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Water Scarcity Mitigation Strategies and Implementation Challenges Among the Populace of Batagarawa Local Government Area of Katsina State, Nigeria

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ABSTRACT
Scarcity of water poses serious risk to the health and livelihoods of people living in the arid and semi-arid parts of northern Nigeria. This is due to mostly climate change, poor water infrastructure, improper water management and growing populations that keep putting pressure on the limited sources of water in the areas. The objective of this study was to assess the strategies adopted in solving the problem of water scarcity in Batagarawa LGA, Katsina State, as well as to assess challenges associated with the adoption of the strategies. In this study, qualitative research methodology was utilized in the data collection process where Focus Group Discussion (FGD) and direct observation were mainly adopted. The primary data were collected using FGD and direct observation on the field to ensure a more holistic data collection. The secondary data were collected from Katsina State Water Board and from NGOs working among the people of Batagarawa. The data collected was analyzed through the use of thematic analysis technique. According to results from the interviews conducted, it emerged that borehole water is the main source of water supply to the people. Access to water differs based on whether an individual's home possesses a borehole, the proximity of one's home to a communal borehole, and availability of pipe-borne water which in some cases may be hindered by shortage of power. People adopt personal measures in handling the situation such as water conservation and reusing water; however, financial difficulties and lengthy distances make it hard for such measures to be sustained effectively. The study conclude that households make use of several localized measures aimed at coping with water problems, including water storage, rainwater collection, and reuse of water. It was recommended that the governments should support households with financial or technical help in obtaining their own boreholes and installation of water storage systems.

Keywords:
Coping strategies,
Pipe-born water,
Water scarcity, and
Water supply

INTRODUCTION

Water scarcity is a situation where there is insufficient availability of fresh, quality water due to the lack of such water physically or economically (Liu *et al*., 2017; Oki and Quiocho, 2020; Ingrao *et a*l., 2023;). This happened when there is an inequality in water resource supply and demand, meaning there is an excess demand for fresh water as opposed to its available amount, and it is classified as physical and economic scarcity (Liu et al., 2020).

Many factors contribute to water scarcity, including drinking water scarcity, agricultural water scarcity, and individual household water scarcity (Gleick and Cooley, 2021; Rosa *et al*., 2020). About 70% of total fresh water withdrawn globally is for agriculture, which makes agricultural water scarcity an essential component of water scarcity (Ingrao *et al*., 2023 However, the global water issue is exacerbated by exponential population increase, urbanization, economic development, technological advancements, changes in land cover, and climate change (Biswas *et al*., 2022).

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Water scarcity is an important global issue affecting many countries worldwide, which is recognized as a major concern to further development and sustainable development goals (Dolan *et al*., 2021; Liu *et al*., 2025). In recent global estimates, more than half of the population of the world faces some kind of water scarcity on a seasonal basis, with millions affected every year (Kummu *et al*., 2016). Water shortage issues are prevalent in countries that are considered underdeveloped or poor since such countries lack adequate infrastructure for addressing physical water shortages (Distefano and Kelly, 2017; Ingati *et al*., 2024). The presence of physical and economic water shortages leads to high levels of water poverty within a community. The issue of water poverty presents a serious health hazard as the water might be contaminated by pathogens and other substances irrespective of its availability. One example is radon, which causes an increased incidence of lung cancer and some researchers believe to be connected to the development of stomach cancer (Bello *et al*., 2025). However, WHO says there is no confirmed connection between the two diseases (WHO, 2023).

According to the Joint Monitoring Programme for UNICEF and WHO, there are more than two billion people in the world without proper access to drinking water (World Health Organization [WHO] and United Nations Children's Fund [UNICEF], (2021). This number refers to one out of four individuals in the entire world lacking access to drinkable water. There is an alarming difference in the accessibility to clean water in poor countries and rural communities. In terms of the scarcity of drinking water, the World Bank (2024) pointed out that billions of individuals might have problems with water if proper measures are not taken. This could probably lead to 1.4-1.6 million deaths per year due to the scarcity of drinking water (WHO, 2024).

As a result of challenges of the scarcity of water, many societies, especially those found in developing countries, have opted to implement different sustainable approaches in response to the problem of water scarcity. Consequently, some African and international governments have turned to natural solutions that could aid in dealing with water related issues (Boelee *et al*., 2017, Kalantari *et al*., 2018, Frantzeskaki *et al*., 2019, Seddon *et al*., 2020). The methods used include reforestation, removal of exotic plants, reconnection of floodplains to the river networks, and construction of various interventions as ways in which nature conservation and ecological restoration can be performed(Campuzano-Vera et al., 2025; Di Sacco et al., 2020; Weidlich et al., 2020). It may also involve the construction of artificial wetlands and installation of green roofs. Some studies have shown how certain site-scale interventions such as constructed wetlands (Kivaisi, 2001) are capable of treating wastewater in developing countries as well as how certain landscape scale interventions such as natural wetlands (Bullock and Acreman, 2003) and forests (Dadson et al. 2017, Filoso et al. 2017) affect the hydrologic cycle.

Numerous studies on water scarcity mitigation techniques have been undertaken from a global and regional level perspective. For example, there are several studies by Ahsan et al. (2022), who focused on adaptation strategies at the household level within coastal Bangladesh. Other researchers like Acreman *et al*. (2021) undertook research on nature-based interventions in Africa. Similarly, Martey et al. (2025) focused on farm household risk reduction in Ghana while Ekmekcioğlu *et al.* (2022) and Adamu and Kazeem (2022) focused on urban water scarcity and domestic water scarcity, respectively.

The issue of water scarcity has received much scholarly attention in the state of Katsina. This includes studies such as that carried out by Jidauna *et al*. (2016), which examined local perceptions of the adaptive capacity to water stress in Safana, and those done by Sani *et al*. (2024) and Lawal *et al*. (2019), which analyzed the problem of water shortage and water management challenges in Daura Metropolis. Nonetheless, a significant knowledge gap exists, seeing that there has not been a comprehensive analysis of the types and efficacy of water scarcity mitigation methods adopted by the people in Batagarawa Town. More importantly, most of the studies done in Katsina State did not analyze water scarcity through a qualitative approach. It is therefore unclear which strategies are effective, ineffective or unsuitable, and why they would be constrained socioeconomically or culturally. It is against this background that the purpose of this study was to conduct a complete analysis of the nature and efficacy of mitigation techniques concerning the issue of water scarcity by the residents of Batagarawa Town.

MATERIALS AND METHODS

Study Area

The research is carried out in Batagarawa local government area in Katsina state, Nigeria. The area is found between latitudes 12° 54' N and longitudes 7° 37' E as indicated in Figure 1 below. According to recent figures, there are 342,846 inhabitants in Batagarawa town, with a growth rate of 3.5%. This figure represents the estimated number from the NPC census of 2006 which stands at 184,575 people. The total land area is approximately 444 km2. Seasonally, the temperature varies slightly within the range of 26^0C – 32^0C, averaging at 30^0C. The annual rainfall received ranges between 500 mm annually with 40-50 percent humidity (Sulaiman, 2021). The area is mainly populated by peasant farmers who contribute the bulk of the agricultural produce, making agriculture the economic base for the area.

Sorghum, millet, cowpea, sesame, and groundnuts among others are major crops cultivated in the region (LawaI, 2010; Sulaiman, 2021).

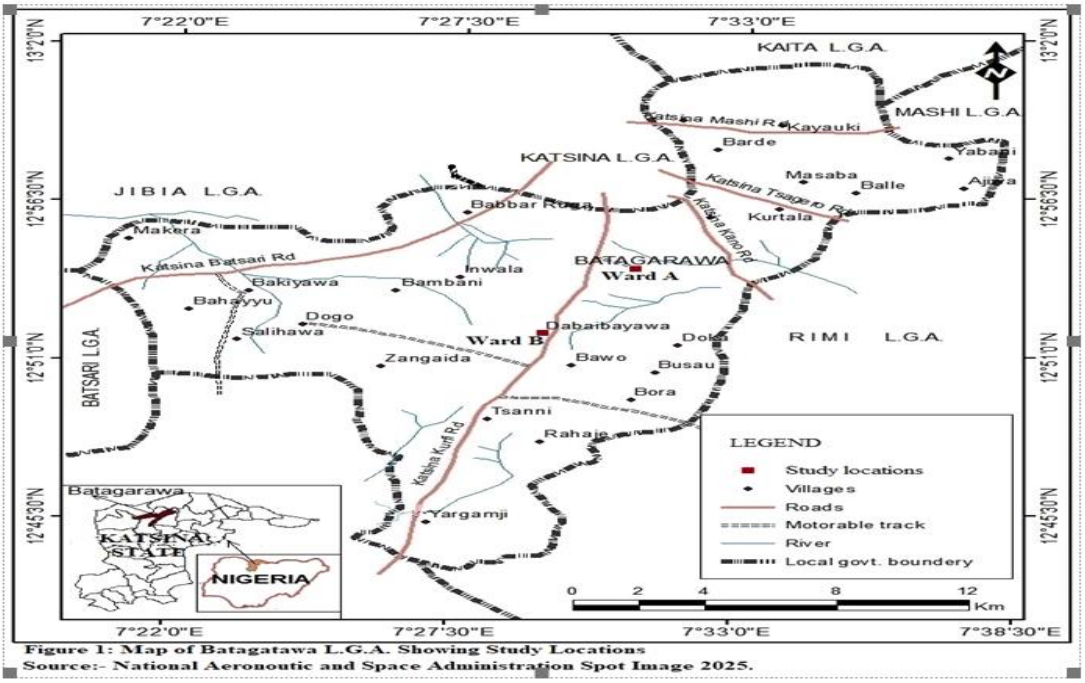

Figure 1: Map of Batagatawa L.G.A. Showing Study Locations
Source:- National Aeronoutic and Space Administration Spot Image 2025.

Figure 1: Map of Batagatawa Showing the Study Locations.

Research Design

In conducting the study, a mixed-methods approach was adopted which involved collecting qualitative data. This involved carrying out of direct field observation and conduction of interview. The method of collecting qualitative data involved conducting in-depth interviews with key informants. In-depth interviews were selected due to its efficiency in capturing varied ideas, fostering active engagement between members of the community, and analyzing shared norms, collective experiences, and different views of the issues under research within a group. Additionally, direct field observation was done to ensure that comprehensive and diverse data were collected in order to get actual and unbiased results since self-reporting data like survey can introduce some biasness. This helped the researcher observe happenings in their natural setting, thus getting insights on what may be misrepresented. Finally, in addition to primary data, secondary data was collected from different reliable sources to support the findings of the research. They include documents from government agencies like Katsina State Water Board, academic articles, previous studies on water scarcity in northern Nigeria, and documents from NGOs and international agencies like UNICEF and WHO.

Population and Sampling Techniques

The study population comprised members of the Batagarawa Local Government Area (LGA). They were selected from Batagarawa A and Batagarawa B. Each of the two localities serves as a representation of the wider society. For the selection of subjects in the Focus Group Discussion (FGDs) interviews, both convenience and cluster sampling techniques were used. The choice was made due to the practical aspects like accessibility, availability, and willingness to be part of the interview process. Five FGDs were carried out in each of the two areas (a total of 10 FGDs). There were 49 subjects from Batagarawa A and 56 from Batagarawa B (a total of 105 subjects). The number of subjects who participated in the discussion in each of the groups differed from one area to another. The numbers of subjects who participated in each of the discussion groups were ranging from six (6) to twelve (12).

Data Analysis

Qualitative data from interviews were subjected to content analysis based on thematic approach. This was complemented by the use of visual materials in the form of plates.

Research Ethics and Validation

Consent from all the study participants was sought before data collection. This was meant to make sure that all research principles were strictly adhered to. The piloting of the FGD guide questions was done to enhance the precision of the questions. In addition, instrument validation by an expert was done to ascertain the quality of the questions.

RESULTS AND DISCUSSION

Characterization of Water Sources and Analysis of Proximity in the Area

It was discovered that dug boreholes are the main sources of water supply for the residents of Batagarawa Community. With regard to travel distances, based on views expressed by locals, some houses have boreholes in their homesteads and therefore do not need to travel. Even though the communal boreholes may be located near, another resident depending on pipe water also admitted experiencing lack of water especially when there is no power in the community. Another resident stated:

> *"The water provision in our community is mainly through boreholes. It can be observed that our water provision uses decentralization dualism where the majority of the population depends on themselves for the water supply by drilling boreholes in their own homes" (FGD2/P3, participant from Batagarawa A).*

This research differs from the findings of Bello (2019), whose study showed that for the 69% of the inhabitants, water vending was the source of water in Zango and Rimin Kebe, Ungogo LGA, Kano State. This trend is in agreement with earlier studies carried out in the Metropolitan area of Kano by Nura (2014). The problem of economy continues to affect this process because of the high price involved in constructing boreholes. This is because not many individuals can be able to afford such an investment. Traditional well sources cannot be trusted owing to the seasonality of the water flow in the well.

Water Scarcity Mitigation Strategies and Implementation Challenges in the Study Area

Field observation and interviews carried out in Batagarawa in Katsina state have made it clear that the water shortage being faced by the people in this area is a serious one. This necessitated for the use of various mitigation strategies at the domestic level. Some of these include water conservation in the form of storing water in wells, surface reservoirs, and rainwater harvesting during the wet season. Furthermore, the members of this community obtain water from households with boreholes. This is seen in Plate 1. One of the members of the community gave an account of why such mitigation practices are necessary through the following response:

"We practice this mitigation strategy because of water shortage which we face in our community. There are various kinds of mitigation practices we practice but what we specifically concentrated on were those which include storing water wherever possible. This entails that we use water storage methods using large water tanks. In addition, we also harvest rainwater when there is rain and recycle water in households" (FGD 4/P2, participant from Batagarawa B).

Plate 1: Groups of People Fetching Water from Borehole.

Source: Fieldwork, 2024.

The findings of this study corroborate the conclusions made by Ssekyanzi et al. (2024) and Chan *et al.* (2021), wherein the methods of mitigating water scarcity included constructing water storage tanks and establishing water distribution. Likewise, Bunker (2005) did research regarding water management solutions in remote rural areas. Specifically, the study was about the effectiveness of implementing the rooftop rainwater harvesting system in rural schools in the Netherlands. It proves the importance and usefulness of using a rooftop rainwater collection system in supplying water to isolated communities, as per the requirement mentioned in Batagarawa. Efficient rainwater collection is done through the coordination between three main elements. These are areas where the rain falls (e.g., rooftops), conveyance systems to transport rainwater (e.g., gutters), and storage facilities where rainwater is collected for future use (Feloni and Nastos, 2024). Another technique employed everywhere in the world is traditional rainwater harvesting systems (TRHSs). This technique has been used since centuries in many cultures in order to control the rainfall and ensure the supply of water (Bunker, 2005).

Challenges Faced by the People of the Area

From the results of the study, various challenges faced by the people of the area with regard to safety and access to portable water were noted. These included reliance on nature to provide them with water, the far distance travelled in search of water, as well as usage of polluted water. The prolonged waiting in queues, as shown in Plate 2 above, was another problem encountered by the residents, more so when there is no electricity supply. In addition, one of the respondents added:

> *"I consider the most significant issue facing us in the challenges with water in this community is poverty. This is due to the fact that most of the affluent people in this town do not venture out in search of water because they have boreholes at home which enables them to draw water and pump it into the tanks, thus enabling them to have access to water anytime. However, it becomes difficult for us poor people to even think of having a borehole since it is already challenging to feed our family, let alone drilling a borehole in my compound" (FGD 5/P4, Batagarawa B participant).*

Plate 2: People waiting to get water from Borehole
Source: Fieldwork, 2024.

The findings of this study align with the opinion of Isukuru *et al*. (2024) that economic disparity is one of the largest barriers to availability safety and portable water globally. Nevertheless, other factors, such as political influence and cultural practices as pointed out by Isukuru et al. (2024), oppose the findings of this study.

Barriers to Mitigation Strategies

There were several challenges identified during the interviews that inhibit the ability of people to implement mitigation techniques effectively. According to one of the respondents:

'' Sometimes, shortage of money does not allow us to purchase needed equipment'' (FGD 1/P1, participant from Batagarawa A).

This issue in combination with the fact that people should travel over long distances to get access to water when local resources become unavailable significantly complicates this process. It reduces the ability of people living in Batagarawa to consistently use efficient

measures against the problem under discussion. The results obtained in this study are similar to those found by Tarl *et al*. (2014), who identified problems in efforts to mitigate the issue caused by constraints including small amounts of finances, lack of involvement of the community members, and changing climate conditions. It is crucial to analyze the advantages and disadvantages of previous initiatives in order to develop more advanced approaches. There are some particularities of the water sector that include stakeholders' involvement in investment, political interference, and customers' demands that represent risks for PPPs (Harris *et al*. (2003); Ameyaw and Chan (2015); Sulser (2018). In the area, there are some government interventions as well as institutional interventions that have tried to curb the problem of water shortage. One such intervention is the SURWASH initiative in Batagarawa, which involves increasing the supply of water and providing better facilities and standards for sanitation and hygiene.

Man-Made based Initiatives Solution and their Effectiveness in the Area

The Man-made based initiative solutions (MBIS), based on Batagarawa Community findings, that mostly applied in water augmentation and conservation include the following;

Rainwater harvesting (RWH) serves as a primary household technique for providing locally effective water, which is, however, a seasonal method of water provision. These methods possess substantial potential in terms of water improvement and capacity of water storage when incorporated into wetland and ecosystem preservation strategies. Nevertheless, they depend highly on household resources and seasonal rainfall. According to the participants, rainwater harvesting (RWH) was found to be the most popular among water techniques. As one of the participants stated that:

"For example, we, the majority of people from Batagarawa community use RWH due to its simplicity and availability. It is the commonest and most dominating household practice of obtaining water, especially during the rainy season in this area. This is a locally effective technique, as we do not need to use complicated facilities that are nonexistent here." (FGD 4/P5).

The finding from this study is in line with the research conducted by Acreman *et al*. (2021), which showed that the effectiveness of man-made based initiative solution (NBIS) in addressing water challenges in Africa. Unlike this current study, the authors classify NBIS into site-specific and landscape scale. In terms of effectiveness of water scarcity, the participants indicated that man-made based solutions such as rainwater harvesting and green roofs are considered effective and decentralised techniques for water scarcity management. They further have the potential of reducing runoff and acting as an alternative source of water in non-potable applications. Residents from Batagarawa talked about the use of roof green. According to one of the participants:

"I decided to install a green roof on my house because I needed to address the issue of local floods. It was quite successful since it has greatly helped in reducing the surface runoff. In addition, it has prevented flash floods that have at times wreaked havoc in our community particularly during the height of the rainy season"(FGD 4/P4, participant from Batagarawa B).

The results of this study highlighted the important role played by green roofs in managing storm water in cities. This correlate well with earlier studies done in Low Impact Development (LID), such as the studies conducted by Stovin (2010) and Platz *et al*. (2020). Hydrologic performance of green roofs was tested in another study conducted by Mentens *et al*. (2006), where the performance of the green roof in delaying storm water discharge was observed.

CONCLUSION

The research concluded that drilled borehole wells are the most important sources of water for the local population. The sources of water vary based on whether households have their own boreholes, are located near community boreholes, and whether pipe-borne water can be relied upon based on the availability of electricity. Households make use of several localized measures aimed at coping with water problems, including water storage, rainwater collection, and reuse of water. Nevertheless, money shortages, seasonality, and long trips to obtain water hamper the implementation of proper measures. Additionally, it should be stated that man-made based initiative solutions (NBS) like rainwater harvesting and wetland conservation may prove helpful in solving the water problems facing the communities.

Recommendations

i. The study suggests that governments should support households with financial or technical help in obtaining their own boreholes and installation of water storage systems.

ii. NGOs should come up with advocacy programs that can promote wetland conservation, and the creation of artificial wetlands.

iii. Individuals from the community who are well to do financially should contributes or help in alleviating the scarcity of water in the community through the sitting of drill boreholes at strategic locations in the community.

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