graduate	31	9.8
	Total	315	100
Monthly Income	Less than 5000	14	4.4
	5001-10000	57	18.0
	10001-20000	155	49.2
	above 20000	89	28.2
	Total	315	100

Table 2 presents the distribution regarding the educational level of participants; when respondents were asked about their education level, 13.3% respondents reported primary education level, 28.2% were middle, 32.3% were Matric, 16.1% were graduate while only 10% respondents' qualification were post graduate. Table 2 indicated that only 4.4% of respondents' monthly incomes were less than 5000, 18% were between 5001-10000, 49.2% of respondents' monthly incomes were between 10001-20000, and 28% of respondents' incomes were above 20000. Therefore, it is concluded that almost 49% of the respondents' monthly income was between 10001-20000, which means respondents have the average economic condition and pay capacity of water tariff of the water supply facility.

Table 3

Community participation and water supply scheme systems

Demographic Characteristics	Description of Characteristics	N	%
Community cooperation with executing agency	Low	75	23.8
	None	66	20.9
	High	75	23.8
	Very high	99	31.4
	Total	315	100.0
Impact of community involvement on quality of work	Disagree	75	23.8
	Do Not Know	63	20.0
	Agree	75	23.8
	Strongly Agree	102	32.3
	Total	315	100
Supervision by the community during and after the execution	CBO	53	16.8
	Community	115	36.5
	Government	113	35.8
	NGOs	34	10.7
	Total	315	100.0

The results presented in Table 3 are about the community cooperation with the executing agency regarding the water supply system in their communities. Results show that almost 55.2% of respondents reported very high responses regarding their participation in community meetings regarding the need for a water supply programme. Similarly, a huge proportion of 56.3% of participants reported a high response in favour of the positive impacts of community involvement on the quality of work. When the respondents were asked about the supervision process during and after the execution of the water supply project, most of the respondents (36.5%) reported that it should be done by the local community, and 35.8% thought these services should be provided by the government. The participants of the study highlighted that the role of the community is very important in the functioning and sustainability of the water supply system in their communities.

Chi-Square Test

The researcher applied Chi-Square statistics through cross-tabulation to present the distributions of two categorical variables simultaneously, with the intersections of the categories of the variables appearing in the cells of the table. In this study, to test the hypothesis, chi-square tests have been applied to find out

the association between community participation in planning and user satisfaction such as (H1) higher the level of community participation in planning, higher the level of user satisfaction and greater the chances of sustainability of the water supply programme.

Table 4

Association between community participation in planning and user satisfaction

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.471E3[a]	1764	.000
Likelihood Ratio	1.125E3	1764	1.000
Linear-by-Linear Association	.304	1	.581
N of Valid Cases	315		

a. 1924 cells (100.0%) have an expected count of less than 5. The minimum expected count is .01. α = 0.5, P = .000, df = 1764

Table 4 is about the association between community participation in planning and user satisfaction. It shows that, as the calculated value of p is less than α, this rejects H_o that the lower the level of participation in the planning of the rural water supply programme, the lower the user satisfaction and sustainability of the water supply programme, and it can be concluded that the chi-square test support H1 that higher the level of community participation in planning, higher the level of user satisfaction which ensure the sustainability of rural water supply programme. So, an association was found between community participation in planning and user satisfaction.

Chi-square has been applied to find out the association between community participation in execution and user satisfaction. The hypothesis (H2) is that the higher the level of community participation in execution, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.

Table 5

Association between community participation in execution and user satisfaction

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.700E3[a]	144	.000
Likelihood Ratio	1.190E3	144	.000
Linear-by-Linear Association	288.459	1	.000
N of Valid Cases	315		

a. 160 cells (94.7%) have an expected count of less than 5. The minimum expected count is .01. α = 0.5, P = .000, df = 144

Table 5 explains that as the calculated value of p is less than α, this rejects H_o lower the level of participation in the execution of the water supply programme and lower the level of user satisfaction. It can be concluded that there is an association between community participation in execution/ implementation and user satisfaction. So, the chi-square test supports H2 that the higher the level of community participation in the execution of the rural water supply programme, the higher the level of user satisfaction, which ensures the sustainability of the rural water supply programme.

The study also checks the association between community participation in operation maintenance and user satisfaction through Chi-square analysis as the study hypothesis (H3). The higher the level of community participation in operation and maintenance, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.

Table 6

Community participation in operation and maintenance and user satisfaction

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.452E3[a]	156	.000
Likelihood Ratio	1.244E3	156	.000
Linear-by-Linear Association	238.147	1	.000
N of Valid Cases	315		

a. 176 cells (96.7%) have an expected count of less than 5. The minimum expected count is .01. α = 0.5, P = .000, df = 156.

Table 6 explains that as the calculated value of p is less than α, this rejects H_o lower the level of participation in operation and maintenance lower the level of user satisfaction. So, it can be concluded that there is an association between community participation in the operation and maintenance stage and user satisfaction. So, the chi-square test supports H3 that the higher the level of community participation, the higher the level of user satisfaction, which ensures the sustainability of the water supply programme.

Similarly, study hypothesis H4 is also tested through the chi-square test and tries to find the association between community participation in evaluation and user satisfaction. Study hypothesis (H4) The higher the level of community participation in evaluation, the higher the level of user satisfaction and the greater the chances of sustainability of the water supply programme.

Table 7

Association between community Participation in evaluation and user satisfaction

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.452E3[a]	156	.000
Likelihood Ratio	1.244E3	156	.000
Linear-by-Linear Association	238.147	1	.000
N of Valid Cases	315		

a. 176 cells (96.7%) have an expected count of less than 5. The minimum expected count is .01. α = 0.5, P = .000, df = 156,

Table 7 explains that as the calculated value of p is less than α, this rejects H_o that the lower the level of community participation, the lower the level of user satisfaction. It can be concluded that there is an association between community participation in evaluation and user satisfaction. So, the chi-square test supports the H4 that the higher the level of community participation in evaluation, the higher the level of user satisfaction, which ensures the sustainability of the rural water supply programme.

Discussion

The study investigated the determinants of community participation in sustainable functionality of rural water supply systems from district Lahore, guided by the following objectives: to assess the level of community participation in planning, execution, operation maintenance, and evaluation of rural water supply programmes. To meet all the above objectives, the researchers conducted a study in three areas of district Lahore where water supply programmes were functional and provided water facilities to the rural communities. The study was based on the views and opinions of community members of the water supply programme to assess their level of participation in planning, execution, operation and maintenance evaluation and its impact on the sustainability of the water supply programme. A sample of 315 was drawn from the population of the study area by using a simple random sampling technique. The respondents were community members, representatives of the management committee and the executing agency.

The researcher opted for a primary data collection technique in the form of a structured tool for data collection. The researcher selected a semi-structured questionnaire because it was most appropriate for an in-depth study. Questions could be explained and repeated according to the understanding of the respondents and could be useful for any type of population, including handicapped children, women, men, and old age. The tool was first validated through pilot testing to confirm the reliability of the questions, their sequence and their meaning. After this, data is collected and analyzed through descriptive and inferential statistical procedures. All ethical considerations were taken into account during conducting the study.

Existing literature and case studies revealed that the success and sustainability of many water supply programmes were due to the effective participation of community and key stakeholders, the high capacity of the communities and committees in the operation and maintenance of water systems and the management of water resources. Moreover, the literature revealed that community-driven programmes like water supply projects were considered more sustainable and functional.

Recommendations

- The study recommends that pre-capacity building sessions be conducted before the implementation of the water supply programme. Communities should be given information about construction supervision, labour provision, and the sharing of their resources.
- The study also recommends that the committee members should be accountable and transparent to the project members to maintain the goodwill of the members to continuously participate in the provision of implementation resources and also ensure the participation of the community in the execution phase of the water supply programme.
- Executing agencies and committees should collectively conduct and launch campaigns on health and hygiene, the importance of clean water, and waterborne diseases, and they should also involve the health and education sector in this regard.
- Institutions must arrange learning, knowledge-sharing programmes, training workshops, and seminars at the provincial level to provide communities opportunities to share their experience and success stories with each other, to update them with current water facilities and management practices so they can learn and implement them to improve the functioning of water supply programmes.
- The executing agency and management committee should conduct a post-evaluation survey in communities to find out community opinion regarding water quality and quantity, tariff, issues and any intervention suggested by the community.

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