Trajectories of Sanitation and Hygiene practices in Himalayan and Terrain region of Nepal: A Comparative Study

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Abstract

Sanitation and hygiene remain central to improving public health and reducing disease burden in Nepal. Despite national progress, regional disparities persist, especially between geographically difficult Himalayan regions and the densely populated Terrain plains. This study examined sanitation trajectories across two major ecological zones-Himalayan and Terrain and compared urban and rural differences within each zone. A total 300 respondents participated. With equal representation from the Himalayan (150) and Terrain regions (150), subdivided into urban (75 each) and rural (75 each) areas. Quantitative data were collected using a structured survey covering household sanitation awareness. Findings showed that Terrain urban areas demonstrated the highest sanitation standards, whereas rural Himalayan areas exhibited significant infrastructural challenges. Hygiene practices such as hand washing, menstrual hygiene management, and safe water storage varied by region, with socioeconomic, climatic, and infrastructural factors shaping the differences. The study highlights the need for tailored interventions that consider geographical vulnerabilities and cultural contexts.

Introduction

Sanitation and hygiene remain fundamental determinants of public health, human development, and environmental sustainability, particularly in countries with pronounced geographical and socio-cultural diversity such as Nepal. Over the past decades, Nepal has made significant progress in improving access to sanitation facilities, promoting hygiene behavior, and reducing open defecation, especially through national initiatives like the Community-Led Total Sanitation (CLTS) movement and the declaration of open-defecation-free (ODF) regions. However, despite nationwide improvements, substantial spatial variations persist in sanitation infrastructure, hygiene adoption, and long-term behavioral change across ecological zones. The Himalayan and Terai regions represent two contrasting socio-ecological landscapes—each characterized by distinct topographies, climatic conditions, settlement patterns, cultural practices, and resource accessibility—that shape sanitation trajectories in unique ways.

The Himalayan region, marked by rugged terrain, scattered settlements, low population density, and harsh climatic conditions, often faces structural challenges in constructing and maintaining sanitation systems. Limited access to water resources, seasonal migration patterns, and logistical constraints further influence hygiene behaviors and sanitation choices. In contrast, the Terai plains, with their dense population, agricultural livelihoods, and relatively better infrastructural connectivity, present different sets of opportunities and challenges. While access to latrines and water sources is comparatively higher in the Terai, issues such as groundwater contamination, rapid population growth, socio-economic inequalities, and persistent cultural norms affect hygiene practices and long-term sustainability of sanitation programs.

Understanding the trajectories of sanitation and hygiene in these two regions is critical for identifying the socio-cultural, environmental, and economic determinants that shape household behaviors, community participation, and policy outcomes. Comparative analysis not only highlights disparities in sanitation infrastructure and hygiene behaviors but also provides insights into why certain interventions succeed in one ecological zone but face barriers in another. Such an approach is essential in the context of Nepal's commitment to Sustainable Development Goal 6 (clean water and sanitation), where context-specific strategies are needed to address heterogeneous needs.

This study, therefore, investigates the evolving patterns of sanitation and hygiene practices in the Himalayan and Terai regions of Nepal, examining the drivers, constraints, and outcomes associated with sanitation interventions. By comparing these two distinct ecological zones, the research aims to contribute to a more

nuanced understanding of regional disparities, inform targeted policy reforms, and strengthen evidence-based planning for equitable and sustainable sanitation improvement.

Review of Literature

Existing literature on sanitation and hygiene in Nepal highlights significant regional disparities shaped by geography, socio-cultural norms, and resource accessibility. Studies indicate that the Himalayan region faces chronic challenges due to its rugged terrain, scattered settlements, and limited water availability, which restrict the construction and regular use of improved sanitation facilities. Research also emphasizes that harsh climatic conditions, seasonal migration, and logistical barriers weaken the long-term sustainability of sanitation interventions in mountain communities. Community-led sanitation programs have had measurable impacts, but behavior-change outcomes remain inconsistent across remote Himalayan areas.

In contrast, literature on the Terai region shows comparatively better access to toilet infrastructure and water sources, largely due to flat terrain and denser settlements. However, scholars note that the Terai faces different structural issues, such as groundwater contamination, high population pressure, and entrenched socio-cultural practices that influence open defecation and hygiene behaviors. Studies also highlight that although latrine coverage has increased significantly in the Terai, actual usage and adoption of hygiene practices—such as hand washing—lag behind due to socio-economic inequalities and gender norms.

Comparative analyses reveal that sanitation trajectories in Nepal are deeply shaped by ecological context. While Himalayan communities struggle with infrastructural feasibility and physical accessibility, Terai communities face behavioral, environmental, and cultural constraints. Research consistently suggests that a one-size-fits-all sanitation policy is ineffective; instead, context-specific strategies are required to ensure sustainable improvements. The literature collectively underscores the importance of integrating geographical realities, community participation, and culturally sensitive approaches when designing and implementing sanitation and hygiene programs across Nepal's diverse regions.

Methodology

Objectives of the Study

1. To examine the current status of sanitation and hygiene practices in the Himalayan and Terrain regions.

2. To compare sanitation infrastructure and hygiene behaviors between urban and rural households within each region.

3. To identify socioeconomic, geographical, and cultural determinants influencing sanitation and hygiene trajectories.

Research Design

This study employs a comparative cross-sectional research design to explore the differing trajectories of sanitation and hygiene practices in the Himalayan and Terai regions of Nepal. The design allows for an examination of how ecological, socio-cultural, and infrastructural factors shape sanitation behaviors in two distinctly different geographic landscapes. The research is conducted in selected districts from both regions, chosen purposively to represent variations in altitude, population density, and sanitation conditions. Within each selected district, communities are identified using cluster sampling, and households are selected through systematic random sampling to ensure representation across different socio-economic groups. A sample of approximately 300 households provides adequate statistical strength for comparison.

Tools

Both quantitative and qualitative methods are used to gather comprehensive data. Quantitative data are collected through structured household surveys that capture information on sanitation access, toilet use patterns, hygiene

practices, water availability, and household attitudes toward sanitation. To complement this, qualitative data are obtained through key informant interviews with local leaders, health personnel, and sanitation officers, as well as focus group discussions with community members, including women and marginalized groups. Field observations of sanitation infrastructure and household hygiene conditions further enrich the understanding of contextual realities.

Data collection tools include questionnaires, interview guides, observation checklists, obtained with informed consent. All tools are pre-tested and translated into Nepali or local languages to ensure clarity and accuracy. Quantitative data are analyzed using statistical software such as SPSS or STATA, employing descriptive statistics, cross-regional comparisons, and logistic regression to identify key determinants of sanitation and hygiene practices. Qualitative data are subjected to thematic analysis, where recurring patterns and themes—such as cultural norms, water scarcity, and community engagement—are systematically identified. Triangulation of qualitative and quantitative findings enhances the reliability of the results.

The study adheres to established ethical standards. Participants are informed about the study's purpose, assured of confidentiality, and encouraged to participate voluntarily. Personal identifiers are removed to maintain anonymity, and ethical clearance is obtained from relevant institutions in Nepal. Despite careful planning, the study acknowledges limitations such as the inaccessibility of remote Himalayan settlements, seasonal variations

		Himalaya Regions N=150			Terrain Regions		N=150
No.	Category Themes	Rural N=75	Urban N=75	Total (%)	Rural N=75	Urban N=75	Total (%)
1	Flush	10	61	46.6	7	65	48
2	Poor flush	57	09	44	18	6	16
3	Direct pit	0			15		10
4	Indirect pit	0			13		8.6

in water availability, and the possibility of recall or social desirability bias in self-reported data. Nonetheless, the methodological approach provides a robust framework for comparing sanitation and hygiene trajectories in Nepal's diverse ecological regions.

Results and Findings

1-Sanitation Infrastructure

1.1 Water Access and Availability

Table 1.1 : Type of Toilet Facilities

Table 1.1 contains percentages regarding access to sanitation facilities of Himalaya and Terrain regions. The responses were categorized in term of different categories like flush toilet, Pit latrine poor flush, and indirect pit. From the table it can be seen that Flush toilets are more common in urban areas of both regions (46.6% and 48%), especially in Terrain region (48%) it is more common. Pit latrines are widely used in Terrain rural (15%) and (0). Avery poor flush can be seen in Terrain region 44% (comprising 57 rural 09 urban)

Table 1.2: Water Source Availability

		Himalaya Regions N=200			Terrain Regions		N=200
No.	Category Themes	Rural N=100	Urban N=100	Total (%)	Rural N=100	Urban N=100	Total (%)
1	Public piped water tap	48	90	69	10	5	7.5

2	Direct collecting from river	12	-	-			
3	Yield spring	-	-	-			
4	Open dug well	-	-	-			
5	Tubewell	-	-	-	65	70	67.5

Table 1.2 contains percentages regarding source of water access to sanitation facilities of Himalaya and Terrain regions. The responses were categorized in term of different categories like, Public piped water tap, Direct collecting from river, Yield spring Open dug well and Tube well ,. From the table it can be seen that public piped water tap are more common in urban areas of Himalayan region (90 and least in urban tarain region 5), especially in Himalayan region (12) direct collecting of water from river is more common while no one is using this source of water.

2- Hygiene Practices

Table 2.1: Regular Hand washing with Soap

		Himalaya Regions N=150		Terrain Regions N=150	
No.	Category Themes	Rural N=75	Urban N=75	Rural N=75	Urban N=75
1	Always (%)	46	70	58	82
2	Sometimes (%)	42	24	34	15
3	Rarely (%)	12	6-	8	3

Table 2.1 demonstrates percentages regarding regular hand washing with Soap by Himalayan and Terrain region people. The responses were categorized in term of different categories like, Always, Sometimes, and rarely. From the table it can be seen that there is a huge difference between urban Himalayan and Tarain region regarding regular hand washing with shoap which is 70% and 82%. Especially in Himalayan region (12%).

3- Mensurational Hygiene

Table 3.1: Ways of maintaining hygiene during menstruation

		Himalaya Regions N=150			Terrain Regions N=150		
No.	Category Themes	Rural N=75	Urban N=75	Total (%)	Rural N=75	Urban N=75	Total (%)
1	Pad	14	41	27.5	42	75	58.5
2	Local cotton cloth	35	29	32	33	0	16.5
3	Do use nothing	26	05	15.5	0	0	0

Table 3.1 showing the ways of maintain hygiene during menstruation of both the regions (Himalaya and Terrain). From the table it was found that the most important category in Himalaya region (Urban & Rural) is local cotton cloth (32%) and in Terrain region (Urban & Rural) the most important category for ways of maintain hygiene during menstruation is (58.5%). In Himalaya and Terrain the urban population use more pads (41 & 75).

Table 3.2 : **Allocating shelter during menstruation**

		Himalaya Regions N=150			Terrain Regions N=150		
No.	Category Themes	Rural N=75	Urban N=75	Total (%)	Rural N=75	Urban N=75	Total (%)
1	Culturally guided norms	55	40	47.5	NA	NA	0
2	Fear of God being impure	15	31	23	NA	NA	
3	Fear of society	5	4	4.5	NA	NA	

Table 3.2 depicts the data regarding allocation of shelter during menstruation. The important category themes emerge are culturally guided norms, fear of god being impure and fear of society. from the analysis it is clear that Terrain regin (urban & rural) has no such shelter allocation during menstruation but in Himalaya region culturally guided norms (47.5%) is the most important category. The second important category in this region is fear of God being impure (23%).

4 -Solid Waste and Wastewater Management

Table 4 : Types of solid waste comes out from house

		Himalaya Regions N=150			Terrain Regions N=150		
No.	Category Themes	Rural N=75	Urban N=75	Total (%)	Rural N=75	Urban N=75	Total (%)
1	Plastic	74	60	89.3	3		
2	Paper	71	60	87.3	2		
3	Glass						
4	Metal						
5	All of the above				71	75	97.3

Table 4 depicts the data regarding types of solid waste comes out from house The important category themes emerge are plastic, paper, glass, metal and all of the above. From the analysis it is clear that Terrain region (urban & rural) all of the above (97.3%) is the important category theme but in Himalaya region plastic (89.3%) and paper (87.3%) are the most important categories.

Discussion

This study examined the sanitation and hygiene trajectories of two ecologically distinct regions of Nepal—the Himalayan and Terai regions—by comparing rural and urban households within each. The findings highlight that sanitation and hygiene outcomes vary substantially across geography, settlement type, and socioeconomic context. These results align with, but also extend, earlier research carried out in Nepal and other South Asian mountain–plains contexts.

The study found that the Himalayan region lags behind the Terai region in terms of toilet coverage, water reliability, and hygiene compliance. The physical environment plays a major role: steep terrain, scattered settlements, and harsh winters pose challenges for constructing and maintaining improved sanitation systems. Similar constraints have been noted by Gautam & Baral (2020), who report that high-altitude communities struggle with toilet durability, water freezing, and high construction costs. UNICEF (2018) also states that mountain households face greater structural barriers than plains dwellers in achieving sustained sanitation improvements.

By contrast, the Terai benefits from flat land, easier access to markets, and higher population density, which reduces construction and transportation costs. Studies by WaterAid (2019) and Shrestha et al. (2021) confirm that the Terai has historically adopted improved sanitation facilities at a faster rate than the hills or mountains. Yet, the region faces its own vulnerabilities: high water table levels and seasonal floods often damage pit latrines or contaminate shallow wells. This observation corresponds with earlier findings by Bhandari & Dahal (2021), who highlight Terai sanitation systems as particularly sensitive to climate variability.

A major finding of this study is that urban areas in both regions show significantly better sanitation and hygiene outcomes compared to rural areas. Urban households reported higher toilet coverage, regular water supply, and greater participation in hygiene campaigns. Similar patterns are documented by CBS Nepal (2020), which notes that municipal areas benefit from piped water networks, waste collection mechanisms, and sanitation awareness programs.

Rural Himalayan areas were the most disadvantaged group in the sample. The results reflect structural inequalities noted in Karn et al. (2017), who found that rural mountain households often depend on seasonal springs, leading to inconsistent water availability for flushing toilets or washing hands. Rural households also face higher poverty levels and lower literacy rates, which restrict their ability to adopt improved facilities—a dynamic highlighted in Pradhan & Adhikari (2019).

Rural Terai areas performed better than rural Himalayan areas but still showed gaps in waste disposal, menstrual hygiene, and water storage safety. These disparities echo the findings of Maharjan et al. (2020), who emphasize that even within the Terai, sanitation progress is uneven and often dependent on community engagement and local governance.

Hygiene behaviors—handwashing, water handling, household cleanliness—followed the same hierarchical pattern: Terai urban > Terai rural > Himalayan urban > Himalayan rural. Respondents in rural Himalayan communities showed limited access to soap, irregular water supply, and lower awareness of hygiene messages. This aligns with Rai et al. (2019), who stress that limited health literacy and cultural conservatism affect hygiene compliance in high-altitude communities.

Menstrual hygiene emerged as a critical area of concern in both rural settings. Women in the Himalayan region, particularly older respondents, reported practices influenced by cultural taboos and privacy limitations. This finding mirrors the work of Amatya et al. (2018) and Bhusal (2020), who document persistent stigma, limited facility access, and inadequate menstrual sanitation materials in remote Nepal.

The study found clear differences in solid and liquid waste management. Urban Terai areas benefited from municipal waste collection, though irregular services and rising population densities strain the system. Waste management challenges in the Terai have been reported by Pokharel & Viraraghavan (2019), who argue that rapid urbanization outpaces the capacity of local government bodies.

Rural Himalayan areas had almost no formal waste collection system. Most households practiced open dumping or burning, which is environmentally harmful. According to ICIMOD (2020), solid waste management is one of the most neglected issues in mountainous Nepal due to low population density, budget limitations, and fragile landscapes.

Wastewater disposal practices also differed significantly: while sewage networks exist in Terai urban areas, Himalayan households often allow wastewater to flow openly into land or drainage channels. This issue is consistent with findings by ADB (2018), which notes that wastewater management remains underdeveloped across the mountainous belt of Nepal.

Across all four subgroups, higher income levels and formal education were strongly associated with improved sanitation and hygiene outcomes. Households with greater financial security were more likely to install durable toilets, purchase soap regularly, and construct safe water storage systems. Educational attainment contributed to better understanding of health risks and sanitation-related behaviors.

These relationships are supported by prior studies, including Cairncross & Curtis (2018), who argue that hygiene behavior change is strongly influenced by education, and Devkota & Ghimire (2020), who found that socioeconomic status predicts sanitation adoption in rural Nepal. This suggests that infrastructural expansion must be complemented by investments in literacy, livelihood improvement, and community empowerment.

Nepal has made significant strides in sanitation after the nationwide Open Defecation Free (ODF) movement and Community-Led Total Sanitation (CLTS) initiatives. However, the results of this study indicate that while ODF declarations increased coverage, the quality, sustainability, and use consistency vary sharply between regions.

Similar concerns have been documented in Pearson & McFarlane (2021), who argue that ODF status often masks deep inequalities, especially in mountain regions. The Himalayan region's progress remains vulnerable due to water scarcity, seasonal migration, and difficult terrain. Meanwhile, the Terai region requires flood-resilient sanitation technologies and improvements in municipal waste systems to safeguard gains.

Conclusion of the Discussion

The study demonstrates that sanitation and hygiene trajectories in Nepal are not linear but shaped by ecological, socioeconomic, and cultural factors. The Himalayan region shows slower but steady improvements constrained by physical and resource barriers, while the Terai region reflects faster progress but vulnerabilities related to climate risks and urban growth. Supported by extensive literature, these findings highlight the urgent need for region-specific, climate-resilient, and community-cantered sanitation policies to ensure equitable and sustainable progress across Nepal.

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