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Improving Water Sanitation and Hygiene (WASH) Services in Rural Punjab: A Policy Imperative for Public Health and Development

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Abstract: *Access to safe water, adequate sanitation, and hygiene (WASH) is fundamental to public health, yet rural regions of Punjab continue to face persistent challenges in WASH service delivery. This study employs an interdisciplinary approach to examine the structural, behavioral, and institutional factors that contribute to WASH-related vulnerabilities in rural Punjab. Grounded in the Social Determinants of Health Framework, the Ecological Model of Health Behavior, and Governance and Policy Implementation Theory, the research explores how socio-economic disparities, community norms, and governance inefficiencies collectively impact health outcomes and the effectiveness of WASH interventions. Findings highlight that WASH inequities are closely linked to poverty, gender disparities, education levels, and institutional fragmentation. The study highlights the importance of developing integrated, equity-focused policies that extend beyond infrastructure provision to encompass behavior change strategies, strengthened local governance, and increased community participation. Ultimately, the research advocates for a holistic, multi-level policy response to improve WASH services as a public health and development imperative in rural Punjab.*

Keywords: Public Health, Water, Sanitation and Hygiene (WASH), Challenges and Service Delivery of WASH, Collective Community Interventions, Policy Transformation

Introduction

Safe water, adequate sanitation, and proper hygiene (WASH) are essential human rights and a vital foundation for both the population's health and sustained development (Ullah et al., 2024). In addition to preventing communicable diseases, WASH services have also played a significant role in improving the quality of life, dignity, and livelihoods of humans, as well as enhancing productivity, especially among marginalized groups (Yasmin et al., 2024). WASH provision and all its aspects, specifically inadequate WASH provision, will remain a significant problem in every part of the world, particularly in low- and middle-income economies, whose WASH infrastructures significantly contribute to the disease burden, malnutrition, and socioeconomic disparities. The World Health Organization (2023) has noted that insufficient water, sanitation, and hygiene make a significant contribution to morbidity and mortality worldwide, particularly among children, with the majority of these events affecting vulnerable population groups residing in rural areas (Zeeshan et al., 2023).

Inadequate systems of WASH cannot offer only short-term health effects; they also result in life-long poor nutritional status, poor stunted growth, and mental retardation in children, both of which delay adult human capital (Afzal et al., 2023). The other category of people who are likely to suffer includes women and girls. The lack of proper sanitation facilities frequently means missed opportunities in education and economic ability. Females are also more vulnerable to gender-based violence. These conditions are unprecedented and primarily negatively impact people living in rural and impoverished areas, where access to clean water and basic sanitation is critically low (Yasmin et al., 2024). The WASH crisis is a significant obstacle to achieving the various Sustainable Development Goals (SDGs) pledged by the United

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Nations in advancing the sustainable development of this planet in these regions, in addition to being a public health crisis (Ullah et al., 2023; Afzal et al., 2024).

The interlinked SDGs framework has a direct and indirect relationship with WASH, and SDG 6 (Clean Water and Sanitation) has the closest connection, seeking to ensure the availability and sustainable management of water and sanitation for all. SDG 3 (Good Health and Well-being) shares a close association because poor WASH is a significant cause of preventable diseases, maternal and child deaths, as well as undernutrition. The economic and nutritional health effects of waterborne diseases and time lost significantly impact the collection of waterborne income, particularly in relation to SDG 1 (No Poverty) and SDG 2 (Zero Hunger), in rural areas. SDG 4 (Quality Education) is impaired, as children, especially girls, tend to miss school due to the unavailability of toilets, menstrual hygiene rooms, and illnesses caused by unsafe water (Afzal et al., 2022). WASH is even closely connected with SDG 5 (Gender Equality) because women and girls have to make a disproportionate effort to collect water, and a lack of safe sanitation makes them more prone to harassment. The losses in productivity attributed to the WASH-related illnesses affect SDG 8 (Decent Work and Economic Growth). Moreover, SDG 10 (Reduced Inequalities) is also linked to the inequality in access to WASH in both rural and urban areas, as well as across socio-economic groups. Lastly, SDG 13 (Climate Action) and SDG 11 (Sustainable Cities and Communities) also apply, as water resources are increasingly at risk due to climate change and urbanization, and resilient WASH systems are necessary to address this risk.

Therefore, WASH investing is a moral, health, and cross-cutting strategy towards inclusive and sustainable development that helps accomplish SDG targets and achieve inclusive and sustainable development. The WASH scenario in developing nations, such as Pakistan, is an intricate interaction between infrastructural and policy vacuum, and social inequalities. Although the situation has been improving in urban settings, rural areas, especially in Punjab, the country's most populous province, continue to face immense obstacles. A significant percentage of rural households continue to use unsafe sources of drinking water, lack access to improved sanitation, and lack knowledge or the means to practice basic hygiene (Afzal et al., 2022). These gaps lead to high rates of water-related diseases, stunting, and infant mortality, which instead amount to compromising larger efforts of health equity and rural and national development. Punjab is a critical case for WASH-related interventions, given its demographic weight and strategic status in national development.

Although several government and non-government efforts have been made to enhance the WASH infrastructure, challenges persist, including poor implementation, lack of community participation, ineffective institutional coordination, and inadequate funding systems. Additionally, existing policies fail to integrate WASH services into population health planning, resulting in a lack of synergy in the intervention mode and rendering the approach counterproductive. According to the Pakistan Bureau of Statistics (2023), only 64% of rural households have access to improved drinking water sources, 40% of rural households lack access to improved sanitation facilities, and open defecation, though reduced, is still practiced in specific marginalized communities. Wastewater disposal and poor drainage systems further exacerbate environmental health risks. Hygiene awareness is relatively low, especially among women and children (Afzal et al., 2022). A UNICEF 2022 report indicates that only 58% of rural households practice hand washing with soap at critical times. These deficits in WASH infrastructure and behavior contribute significantly to waterborne diseases, with Punjab reporting high rates of diarrheal diseases, hepatitis A/E, and typhoid, particularly among children under five.

Considering the importance and sensitive nature of the issue, urgent policy and infrastructure reforms are necessary to address these persistent WASH gaps and improve public health outcomes in the province. The current study aims to explore the situation of WASH services in rural Punjab, including their impact on national health and socio-economic growth. The empirical collection of data and stakeholder attitudes merge to identify gaps in the system and develop policy recommendations for more effective, integrated, and equitable WASH programming. Finally, the analysis highlights why WASH improvements should be conceptualized not only as technical upgrades, but also as policy interventions to make them inevitable, thereby reducing disease burden, building human capital, and meeting the Sustainable Development Goals (SDGs).

Significance of the Study

There is outstanding academic as well as policy relevance in this study, particularly with regard to the current situation of Pakistan, in which the country is trying its best to offer equal and sustainable WASH (Water, Sanitation, and Hygiene) services. The health and socio-economic effects are far-reaching in rural Punjab, where a significant portion of the population still lacks easy access to clean water, sanitation, and hygiene facilities. Poor WASH conditions are directly correlated to high instances of waterborne diseases, undernutrition, and child mortality, although multi-level local studies on the topic of interconnections are sparse. The study will fill important knowledge gaps and provide empirical evidence through the systematic evaluation of the current state of WASH and its impact on public health and development. It will also bring out the socio-economic aspects of WASH access, a factor that is strongly ignored by policymakers but a significant component in inclusive development. Additionally, the research will assess the relevance of existing policies and identify implementation bottlenecks with the aim of developing viable, evidence-based recommendations to enhance WASH governance. The resultant data shall aid local governments, public health organizations, and development agencies in setting up a more responsive and sustainable approach to WASH that would catalyze better health, poverty alleviation, and contribute to the Sustainable Development Goals (SDGs) in rural Punjab.

Objectives of the Study

- To assess the current status of water, sanitation, and hygiene (WASH) infrastructure and practices in rural Punjab, Pakistan.
- To identify the key health outcomes particularly the prevalence of waterborne diseases associated with inadequate WASH services among rural populations.
- To evaluate the effectiveness and implementation gaps in existing WASH-related policies and programs at the provincial and local levels.
- To propose evidence-based policy recommendations for improving WASH service delivery as a means of enhancing public health and achieving sustainable development in rural Punjab.

Theoretical Framework of the Study

The current empirical research work would be positioned into an interdisciplinary theoretical approach that informs itself about the public health theory, the social determinants of health and governance theory in the attempt to take an exhaustive look at WASH (Water, Sanitation, and Hygiene) in rural Punjab. The framework allows an in-depth appraisal of the relationship between access to WASH services and the result in the population's wellbeing because it combines these opinions. This multi-dimensional solution promotes the syndication of concerted and multidimensional policy interventions beyond physical infrastructure to the social, behavioral, and governance-related threats to sustainable WASH access.

Social Determinants of Health Framework

The study applied the Social Determinants of Health (SDH) Framework, as envisioned by the World Health Organization (WHO), to assess the extent to which broader social, economic, and environmental factors in rural Punjab determine health. The SDH models directly lay stress that health is not only influenced by individual choices or access to health services, but it is highly determined by the environment in which the individuals are born, grow, live, work, and age. In rural Punjab, sustained shortages of access to clean water, insufficient sanitation facilities, and a low level of hygiene awareness are not merely technical or behavioral issues; they are also embedded in an intricate web of structural inequalities. Social factors like poverty, low level of education, gender differences, and marginalization of the community in rural areas are also considered to be the primary social determinants, which add to the WASH-related vulnerability. These circumstances lead to excessive load of communicable but preventable diseases, undernutrition, poor maternal and childhood health, and low general well-being. Using the SDH framework, this paper provides a critical evaluation of the fact that WASH inequalities are not as widespread, but instead highly connected to socio-economic disparities, education levels, and gender relations of power. Such a lens can be used to make equity-based context-sensitive policy recommendations to reform the causes of health disparity and facilitate inclusive development by enhancing WASH services

Ecological Model of Health Behavior

The study examines the impact of the Ecological Model of Health Behavior on how a complex pattern of relationships at various levels of influence contributes to the formation of hygiene-related individual behavior, including handwashing with soap. However, the model assumes that individual behavior is not shaped in isolation but is, instead, embedded in a larger social and structural ecosystem that comprises five interrelated levels: individual, interpersonal, community, institutional, and policy levels. A model of hygiene behavior in rural Punjab suggests that an analysis of these barriers and facilitators to good WASH behavior can be conducted on multiple levels. Questrom, 2017, p. At an individual level, it is essential to consider the knowledge, beliefs, and attitudes toward hygiene. The interpersonal level emphasizes the family dynamics, peer pressure, and caregiving dynamics. Organizational, cultural practices, regional leadership, and traditional practices organically take center stage in influencing behavior. The presence and quality of health or education infrastructure are identified as institutional-level factors. In contrast, governmental strategies, resource allocation, and the application of regulations regarding health or education are considered policy-level factors. This study adopts the ecological model, which recognizes that improving hygiene culture in rural Punjab requires more than just carrying out awareness campaigns. It requires an integrated response that incorporates community leaders, empowers institutional capacities, and fosters a favorable policy environment. This systemic view is key to laying out sustainable, culturally sensitive and sustainable behaviour change interventions capable of minimizing WASH-related health risks

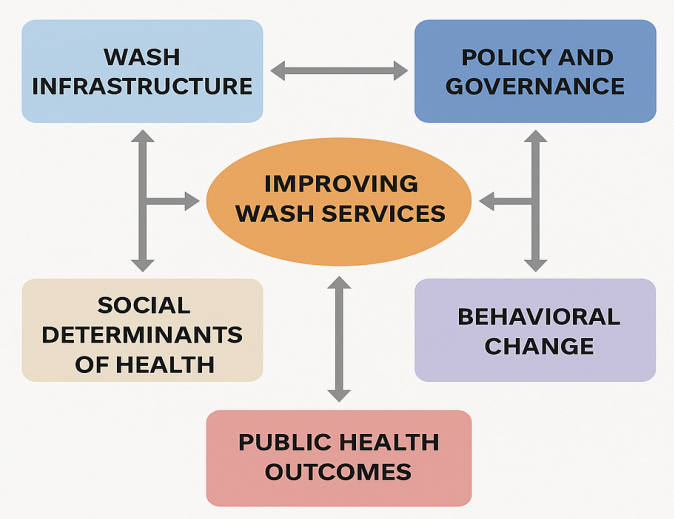
Governance and Policy Implementation Theory

The study also applied the theory of Governance and Policy Implementation to analyses the institutional and administrative aspects of WASH service delivery in rural Punjab critically. WASH services are entrenched in the systems of public policy, and they are characterized primarily by the success of service delivery systems and inter-agency collaboration as well as the ability of local actors. The governance theory also emphasizes accountability, transparency, decentralization, stakeholder's coordination, and community partnerships in effective execution of policies of public services. These factors have been identified to be pertinent especially in situations where failure of services has been attributed to fluctuated responsibilities, failed regulation, lack of citizen participation and inadequate resource commitment in the case of WASH. By implementing this theoretical lens, the study will be in a position to examine the policy-practice disparity where the lofty provincial WASH plans tend to be undermined during the local implementation phase due to bureaucratic delays, lack of skills or coordination amid the departments. It also gives a guideline to contrast the effectiveness of decentralization policies and responsiveness of the local governing structures and the functionality of the community-based monitoring in achieving the accountability. Through Governance and Policy Implementation Theory integration, the paper will point out that effective governance systems should support technical interventions. Making WASH improvements sustainable, equitable and developmentally effective requires strengthening of institutional arrangements, improving participatory mechanisms, and guaranteeing political and administrative commitment.

Conceptual Framework for the Study

The conceptual model of the given research will demonstrate the connections between the main issues influencing Water, Sanitation, and Hygiene (WASH) services in rural Punjab, Pakistan, and the ways they can affect the health of people and sustainable development. The framework not only takes into consideration many factors but also helps us in determining how the WASH interventions could help in health and socio-economic status in rural settings, among others, the issue of accessibility to clean water and reliability of water sources, availability of sanitation and hygiene in the rural areas, and the practice. Social determinants of the population, such as socio-economic condition of the population, gender roles, disparities, equity, and community participation and collective action in WASH activities, are also a focus of this framework.

Figure 1



Improvement of WASH services (safe water, sanitation, hygiene) in rural Punjab is the central point of this framework. The result of this enhancement is the enhanced health of the population (fewer waterborne diseases, fewer underweight and child deaths). The framework acknowledges that social and economic aspects, gender affairs, and community participation have a direct impact on the WASH infrastructure and health outcomes. Moreover, the structure of the policy and governance is instrumental in ensuring that interventions on WASH are effectively implemented and sustainable. Effective behavior change interventions, particularly in hygiene matters, play a crucial role in achieving good health outcomes and mitigating disease burden.

Materials and Methods

This study employs a mixed-methods approach, combining both quantitative and qualitative methods, to comprehensively assess the current status, challenges, and policy implications of Water, Sanitation, and Hygiene (WASH) services in rural Punjab, Pakistan. The design allows for a nuanced understanding of the relationship between WASH services and public health outcomes, particularly in under-resourced communities. The research will be conducted in **four rural districts** of Punjab province, chosen purposively to represent varying levels of WASH infrastructure and socioeconomic development: Bhakkar, Sargodha, Gujrat, and Jhelum.

A multistage stratified random sampling strategy was employed for quantitative data collection from the target areas. Household heads or primary caregivers were approached to gather primary information on water access, sanitation practices, hygiene behaviors, and child health indicators. A total of 400 households (100 per district) were approached for this study. For qualitative data, the Purposive sampling method was applied, and 8 Focus Group Discussions (FGDs), 2 per district (with adult community members), were conducted. Furthermore, 12 Key Informant Interviews (KIIs) were conducted with local government officials, professional health workers, and NGO representatives to gain insight and validate the available data.

For this study, a structured questionnaire was adopted to collect the primary information from households. The research instrument comprises different sections. The first section covers the demographic and socio-economic background of participants. Section two covers the existing drinking water sources, the quality of water, the availability and functionality of sanitation facilities, and hygiene conditions and practices in daily life. In the third section, researchers include an observational checklist that validates physical WASH infrastructure at the household level, such as latrines, hand-washing stations, water source proximity, and cleanliness, among others. The fourth section of the instrument covers the available health facilities, significant health risks, and the health outcomes from selected areas.

For qualitative information, the researcher chose Semi-structured guides for FDGs and KIIs that highlighted the perceptions of participants regarding WASH services, barriers to access, gender roles in

WASH-related decisions, and household and community-level policy awareness, community involvement, and other relevant aspects. The collected data were analyzed using advanced statistical software, specifically the Statistical Package for the Social Sciences (SPSS). Various descriptive statistics, bivariate analysis, and multivariate regression were applied to obtain the results. For qualitative data, thematic analysis was applied to identify recurrent patterns and key policy gaps.

Results and Major Findings

The demographic profile of the study participants reveals several key insights relevant to the planning and implementation of WASH (Water, Sanitation, and Hygiene) interventions in rural Punjab:

Table 1

Demographic Information of Study Participants (n = 400 Households)

Variable	Category	Frequency (n)	Percentage (%)
Gender of Respondent	Male	140	35.0%
	Female	260	65.0%
Age of Respondent	18–30 years	80	20.0%
	31–45 years	170	42.5%
	46–60 years	110	27.5%
	60+ years	40	10.0%
Education Level	No formal education	150	37.5%
	Primary (1st–5th)	100	25.0%
	Secondary (6th–12th)	100	25.0%
	Higher Education	50	12.5%
Household Size	1–4 members	120	30.0%
	5–7 members	200	50.0%
	8+ members	80	20.0%
Primary Source of Income	Agriculture	220	55.0%
	Daily wage labor	90	22.5%
	Government/private employment	60	15.0%
	Other (e.g., remittances)	30	7.5%
Caste/Social Category	Scheduled Caste (SC)	130	32.5%
	Scheduled Tribe (ST)	20	5.0%
	Other Backward Classes (OBC)	150	37.5%
	General	100	25.0%

Table 1 presents that a significant majority (65%) of respondents were female, which is notable because women are typically the primary managers of household water and sanitation needs. The largest age group among respondents was 31–45 years (42.5%), followed by those aged 46–60 years (27.5%). This reflects a predominantly adult, working-age population, which can be an asset for mobilizing community-led WASH initiatives. However, only 20% were younger adults (18–30), potentially indicating limited youth engagement in community planning processes. A substantial proportion of respondents (37.5%) had no formal education, and only 12.5% had higher education. Low education levels can hinder the effectiveness of health promotion campaigns, highlighting the need for culturally sensitive and locally tailored communication strategies in WASH programs.

Half of the households (50%) had between 5 and 7 members, with an additional 20% having eight or more. Larger households may place greater pressure on limited water and sanitation resources, increasing the risk of poor hygiene and disease transmission, particularly in underserved areas. Agriculture remains the dominant source of income (55%), followed by daily wage labor (22.5%). These livelihoods are typically vulnerable to seasonal variability and economic instability, which may limit households' ability to invest in private sanitation infrastructure or pay for improved water services. The sample includes a diverse representation of social groups, with Scheduled Castes (32.5%) and Other Backward Classes (37.5%) forming the majority. These historically marginalized communities often face systemic barriers to

accessing quality public services, including WASH. Equitable program design must consider these disparities.

Table 2

Association Matrix of Key study Variables

Variables	Gender	Age Group	Education	Caste	Income Source	Household Size	Access to Safe Water	Regular Hand washing
Gender	1.00	0.05	0.12	0.08	0.10	0.06	0.15	0.18
Age Group		1.00	0.25	0.09	0.14	0.20	0.10	0.13
Education Level			1.00	0.22	0.18	-0.05	0.35	0.42
Caste Category				1.00	0.16	0.12	-0.28	-0.21
Income Source					1.00	0.08	0.20	0.17
Household Size						1.00	-0.12	-0.10
Access to Safe Water							1.00	0.38
Regular Hand washing								1.00

Note: All values range from -1 to +1; stronger associations are closer to ±1. Empty cells reflect symmetry values above and below the diagonal are the same.

Table 2 presents the correlation matrix, illustrating the interrelationships between key demographic and WASH-related variables. These associations can inform targeted and efficient interventions, as the education level shows the most substantial positive impact and is moderately and positively associated (access to safe water (0.35), regular hand washing practices (0.42)). This suggests that as education increases, so does awareness and adoption of safe water and hygiene practices. It underscores the importance of integrating WASH awareness into formal and informal education efforts. Caste category has a negative correlation with access to safe water (-0.28) and hand washing (-0.21). Households from marginalized castes (e.g., SC/ST) are likely to face systemic exclusion from WASH infrastructure or services. Equity-focused policies must prioritize these groups for outreach and investment. Gender has a weak positive association with hand washing (0.18) and access to safe water (0.15), possibly reflecting that female respondents who typically manage household hygiene are more engaged in these practices. WASH campaigns could further empower women as key agents of behavior change in households.

Larger households show a slight negative correlation with access to safe water (-0.12) and Hand washing (-0.10). Larger families may strain household resources or lack sufficient sanitation infrastructure, requiring targeted support such as subsidized toilet construction or water supply enhancements. Income source is weakly to moderately associated with safe water access (0.20) and hand washing (0.17). Those employed in formal or stable sectors are more likely to afford and maintain proper WASH facilities, indicating a socioeconomic gap that must be addressed through subsidies or public provisioning. The age group is only weakly associated with WASH behaviors, but has a moderate link with education (r = 0.25). This could reflect generational shifts in educational access and awareness.

Table 3

Interdependence among Study Variables

Variable Category	Variable Name	Category / Unit	n (%) / Mean ± SD
Demographics	Gender	Male / Female	140 (35%) / 260 (65%)
	Age Group	18–30 / 31–45 / 46–60 / 60+	80 / 170 / 110 / 40
	Household Size	No. of Members	Mean = 5.8 ± 2.1
Education	Education Level	None/Primary/Secondary / Higher	150 / 100 / 100 / 50
Income	Primary Source of Income	Agriculture / Labor / Job / Other	220 / 90 / 60 / 30
Social Category	Caste	SC / ST / OBC / General	130 / 20 / 150 / 100
Water Access	Main Water Source	Tap/Bore well/Handpump/Surface	140 / 110 / 90 / 40 / 20
	Access to Safe Water	Score (0–5 scale)	Mean = 3.2 ± 1.4

Variable Category	Variable Name	Category / Unit	n (%) / Mean ± SD
Sanitation Access	Toilet Availability	Yes / No	290 (72.5%)/110(27.5%)
	Toilet Type	Flush / Pit / Other	200/80/10(among users)
	Sanitation Access Score	Score (0–10 scale)	Mean = 6.1 ± 2.2
Hygiene Behavior	Regular Handwashing	Yes / No	280 (70%) / 120 (30%)
	Handwashing Score	Score (0–10 scale)	Mean = 6.7 ± 1.9
WASH Education	WASH Campaign	Yes / No	220 (55%) / 180 (45%)
	Hygiene Training	Yes / No	90 (22.5%)/310 (77.5%)
Health Outcomes	Diarrhea in Last 2 Weeks	Yes / No	96 (24%) / 304 (76%)
	Waterborne Illnesses	Any (past month)	9.5%)

Table 3 indicates the interdependence of all study variables, with female respondents making up 65% of the sample, highlighting the central role of women in water and sanitation responsibilities. Their inclusion is critical in community engagement and hygiene promotion. Most respondents fall within the 31–60 years age range, a productive age group often responsible for managing household routines, including WASH activities. The average household includes nearly 6 members, suggesting that facilities like toilets and water sources are shared among many, which may affect hygiene maintenance and increase the risk of disease. A large share (37.5%) of participants had no formal education, and only 12.5% achieved higher education. This underscores the importance of low-literacy-friendly WASH communication strategies. Agriculture (55%) and daily wage labor (22.5%) dominate livelihoods, both of which are often associated with economic vulnerability, potentially limiting household ability to invest in private sanitation or water systems.

A significant portion of respondents come from scheduled castes (32.5%) and other backward classes (37.5%), groups that often face structural inequities in public service access, including water and sanitation. While tap water (35%) is the most common source, many still rely on bore wells, hand pumps, or surface water, which may be unsafe or unreliable. The Safe Water Access Score (Mean = 3.2/5) indicates that many households lack consistent access to safe, potable water, raising concerns about waterborne disease exposure. While 72.5% of households have toilets, 27.5% still practice open defecation or use unsafe alternatives, indicating partial success of sanitation programs. Among users, flush toilets dominate, but pit latrines are still used by many, often lacking proper containment. Sanitation Score (Mean = 6.1/10) suggests room for improvement in the quality and accessibility of sanitation facilities. 70% report regular hand washing, a promising behavior pattern. However, the mean hand washing score (6.7/10) shows variation in practice quality, possibly due to a lack of soap or water availability at critical times. Only 22.5% received hygiene training, despite 55% having heard of WASH campaigns. This gap indicates the need for active training programs, not just awareness campaigns. 24% of households reported at least one case of diarrhea in the past two weeks, an alarmingly high figure that reflects ongoing WASH deficiencies. Nearly 30% had at least one member fall sick from water-related diseases in the last month, highlighting the urgent public health implications of poor WASH services.

Table 4

Multiple Linear Regression Predictors of WASH Score (0–10) (n = 400)

Independent Variable	B (Un-standardized Coefficient)	SE	Beta (Standardized)	t	p-value
Constant	3.20	0.45	–	7.11	<0.001
Gender (1 = Female)	0.85	0.18	0.22	4.72	<0.001
Education Level (0–3)	0.67	0.10	0.35	6.70	<0.001
Caste (1 = SC/ST)	-0.52	0.20	-0.13	-2.60	0.010
Access to Safe Water (0–5)	0.45	0.09	0.29	5.00	<0.001
Household Size	-0.08	0.05	-0.07	-1.60	0.110
Received Hygiene Training	1.15	0.25	0.26	4.60	<0.001

To understand which variables significantly predict WASH scores (on a 0–10 scale) among rural households multiple linear regression analysis was carried out to highlights factors influencing WASH behavior among rural population. The education level ($\beta = 0.35$, $p < 0.001$) and each increase in education level (e.g., from none to primary, or primary to secondary) is associated with a significant improvement in handwashing practices. Suggested that better educated individual is more aware of hygiene practices, possibly due to exposure to health education and media. Similarly (Female = 1, $\beta = 0.22$, $p < 0.001$) women have significantly higher handwashing scores than men. This reflects gendered roles in household hygiene management and underlines the importance of engaging women in hygiene promotion campaigns.

Access to safe water ($\beta = 0.29$, $p < 0.001$) have strong positive association. Households with safer water sources are more likely to wash hands regularly, possibly because of better availability and trust in water quality. Hygiene training ($\beta = 0.26$, $p < 0.001$) that received had significantly higher handwashing scores, reinforced the effectiveness of behavior change communication (BCC) and community based WASH intervention. Furthermore, the caste group (SC/ST = 1, $\beta = -0.13$, $p = 0.01$) belonging to a marginalized caste (SC/ST) is linked to lower handwashing scores. Suggested that the systemic barriers such as discrimination, poor infrastructure, or exclusion from public health programs and also calls for equity driven WASH policy / planning.

Overall model performance as $R^2 = 0.47$ → the model explains 47% of the variance in handwashing behavior, which is strong for a social science model. F-statistic is significant ($p < 0.001$) → Confirms the model is valid and meaningful.

Discussions

Improving Water, Sanitation, and Hygiene (WASH) services in rural Punjab is not only a public health necessity but also a crucial developmental imperative. The findings of this study, based on data from 400 rural households, highlight the multifaceted nature of WASH challenges in Punjab, where behavioral, infrastructural, and socio-economic factors intersect to determine health and hygiene outcomes. Despite significant national efforts, a substantial proportion of rural households still lack consistent access to safe drinking water and hygienic sanitation facilities. The study reveals that while a considerable proportion of households reported having toilets, many still rely on basic or shared facilities, and over a quarter of the population continues to practice open defecation. Moreover, access to safe water remains uneven, with many households dependent on bore wells, hand pumps, or surface sources, which are often vulnerable to contamination.

The regression analysis yielded one significant result: education was positively and closely related to handwashing behavior. In this regard, education plays a central role in promoting good hygiene practices. The higher education level of the participants enables them to have a better understanding of disease transmission and the importance of personal hygiene, which directly impacts their health behavior in terms of regular hand washing. Gender, too, turned out to be a crucial factor, showing that women had better scores than men as far as handwashing was concerned.

This result highlights the primary role of women in domestic hygiene and childcare and also suggests a possible underrepresentation of men in hygiene-promoting activities. The policies should thus follow a gender-sensitive approach, where women can be used as ambassadors of hygiene, while also engaging men more in the WASH campaigns. Another key finding of the study is that access to safe water is a significant predictor of improved hygiene behavior. Good households that have a well-maintained water source incorporate frequent hand washing more often than households without an assured water source, implying that access to water is a key facilitator of good health behavior. However, infrastructure alone cannot solve the problem.

The improved handwashing behavior contributed to the effectiveness of hygiene training or community WASH interventions that utilized behavior change communication. The issue, however, is that the coverage of such training is limited, resulting in a missed opportunity to make significant strides in improvement. Social inequities also entangle the WASH landscape. Households of the Scheduled Castes and Scheduled Tribes have a low score of handwashing, showing that there is a continuing negative impact of

systemic impairment and alleviation that have reduced access to WASH services. This conclusion highlights the importance of equity-based solutions that target highly vulnerable and disadvantaged groups of people. In the absence of clear inclusion strategies, there is a risk that WASH interventions will exacerbate social inequalities.

Conclusion

The scenario of WASH service in rural Punjab portrays an ideal of advances as well as overlooked spaces that have a direct relationship to the health of the population and human development. Although a few households have experienced better infrastructure availability and increased sanitary awareness, a large proportion of rural populations still lack access to safe drinking water, hygienically sound sanitation, and regular hygiene education. This paper demonstrates how hygienic behavior and, consequently, health conditions are directly influenced by factors such as education, gender, access to water, and social inequalities. Regression analysis indicates that education and hygiene training are particularly essential in shaping human behaviour, as well as exposing the harmful nature of caste-related inconsistencies and poor water facilities. To advance, WASH services should be given priority not only as a health intervention strategy but also as a social justice and development approach. Policymakers need to adopt a multifaceted approach that involves the development of infrastructure, along with comprehensive behavior change initiatives and exceptional support for marginalized populations. Toilet accessibility and hygiene education should be prioritized in terms of equity and sustainability, while also considering water safety. Enhancing community participation, particularly among women and underprivileged communities, will play a pivotal role in creating lasting change. Finally, quality WASH services should be available to all people as a key element of meeting community health goals, decreasing health burden, and creating healthier and more sustainable rural Punjab.

Recommendations

- Integrate structured hygiene training into existing health and community platforms. Tailor programs to low-literacy audiences using visual, community-based approaches.
- Empower women as WASH ambassadors while also encouraging active participation from men. Gender-sensitive programming can enhance the effectiveness and long-term sustainability of hygiene interventions.
- Develop and implement WASH programs that explicitly address the needs of Scheduled Castes, Scheduled Tribes, and other socially disadvantaged groups through targeted outreach and inclusive service delivery.
- Treat WASH not as a standalone sector but as a core component of public health and disease prevention. Strengthen coordination between the health, education, and rural development departments.
- Develop community-led monitoring systems for water quality, toilet use, and hygiene practices. Encourage local governance bodies to play an active role in overseeing WASH improvements.
- Use mobile platforms, SMS alerts, and geospatial tools to disseminate hygiene information, track service gaps, and enable feedback from rural communities

References

Afzal, M., Zia, A., & Khalid, R. (2022). Behavior change for sustainable development: Evidence from WASH practices in rural Punjab, Pakistan. *Journal of Human Behavior in the Social Environment, 32*(6), 756–772. https://doi.org/10.1080/10911359.2022.2131023

Afzal, A., Jabeen, T., & Javed, M. (2023). Behavior change interventions regarding WASH and its impacts on sustainable community development: A study of district Gujrat, Pakistan. *Journal of Human Behavior in the Social Environment*, *33*(8), 1160-1177. https://doi.org/10.1080/10911359.2022.2131023

Afzal, A., & Jabeen, T. (2022) Water and sanitation, hygiene (wash) practices in intervened and non-intervened communities and its impacts on child health & sustainable community development: a study of district, Gujrat, Pakistan *Journal of Research & Reviews in Social Science of Pakistan, 5*(2), 1696-1718

Afzal, A., Javed, M., & Jabeen, T. (2022). Integrated behaviour change intervention for sustainable community development: a KAP study of WASH in district Gujrat, Pakistan. *Journal of Water, Sanitation and Hygiene for Development*, *12*(11), 838-850. https://doi.org/10.2166/washdev.2022.243.

Afzal, A., Jabeen, T., & Javeed, M. (2022). Knowledge, Attitude and Practice of Mothers Regarding WASH and Its Impact on Children Under-Five: A Study of District Gujrat, Pakistan. *Webology (ISSN: 1735-188X)*, *19*(3).

Afzal, A., Jabeen, T., & Din, N. S. (2024). Socio-Economic Challenges for Sustainable Community Development and WASH: A study from Gujrat, Pakistan. International Journal of Human and Society (IJHS), 3(03). https://ijhs.com.pk/index.php/IJHS/article/view/533

Asghar, M., & Yousaf, M. (2024). Spatial inequalities and household access to WASH services in Pakistan: Evidence from PSLM data. *Asian Journal of Humanities and Social Sciences, 12*(1), 54–70. https://ojs.ahss.org.pk/journal/article/view/707

Batool, A., Iqbal, A., Khan, M. A., & Ali, A. (2023). Association of water, sanitation, and hygiene (WASH) with stunting among under-five children in Southern Punjab, Pakistan. *BMC Public Health, 23*(1), 1–10. https://doi.org/10.1186/s12889-023-17135-z

Hureem, M. A., Mehmood, R., & Javed, A. (2020). Costing of WASH targets under SDG framework: A provincial analysis of Punjab, Pakistan. *Development Studies Research,* 7(1), 88–97. https://doi.org/10.1080/20430795.2019.1635427

Kiran, M., Basharat, R., & Nadeem, M. (2022). Assessment of WASH practices among school-going children in rural Gujrat, Punjab. *LGU Journal of Life Sciences,* 6(2), 45–52. https://lgujls.lgu.edu.pk/index.php/lgujls/article/view/216

Ullah, S., Afzal, A., Zeeshan, M., and Alvi, S, A.(2024)Access to Safe Drinking Water through Rural Water Supply Schemes: Evidence from District Muzaffargarh (Pakistan) *Journal of Asian Development Studies*, *13*(2), 216-266 https://doi.org/10.62345/

Ullah, S., Sunbal, M., Afzal, A., and Din, S, ud.(2023). Participatory Interventions and Development of Social Capital: Evidence from Punjab Rural Support Programme. Journal of Asian Development Studies, 12(3), 1618-1625. https://doi.org/10.62345/jads.2023.12.3.129

Yasmin, R., Afzal, A., Ullah, S., & Javed, M. (2024). Determinants of Community Participation in Sustainable Management of Rural Water Supply System: Evidence from District Lahore, Pakistan. Qlantic Journal of Social Sciences and Humanities, 5(2), 86-94. https://doi.org/10.55737/qjssh.379139395

Yasmin, R., Ullah, S., Afzal, A., & Javed, M. (2024). Impacts of Community Participation on Sustainability of Rural Water Supply Systems: A Study from District Lahore, Pakistan. Qlantic Journal of Social Sciences, 5(2), 85-97. https://doi.org/10.55737/qjss.679534402

Zeeshan, M., Afzal, A., Alvi, A. S., & Tubsem, S. (2023). Knowledge, Attitudes and Practice regarding WASH among Community Dwellers of District Sargodha, Punjab, Pakistan. *Pakistan Journal of Humanities and Social Sciences*, *11*(3), 2945-2954 https://doi.org/10.52131/pjhss.2023.1103.0584