International Journal of Ecology and Environmental Sciences 52: e0927, 2026
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2026.0927

An Empirical Analysis on Social Stratification in the Context of Water Scarcity in Ukhrul District, Manipur

LONGREIWON NAKHEDEI* AND MAITREYEE ROY

Department of Environmental Management and Science, William Carey University, Shillong, 793 019, Meghalaya, India

E-mail: lonnakhedei19@gmail.com, maitreyeeroy36@gmail.com

***Corresponding author**

ABSTRACT

The present study aims to conduct an empirical investigation into the intersection of social stratification and water scarcity in Ukhrul district, Manipur, a hill region in Northeast India that faces acute seasonal water shortages. Ukhrul has experienced increasing water stress due to environmental degradation, deforestation, and inadequate infrastructure. The study employed a mixed-methods approach, combining qualitative and quantitative data collection techniques, including focus groups, semi-structured interviews, household surveys, and field observations, to examine how socio-economic hierarchies shape differential access to water resources and influence coping mechanisms among households. The findings reveal significant disparities: wealthier households mitigate scarcity by purchasing tanker water or having a private water connection. At the same time, economically marginalised groups remain dependent on dwindling communal sources and face greater health and financial burdens. These inequalities are further reinforced by limited access to the pipeline, affordability issues, infrastructural gaps, and uneven local governance. It highlights the role of both individual and collective memories, as well as experiences of past extreme events, in shaping current definitions and expectations of future climatic risks. This emphasises the importance of understanding local perceptions of water scarcity and how variations in these perceptions among families contribute to the development of social vulnerability. The study highlights the connection between social hierarchy and environmental vulnerability, emphasising the need for equitable distribution methods and inclusive water governance. This study provides valuable insights for policy interventions aimed at enhancing water security in the hill districts of Ukhrul, situating water shortages within the broader context of socioeconomic inequality.

Key words: Social stratification, Ukhrul, Manipur, Vulnerability, Socio-economic

INTRODUCTION

The accessibility of clean water sources is one of the fundamental concerns associated with the human population (Gleick 1996). Water shortages have become increasingly prevalent in recent decades, and they are one of the major issues facing many nations worldwide. Rapidly growing issues with water availability and quality have worsened in developing countries, impacting not only the supply of drinking water but also sanitation, food security, the economy, and transportation (Paavola 2004). Water issues are not solely connected to availability or quality; they also involve water management, which is shaped by social conditions, including economic, cultural, and symbolic influences on water management practices, policies, and the distribution of power (De Luque-Villa and González-Méndez 2024).

Access to clean water is also influenced by societal variables, such as socioeconomic standing or basic hygiene awareness (Biswas et al. 2024). Access to water supply sources will be impacted by social variables that assess people's capacity to use safe water as well (Fernanda et al. 2013). Given the growing demands of urbanisation, agricultural intensification, overexploitation of water resources, population pressures, and climate variability and change, water scarcity remains a critical limiting factor that increases the population's vulnerability (Singh et al. 2018).

Due to cultural norms that support the exercise of social and local power, lower-income families may not have access to safe water sources, or higher-income households may be reluctant to share safe water sources with lower-income households. Therefore, several factors, including water management, culture, and political and economic circumstances, can all contribute to water scarcity (Mallick and Fernanda Roldan-Rojas 2015). In the world, managing water scarcity has become increasingly complex, particularly for rural livelihoods that rely on rain-fed agriculture (Mekonnen and Hoekstra 2016).

The three primary dimensions of water scarcity are physical availability, infrastructure, and accessibility (Mallick and Fernanda Roldan-Rojas 2015). These factors emphasise that water shortage pertains not only to the volume of water available but also to its management and distribution. Various factors, including climate, rainfall patterns, and evaporation rates influence the physical availability of water. The infrastructural dimension addresses the efficiency and accessibility of water storage, distribution, and access infrastructure. Accessibility focuses on people's and communities' ability to access a fair and consistent supply of water to meet their needs. Social, economic, and political systems are some of the variables that can influence this.

Since water scarcity affects all spheres of society and the economy, jeopardising the sustainability of the natural resource base, it has received increased attention recently. As a result, maintaining freshwater resources sustainably is essential to meeting the growing demand and ensuring a safe and sustainable water supply for future generations (Ahmadov 2020). To address the issue of water scarcity effectively, an integrated, multidisciplinary approach to managing water resources is crucial. This approach involves the coordination, development, and management of water resources in a way that enhances economic and social welfare while ensuring the sustainability of the essential ecosystem.

Water scarcity in Ukhrul district

In the northeastern state of Manipur, the Ukhrul district features steep topography, forested catchments, and numerous natural springs that have long been relied upon by the Tangkhul Naga people. Ukhrul district is endowed with a good number of perennial and semi-perennial natural springs. Similar to most Indian cities, the district experiences acute drinking water shortages for extended periods, particularly from December to May, when supplies dwindle. As land-use patterns change, forest cover diminishes; several springs that were once perennial have turned seasonal or have disappeared entirely.

Due to the growing population and increasing urbanisation in the hill town of Ukhrul district, there has been a rapid increase in developmental activities expanding from the four corners of Ukhrul town, encroaching on forest areas and affecting the ecosystem. The main water source of Ukhrul town is obtained from the Shirui Hills, Khokthi Kong, and Singuira Kong, located approximately 20 km from Ukhrul town.

The scarcity of water in Ukhrul town and its surrounding villages can be attributed to either a supply-driven shortage of water resources, especially during December to May, or a demand-driven issue, which may be due to the overuse of water and an increasing population. The causes of water scarcity are a multifaceted concept and extend to reasons such as rising population, inadequate infrastructure, income poverty, limited access to water resources, inefficient use, and environmental degradation. Simultaneously, social behaviour is influenced by the lack of water scarcity. According to the Ukhrul ground report, especially women and girls tend to walk at least two to three kms every day to get a bucket of water.

The periodic drying of water bodies has a negative impact on the water security of rural households. Ukhrul's social fabric, characterised by diverse economic positions, types of employment (including subsistence farming, labour, and small businesses), and varying levels of social capital, presents an ideal context for examining how social stratification influences the differential impacts of water availability. Water management is a complex issue in Ukhrul, as it considers societal factors in addition to the examination of water supply and scarcity. There is, however, a dearth of empirical data regarding the local management of water demand and the community's responsibilities in ensuring clean water for all residents. This study aims to provide more empirical support for Ukhrul by identifying the social clusters that affect or even govern drinking water management at the local community level.

RESEARCH METHODOLOGY

Site selection and sampling

Ukhrul district is located in the northeastern part of Manipur. The district covers an area of 4,544 km^2, which is approximately 26% of the state of Manipur, India. It has an area of 4,157 km² under forest, located at latitude 94.37° E and longitude 25.12° N. It has an average elevation of 1,662 m amsl (5,453ft). Ukhrul district is generally hilly, with varying heights of 913 to 3114 m amsl. The district headquarters of Ukhrul district, i.e., Ukhrul town, is about 84 km from Imphal, Manipur, via NH-150.

Ukhrul district experiences a wet summer and a cold, dry winter. Ukhrul is the second rainiest district in Manipur, after Tamenglong. The average annual rainfall is 1,763.7 mm, and the temperature ranges from a minimum of 3°C to a maximum of 28°C. The coldest months of the year in the district are December and January. The climate of the Ukhrul district is a sub-tropical monsoon type of climate (Anonymous 2011).

The present research was conducted in Ukhrul town, the headquarters of Ukhrul district, situated in the northeastern region of the state of Manipur, and inhabited by the Tangkhul tribe. The literacy rate in the district is 81.35% of which 85.52% are males and 76.95% are females. Agriculture is the main sector contributing to the economy of the district. The per capita income is Rs. 20.743 as per the Manipur District Factbook: Ukhrul District (2019). The total population of Ukhrul town was 27,187 according to the 2011 census, and the projected population for 2024 was 34,964.

Sample size and survey

A total of 600 household interviews were conducted in Ukhrul town. The survey was conducted from 2022 to 2024 through focus group discussions (FGDs), semi-structured questionnaires, in-depth case studies, key informant interviews (KIIs), observations, and document reviews. The study employed purposeful sampling, a non-probability sampling method, for selecting the study area, and respondents were selected using simple random sampling. The key informants include the local community leaders and the respondents.

It is challenging to understand and accurately capture people's perceptions, as this involves documenting often elusive opinions, distinguishing between apparent cause and effect, and adopting the role of an objective yet perceptive listener (Simelton et al. 2013, Singh et al. 2018). We employ a constructivist approach, which holds that social context, location, behaviour, and social actors' perceptions each impact how reality is produced (Singh et al. 2018).

Quantitative data were analysed in SPSS version 27. Data were coded iteratively using relevant themes following an inductive approach and then analysed along socio-economic and demographic variables. The data was coded by one researcher, thus ensuring stability (similar use of a code across the dataset) and accuracy. Narratives from the case studies, such as anomalies in climatic conditions, were also analysed to uncover the dynamics around the perception of the people.

A semi-structured questionnaire was specifically developed to collect socio-demographic data, livelihood information, and questions about quality, quantity, and access to water, as well as perceptions of social impacts due to the drinking water crisis and responses to water scarcity. Questions about alternative drinking water sources in the study area were also included. To analyse a possible socio-demographic classification, the following information was collected: gender, age, household size, education level, occupation, monthly income, and expenditure.

The analysis plan was structured in three segments: First segment covers the analysis of the general profile of respondents; second segment focuses on the classification of the respondents according to their socio-demographic characteristics, and the third segment analyses the socio-demographic classifications and their influence on water management, on the water consumption related behaviour and on perception of social impacts.

RESULTS AND DISCUSSION

Demographic attributes of respondents and water demand

The analysis of the respondent profile indicates that the survey comprised 61.8% female participants and 38.2% male participants (Table 1). The primary reason for this was that many households were surveyed during working hours, during which male members, who were predominantly the primary income earners, were absent due to employment obligations. The socio-demographic variables (i.e., gender, age, household size, monthly income and

Table 1. Gender and age group of the respondents (n=600)

Variable	**Frequency percentage**	**(%)**
Gender		
Male	229	8.2
Female	371	61.8
Total	**600**	**100**
Age group		
<20	3	0 .3
21-30	51	8.5
31-40	110	18.2
41-50	194	32.3
51-60	200	33.3
61-70	29	4.8
>71	13	2.2
Total	**600**	**100**

expenditure, education level, and occupation) were correlated to determine which variables showed associations among them using the Spearman correlation.

Income and family size were important factors influencing household expenditure and water use. There was a statistically positive correlation between monthly income and expenditure *þ*(600) = 0.456, $p < 0.000$, suggesting that as income increases, households tend to spend more, possibly reflecting improved purchasing power and a higher standard of living. Similar trend was seen between family size and expenditure (*þ* = 0.472, $p < 0.001$) suggesting that larger families tend to spend more for purchasing water.

The strong positive correlation between family size and water consumption (*þ* = 0.766, $p < 0.001$) highlights the substantial effect of household size on water use. This finding aligns with expectations that larger families consume more water for domestic purposes, including cooking, cleaning, and personal hygiene. From a policy perspective, these results underscore the importance of considering family size and income levels in planning for sustainable water management and household welfare programs.

Availability of water sources

Several water sources and the distribution systems were identified. This suggests that the use of a water source depends on its availability, and households often utilise more than one type of water source. Out of which ponds are considered the main water source for the people in the research areas. Pond water (75%) and shared community tap (39.3%) are the most important sources of water and distribution systems for the residents (Table 2). Only 24.5% of households have pipeline connectivity, while 32% are dependent on private water vendors. The frequency and duration of the water supply remain unclear, leading the majority of households to rely on pond water, which is either owned by the community or by individual households. The study areas demonstrated a lack of proper and reliable infrastructure, including pipelines and tanks. As a result, there is a greater dependency on pond water.

Water resource distribution and economic stratification

An independent-samples Mann-Whitney U test was conducted to investigate the differences in monthly income between households with and without water tanks. It indicated a statistically significant difference in monthly income between households with water

Table 2. Water sources and the distribution system

Sources of water for household	**Responses**		**Percent of cases**
	(n)	**%**	
Household piped water connection	147	13.5	24.5%
Shared water community tap	236	21.7	39.3%
Pond water	450	41.4	75.0%
Natural spring water	60	5.5	10.0%
Water vendors	194	17.8	32.3%
Total	**1087**	**100**	**181.2%**

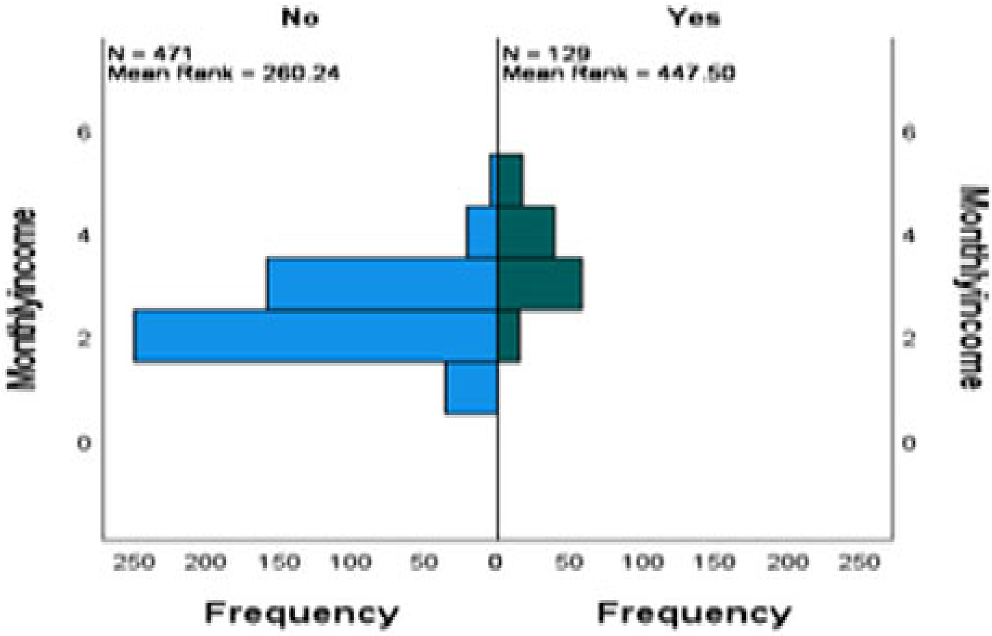

Figure 1: Independent-Samples Mann-Whitney U test

tanks and those without (Mann-Whitney U = 49343, $p < 0.001$). Households with water tanks (N = 129) had significantly higher monthly incomes, as indicated by their higher mean rank (447.50) compared to households without water tanks (N = 471, mean rank = 260.24). This suggests that households with higher monthly income levels tend to invest prefer having water tanks (Fig. 1).

Wealthier households address water scarcity by investing in expensive bore wells (H"/ ¹ 5-6 lakh) obtaining private water vendors, or buying tanker supplied water (H"¹ 350-400 per 500 L), While lower-income households lack the resources and rely on unreliable public pipelines, seasonal springs, or distant ponds for everyday household and drinking purposes, they compromise household chores and miss out on important activities. Considering that women and girls are often responsible for collecting household water in many parts of the world, water scarcity has significant gendered consequences (De Guzman et al. 2023). These obligations become more intense during times of water shortages, forcing women to trek longer and invest more time obtaining water for domestic use (Cole et al. 2024). This additional burden limits options for social interaction, economic participation, and education, while also increasing physical strain and exposing individuals to health concerns (Anthonj et al. 2024, Tomberge et al. 2021).

Water scarcity and environmental drivers

Research indicates that deforestation, forest fires, and the conversion of hilltop terrain for agriculture are closely linked to the depletion of springs, a crucial source of drinking water that reduces aquifer recharge capacity. The information gathered indicates that the water cycle is significantly influenced by fluctuating climate conditions. Climate change leads to an increase in temperature and altered rainfall patterns, which in turn impact the water cycle.

Water resources, ecosystems, agriculture, and human lives are all being impacted by changes in precipitation patterns and seasonal fluctuations. There has been evidence of deforestation, particularly for home fuel and lumber production, which has had a significant impact on the local climate. Environmental evidence is that twenty to thirty years ago, there was frequent occurrence of snowfall in January, which is the seasonal rain, or "winter rain" known as *"maharrem"*. However, snowfall has not occurred in the last fifteen to twenty years, and its recent occurrence has become increasingly unpredictable. The study predicts that the area's climate has been affected by the commercial deforestation of the local people. Higher temperatures and irregular rainfall patterns are impacting water resources, leading to low aquifer recharge.

Additionally, the environment of the town has also been impacted by the expansion of developmental activities, such as a growing population and increasing urbanisation, which have stretched from all corners of Ukhrul town and expanded into the forest area. These activities have disrupted the subsurface water capillaries, resulting in reduced water discharge in the natural springs. Ukhrul town tends to become denser in population as it expands, and this increases the demand for water resources. Given that the population is growing annually, a disparity exists between the supply and demand for water, as well as increased pressure on existing water resources. As the population grows, the water sources either remain constant or become depleted. Ukhrul district experienced a brief dry season from February to April. Currently, the dry season extends from November to May, which is a notable indication of climate change.

Clearing the forest for shifting cultivation has been a long-standing practice among the people as a means of livelihood. Deforestation for various economic purposes is having an increasingly noticeable direct impact on the hydrological cycle. These results were consistent with the opinions expressed in the villagers' focus group discussion and interviews.

Seasonal differences in water availability

Ukhrul district has a bimodal rainfall pattern, occurring from June to September (the monsoon season) and from October to May (the dry season, when rainfall is less). The rainfall during the monsoon was comparatively higher than in other seasons, such as autumn, winter, and spring (October to May) in the region. In line with this result, Habte et al. (2023) reported that there are seasonal rainfall patterns and variability, with peak rainfall occurring in May-June and a short rainfall cycle from September to October. The existence of two distinct rainfall seasons is widely believed to be caused by the Inter-Tropical Convergence Zone and associated atmospheric circulations (Dunning et al. 2016, Mera 2018). Households may change their water sources due to seasonal fluctuations in rainfall and water availability, as well as maintenance and governance issues (Bisung et al. 2015, Dos Santos et al. 2017). Water availability may fluctuate with the changing seasons and the year (Nguyen et al. 2021). From the field survey conducted in the research areas, it is evident that people rely heavily on ponds and spring water. The availability of water in different sources varies with the seasons. Based on the respondents' opinions, field study, and FGD analysis, the residents in the research areas practice direct collection of rainwater in barrels, tanks, and jerrycans, which they use for cleaning, washing, and various household activities.

Furthermore, during the dry season, an acute scarcity of water was noted, with notable signs of dried-up water sources, and no rainwater was available for household activities. It was reported that mostly women get up before sunrise and participate in collecting water from sources to obtain clean water, especially for drinking and cooking purposes. The availability of water in various water sources varies and is influenced by seasonal changes (Chakma et al. 2021).

Prioritising water for cooking and drinking purposes

As anticipated, water intended for cooking and drinking was prioritised and preserved first, a practice common across all households. The water sourced from the pipeline was regarded as superior and reserved exclusively for cooking and drinking purposes. In contrast, the water collected from ponds was allocated for cleaning and other uses. These views are shared by Nounkeu and Dharod (2020) when required to choose, water for drinking and cooking was saved first.

According to field observations, there were instances of water sources drying up in the study areas. The sources are being threatened as a result of anthropogenic activities, such as the clearing of forests, land encroachment, changes in land use patterns, and pollution. The study identified that the water sources used for drinking were basically different from the sources used to gather water for various uses and activities.

Water governance and institutional gaps

Local water governance is one of the most crucial aspects of managing water resources and services.

A comprehensive and integrated approach to managing water resources requires effective water governance, which provides an administrative, financial, and legal framework (Frimpong et al. 2021). According to interviews conducted with PHED officials, several difficulties encountered by PHED were reported. Water infrastructure has long been neglected in the Ukhrul district. Comprehensive water projects are still insufficient for government budgets, and the PHED workforce is inadequate, as only two linemen maintain approximately thirty kilometres of pipelines from Shirui village to Ukhrul town headquarters, which undermines the equitable supply of water during the lean season, i.e., October to May. In addition to that, the traditional societies settled in the hilly regions, and these topographical features are one reason the department finds it challenging to utilise the lost natural momentum and distribute water evenly in Ukhrul town. Without adequate development or availability of additional water sources, it is beyond the department's capabilities. Furthermore, water bodies are drying up due to resource exploitation without restoration or control, and springs have become parched, as have aquifers. This continual deforestation has resulted in a decline in the water capacity of the area; as a result, the water seeping underground, which comes as spring water, is reduced. Engineers and officials are conducting field research to identify key water resources, ensure the current water supply is sufficient, and guarantee that residents receive adequate water.

CONCLUSIONS

Empirical investigations into the social stratification of water reveal that access to and control over water resources are deeply embedded within broader structures of social inequality. Evidence from diverse sociological, anthropological, and environmental studies underscores that disparities in water access are not merely technical or environmental issues but are products of entrenched social hierarchies shaped by class, gender, ethnicity, and spatial location. In rural contexts, empirical data consistently show that affluent and politically empowered groups tend to enjoy greater access to safe, affordable, and reliable water services. At the same time, marginalised populations are disproportionately exposed to scarcity, contamination, and infrastructural neglect. Addressing these inequities requires policy frameworks that recognise water as a common good and a fundamental human right, ensuring equitable access for all social groups.

ACKNOWLEDGEMENTS

The authors would like to thank the respondents for their useful information and suggestions. The authors also thank the Executive Engineer, Assistant Engineer and the staffs of the Water Supply, PHED Ukhrul, Government of Manipur for their valuable information and support.

Authors' contributions: Longreiwon Nakhedei**:** Conceptualization, methodology, investigation, analysis, writing-original draft, Maitreyee Roy: Supervision, review and editing.

Conflict of interest: Authors declare no conflict of interest.

REFERENCES

Ahmadov, E. 2020. Water resources management to achieve sustainable development in Azerbaijan. Sustainable Futures, 2, 100030. https://doi.org/10.1016/j.sftr.2020.100030

Anonymous. 2011. District Census Handbook-Imphal West. Directorate of Census Operations Manipur. http://www.censusindia.gov.in

Anonymous. 2013. Ground Water Information Booklet of Ukhrul District, Manipur. Central Ground Water Board, Ministry of Water Resources, New Delhi.

Anthonj, C., Mingoti Poague, K.I.H., Fleming, L. and Stanglow, S. 2024. Invisible struggles: WASH insecurity and implications of extreme weather among urban homeless in high-income countries - A systematic scoping review. International Journal of Hygiene and Environmental Health, 255, 114285. https://doi.org/10.1016/j.ijheh.2023.114285

Biswas, S., Adhikary, M., Alam, A., Islam, N. and Roy, R. 2024. Disparities in access to water, sanitation, and hygiene (WASH) services and the status of SDG-6 implementation across districts and states in India. Heliyon, 10, e37646. https://doi.org/10.1016/j.heliyon.2024.e37646

Cole, S., Tallman, P., Salmon-Mulanovich, G. and Rusyidi, B. 2024. Water insecurity is associated with gender-based violence: A mixed-methods study in Indonesia. Social Science and Medicine, 344, 116507. https://doi.org/10.1016/j.socscimed.2023.116507

De Guzman, K., Stone, G., Yang, A.R., Schaffer, K.E., Lo, S., Kojok, R., Kirkpatrick, C. R., Del Pozo, A.G., Le, T.T., DePledge, L., Frost, E.L. and Kayser, G.L. 2023. Drinking water and the implications for gender equity and empowerment: A systematic review of qualitative and quantitative evidence. International Journal of Hygiene and Environmental Health, 247, 114044. https://doi.org/10.1016/j.ijheh.2022.114044

De Luque-Villa, M.A. and González-Méndez, M. 2024. Water management as a social field: A method for engineering solutions. Water (Switzerland), 16(2842), 16192842. https://doi.org/10.3390/w16192842

Fernanda, L., Rojas, R. and Megerle, A. 2013. Perception of water quality and health risks in the rural area of Medellín. American Journal of Rural Development, 1(5), 106-115. https://doi.org/10.12691/ajrd-1-5-2

Frimpong, J., Adamtey, R., Pedersen, A.B., Wahaga, E., Jensen, A., Obuobie, E. and Ampomah, B. 2021. A review of the design and implementation of Ghana's National Water Policy 2007. Water Policy, 23(5), 1170-1188. https://doi.org/10.2166/wp.2021.042

Gleick, P.H. 1996. Basic water requirements for human activities: Meeting basic needs. Water International, 21(2), 83-92. https://doi.org/10.1080/02508069608686494

Mallick, B. and Fernanda Roldan-Rojas, L. 2015. Social stratification in the drinking water scarcity context: Empirical evidence of coastal Bangladesh. American Journal of Water Resources, 3(3), 92-99. https://doi.org/10.12691/ajwr-3-3-4

Mekonnen, M.M. and Hoekstra, A.Y. 2016. Sustainability: Four billion people facing severe water scarcity. Science Advances, 2, 2-6. https://doi.org/10.1126/sciadv.1500323

Paavola, J. 2004. Livelihoods, Vulnerability and Adaptation to Climate Change in the Morogoro Region, Tanzania. CSERGE Working Paper EDM, No. 04-12; No. 04-12. University of East Anglia, Norwich. https://hdl.handle.net/10419/80286

Simelton, E., Quinn, C.H., Batisani, N., Dougill, A.J., Dyer, J.C., Fraser, E.D.G., Mkwambisi, D., Sallu, S. and Stringer, L.C. 2013. Is rainfall really changing? Farmers' perceptions, meteorological data, and policy implications. Climate and Development, 5(2), 123-138. https://doi.org/10.1080/17565529.2012.751893

Singh, C., Osbahr, H. and Dorward, P. 2018. The implications of rural perceptions of water scarcity on differential adaptation behaviour in Rajasthan, India. Regional Environmental Change, 18(8), 2417-2432. https://doi.org/10.1007/s10113-018-1358-y

Tomberge, V.M.J., Bischof, J.S., Meierhofer, R., Shrestha, A. and Inauen, J. 2021. The physical burden of water carrying and women's psychosocial well-being: Evidence from rural Nepal. International Journal of Environmental Research and Public Health, 18(15), 7908. https://doi.org/10.3390/ijerph18157908

Received:4th November 2026
Accepted:27th February 2026