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DOMESTIC WATER SUPPLY SOURCES AND HOUSEHOLD UTILIZATION OF RAINWATER HARVESTING IN DUTSIN-MA TOWN, KATSINA STATE, NIGERIA

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ABSTRACT
Water scarcity remains a major challenge in semi-arid regions of Nigeria, exacerbated by climate variability and population growth. This study assessed household utilization of rainwater harvesting as a water supply source, examined the major sources of domestic water supply in the study area and investigated the level of awareness and practice of rainwater harvesting in the study area. The study also analyzed 40 years (1985-2024) rainfall data of the study area. Primary data were collected through structured questionnaires administered to 311 households. Secondary data (Rainfall) were sourced from NASA POWER data from 1985 to 2024. Descriptive statistics and linear time series were used to analyze the data. Findings revealed that the area receives a mean annual rainfall of 757.99 mm, with an increasing trend of 2.2 mm per annum. The major sources of water in the study area during the rainy season and dry seasons were water vendors (29.9%) and (43.7%), respectively. About 98.9% of the respondents are aware of rainwater harvesting, and 82.6% practice it. Despite this, harvested rainwater is mainly used for non-potable purposes due to concerns about water quality. 48.2% of respondents use harvested rainwater for laundry. The study concludes that RWH has strong potential to improve domestic water supply and enhance climate resilience, but its effectiveness is constrained by inadequate infrastructure and seasonal rainfall variability. The study recommends improved storage systems, policy support, and public awareness to maximize the benefits of RWH.

Keywords: Rainwater harvesting, water supply, climate resilience, rainfall variability

INTRODUCTION

Water is an essential element for sustaining life, driving sustainable socio-economic development and maintaining the balance of ecosystems and biodiversity (Akuffobea-Essilfie, William and Asare, 2020). It is the most valuable natural resource with numerous uses and tremendous economic significance (Nka-Patel, Nandsingh, Satpalsingh and Raval, 2020). As such, the Global Risks Report [GRR] by the World Economic Forum [WEF] (2020) lists water crisis as one of the top five risks in all its reports since 2015.

According to the United Nations, increasing population growth, rapid urbanization, climate change, and unsustainable water resource management continue to intensify pressure on available freshwater resources, particularly in arid and semi-arid regions (Ait-Kadi, 2016). Consequently, achieving Sustainable Development Goal 6 (SDG 6), which seeks universal access to safe and affordable drinking water, remains a significant challenge in many parts of Sub-Saharan Africa.

Nigeria is among the countries experiencing increasing water stress due to climate variability, seasonal rainfall fluctuations, inadequate water infrastructure, and growing domestic demand. In many northern Nigerian communities, households depend on multiple water sources such as boreholes, hand-dug wells, streams, water vendors, and, where available, harvested rainwater (Jidauna et al., 2016). However, these sources are often unreliable, particularly during the prolonged dry season when groundwater levels decline, and surface water becomes scarce. The resulting water shortages have significant implications for household welfare, public health, and socio-economic development (Jidauna et al., 2016).

Rainwater harvesting (RWH), defined as the collection, conveyance, storage, and utilization of rainwater for domestic and other purposes, has increasingly been recognized as an effective strategy for augmenting conventional water supplies (Ruhela, Bhutiani and Anand, 2014). RWH reduces pressure on existing water supplies and promotes sustainability (Owusu & Weylen, 2019; Kahinda, Taigbenu and Boroto, 2020; Shitu, Okareh and Coer, 2022; Opare, 2022). Until recently, the importance of RWH as a buffer against climate-linked extreme weather events has been almost invisible in water planning since countries rely almost exclusively on conventional sources of rivers and groundwater supplies (Kahinda *et al*., 2020). The challenges posed by water scarcity in sub-Saharan Africa and some parts of Northern Nigeria necessitate the exploration of alternative and sustainable water management solutions

Compared with the expansion of centralized water infrastructure, RWH offers a relatively low-cost, decentralized, and environmentally sustainable alternative capable of improving household water security while reducing pressure on groundwater resources (Akuffobea-Essilfie et al., 2020; Aladenola & Adeboye, 2021). Beyond improving water availability, rainwater harvesting contributes to climate change adaptation by enhancing household resilience to rainfall variability and prolonged dry spells.

Several studies conducted in Africa and other developing regions have demonstrated the benefits of rainwater harvesting in improving domestic water supply, reducing household vulnerability to water shortages, and promoting sustainable water management. Rainwater is a resource that can be exploited in urban areas. For example, RWH has been adopted in large cities such as Singapore and could be used in densely populated areas (Owusu & Weylen, 2019; Kahinda *et al*., 2020; Shitu & Coer, 2022; Opare, 2022). The main form of rainwater catchment is roofs, but the material used is important because it can affect water quality (Ruhela *et al*., 2014). Rahman *et al*. (2014) carried out research in Malaysia on the sustainability of rainwater harvesting systems in terms of water quality, with emphasis on microbiological contaminants. Aladenola and Adeboye *(2021) carried out a survey study in Nigeria to overcome the impact of climate change on water supply using an RWH system; a city with a* mean annual rainfall of 1,156 mm was selected.

Nevertheless, the adoption and effectiveness of RWH vary considerably across communities due to differences in rainfall characteristics, socio-economic conditions, household perceptions, technical knowledge, storage capacity, and institutional support. Previous studies have largely concentrated on the engineering design, water quality, and technical performance of rainwater harvesting systems. At the same time, relatively few have simultaneously examined rainfall characteristics, household water supply sources, and community adoption of RWH within semi-arid communities of northwestern Nigeria.

Dutsin-Ma Local Government Area of Katsina State lies within the Sudan Savannah ecological zone, where rainfall is highly seasonal and characterized by considerable interannual variability. Although the area experiences sufficient rainfall during the wet season, much of this water is lost as surface runoff due to inadequate harvesting infrastructure. Consequently, households continue to rely heavily on alternative water sources, especially hand-dug wells and commercial water vendors, during the dry season. Understanding the rainfall regime alongside household water sourcing behaviour and perceptions of rainwater harvesting is therefore essential for developing sustainable water supply strategies suitable for the local environment.

This study addresses this knowledge gap by integrating long-term rainfall analysis with household-level assessment of water supply sources and rainwater harvesting practices in Dutsin-Ma. Unlike previous studies that focused primarily on either climatic variability or household water supply, this study combines meteorological analysis with socio-economic survey data to provide a comprehensive understanding of the potential of rainwater harvesting as a climate adaptation strategy. The findings are expected to provide empirical evidence to support water resource planning, climate adaptation policies, and the promotion of sustainable household water supply systems in semi-arid regions of Nigeria.

Accordingly, the study specifically aims to: examine the nature and general characteristics of rainfall influencing RWH in the study area; examine the major sources of domestic water supply in the study area; investigate the level of awareness and practice of rainwater harvesting in the study area; and examine the methods of harvesting rainwater practiced.

STUDY AREA AND METHODOLOGY

Study Area

Dutsin-Ma town is the headquarters of Dutsin-Ma Local Government Area in Katsina State, Northern Nigeria. It is located in the northern part of Katsina State, about 60 km from the State capital (Abaje, Sawa and Ati, 2014). It lies within latitudes 12° 26′ 30″ to 12° 28′ 30″ N of the equator and longitude 7° 29′ 0″ to 7° 31′ 0″ E of the Greenwich meridian (Abaje *et al*., 2014). It is bounded by Kurfi and Charachi LGAs to the north, Kankia LGA to the East, Safana and DanMusa LGAs to the west and Matazu LGA to the southeast (Figure 1). Dutsin-Ma has a land size of about 552.323km^2.

The study area experiences a long dry season and a short-wet season (Babsal, 1998). This is a limiting factor for water resources, especially underground water. The underground water is estimated to be about 550 mm of water obtainable per year (Babsal, 1998). Relief influences the drainage of Dutsin-Ma, which the River Karadua and the River Gada drain. Zobe Dam, which is located in the southern part of the area, is constructed on the River Karadua. The two rivers are tributaries of the dam, where the River Gada drains into the River Karadua. The dam covers 4500 hectares and stores 177 million cubic metres of water in the rainy season. River Karadua is about 2.7 km long, flowing in a north-western direction to the Sokoto basin. The dam is used for water supply, irrigation and fishing (Abaje *et al.*, 2014).

The climate of Dutsin-Ma, as classified by the Koppen classification, is a semiarid, tropical wet and dry climate (Aw). Dutsin-Ma LGA falls within a climatic region that is largely controlled by the tropical maritime air mass and tropical continental air mass. The rainy season in the area reaches its peak in August when the ITD moves north across the state (around latitude 21° to 22°N), and its dry

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season peaks in January or February when it moves to the southernmost part of the country (approximately at 6ºN) (Abaje *et al*., 2014).

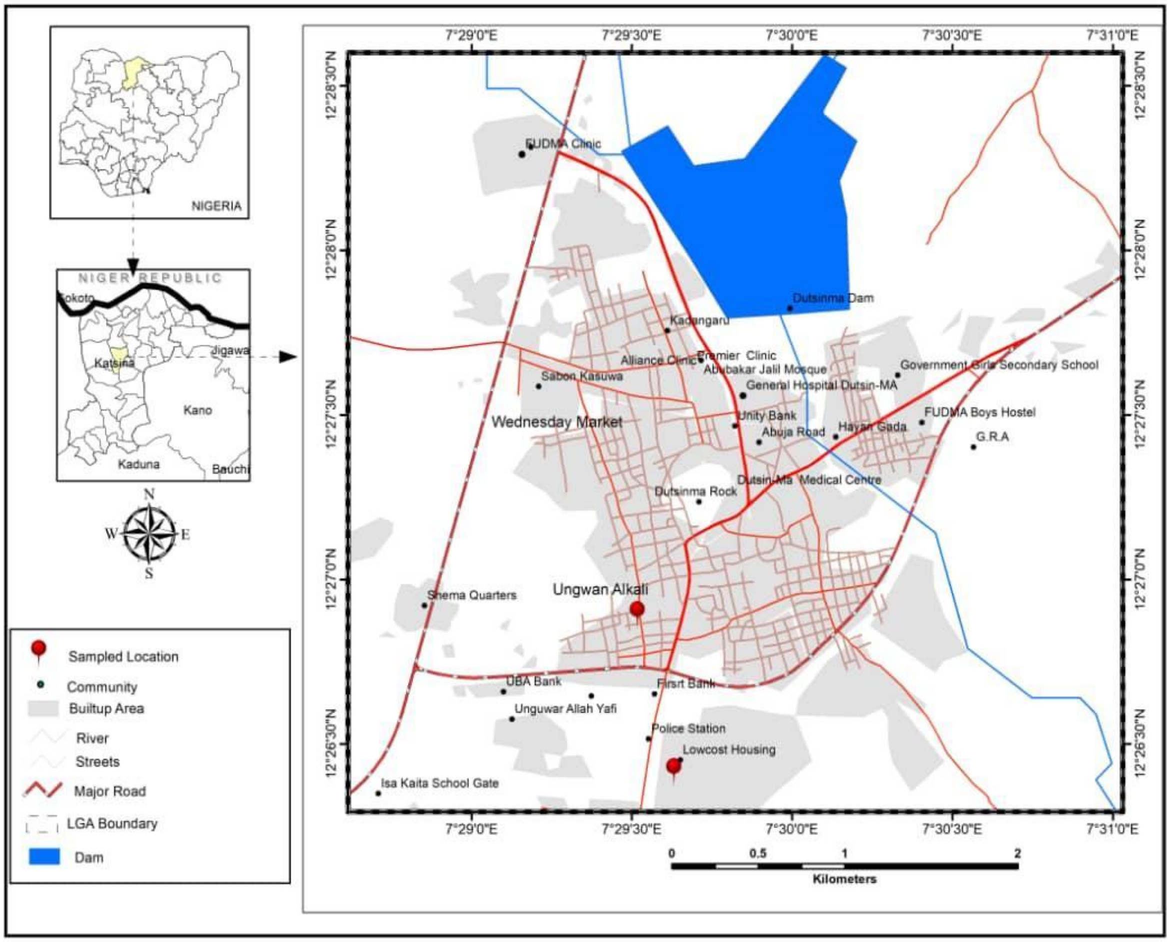

Figure 1: Map of Dutsin-Ma showing the study area.
Source: Modified from Katsina State Ministry of Lands and Survey (2023)

Generally, the area has four distinct seasons. The warm wet season (*Damina*), the growing season that starts around May and ends in October: The warm dry season (*Kaka*), a relatively short season that marks the end of the rainy season in October and ends up with the beginning of the cold dry season (*Rani*) in November, and this cold dry season ends in February, followed by the hot dry season (*Bazara*) (Tukur, 2010).

The mean annual temperature ranges from 29 °C to 31 °C; April and May have the highest temperatures, and December–February have the lowest. December to February is a period of cool and dry (harmattan) season. The area is characterized by high temperatures of about 43 °C, a consistently low relative humidity of 50%, and a shorter rainy season (Tukur, 2010). Evapotranspiration is generally high throughout the year. The highest amount of evaporation occurs during the dry season.

The population of Dutsin-Ma LGA was 169,829 according to 2006 population and housing census data (National Population Commission [NPC], 2007). Dutsin-Ma LGA has 11 wards: Dutsin-Ma ‘A’ and 'B', Karofi 'A' and 'B', Kuki 'A' and 'B', Makera, Kutawa, Bagadadi, Dabawa and Shema. The area is dominated mainly by Hausa and Fulani. The urban Dutsin-Ma town is made up of 2 wards: Dutsin-Ma 'A' and 'B' and has an estimated population in 1991 of 38,629 people according to the 1991 population and housing census (NPC, 1991). The major occupation of the people in this area is agriculture, which accounts for a large share and is estimated to employ about 85% of the total population.

Methodology

The study adopted quantitative techniques, involving a field survey and analysis of 40-year rainfall data. The study obtained primary data from field observations and surveys, using a questionnaire to elicit information from respondents on their socio-demographic characteristics, the practice of RWH, rainwater harvesting techniques, and the purposes for harvesting rainwater. Secondary data were obtained from Rainfall data for 40 years (1985-2024) from NASA Power data (https://power.larc.nasa.gov/data-access-viewer/2025), an administrative map of the study area from the Katsina State Ministry of Lands and Survey, as well as population figures of the study area from the National Population Commission.

The sampling frame is within Dutsin-Ma urbanized town. Two distinct areas were purposively selected for the study from the two wards that make up the study area. Comprehensive Hospital area/low-cost in Dutsin-Ma 'A' is sparsely populated with high-income earners, and Ungwar Alkali in Dutsin-Ma 'B' ward is highly populated with mostly low-income earners. The two areas are distinctly selected because access to alternative water sources may differ.

For this study, the 1991 population census figure was used. According to the 1991 population census, the population of Dutsin-Ma town (Dutsin-Ma Ward 'A' and 'B') was 38,629. Dutsin-Ma 'A' had a population figure of 4,834 and Dutsin-Ma 'B' had a population figure of 33,795 (NPC, 1991). The reason for using the 1991 population figure instead of the 2006 figure was that it gave the breakdown of locality/wards. The population of Dutsin-Ma was projected to 2024 using Mehta's (1998) method of population projection, expressed as:

$$P_n = P_o\,(1+ R/100)^n \quad \text{……………………………...…(Eq.1)}$$

where: R= annual rate of growth (3.7%, for Katsina by UN World Population Prospect)
P_n= population in the current year
Po = population in the base year (38,629)
n= number of intermediary years (1991-2024=34 years)

The sample size was determined using Krejcie and Morgan's (1979) table. The result obtained was used to administer questionnaires to the respondents in the study area. Based on the projection, the current population of Dutsin-Ma in Katsina State is 132,858, with an annual growth rate of 3.7. From Morgan's table, a population size of 132,858 corresponds to a sample size of 383 at a 5% margin of error. This was the sample size used to administer questionnaires across the two (2) political wards that represent the study area. The questionnaire was administered using the Yamane (1969) formula (Table 1).

Proportion of respondents in each ward = n (383) / N …………………… (Eq.2)

Where n = Population of the selected wards, N = Total population of the selected wards.

Households were selected at regular intervals of every 2nd household to ensure equal representation. Target respondents were household heads (male or female) as they make key water-related decisions. This approach ensures a diverse range of opinions while avoiding bias in selection.

Table 1: Sample Unit and Sample Size

Sample ward	Population as at 1991	Population projected to 2024	Sample size
Dutsin-Ma 'A'	4,834	16,625	49
Dutsin-Ma 'B'	33,795	116,233	334
Total	**38,629**	**132,858**	**383**

Source: Author's computation (2025).

The data collected from the administered questionnaires were analyzed using descriptive statistics, including tables, percentages and charts.

Test for Normality

The standardized coefficient of Skewness (Z_1) and Kurtosis (Z_2) statistics, as defined by Brazel and Balling (1986), were used to test for normality in rainfall for the study area. The standardized coefficients of Skewness (Z_1) and Kurtosis (Z_2) were calculated as follows:

The standardized coefficient of Skewness (Z_1) was calculated using:

$$Z_1 = \left[\left(\sum_{i=1}^{N}(x_i - \bar{x})^3/N\right) \Big/ \left(\sum_{i=1}^{N}(x_i - \bar{x})^2/N\right)^{3/2}\right] \Big/ \left(6/N\right)^{1/2} \quad \text{.................................... (Eq. 3)}$$

Moreover, the standardized coefficient of Kurtosis (Z_2) was calculated using:

$$Z_2 = \left[\left(\sum_{i=1}^{N}(x_i - \bar{x})^4/N\right) \Big/ \left(\sum_{i=1}^{N}(x_i - \bar{x})^2/N\right)2\right] - 3 \Big/ \left(24/N\right)^{1/2} \quad \text{................................ (Eq. 4)}$$

Where x is the long-term mean of x_i values, and N is the number of years in the sample. If the absolute value of Z_1 or Z_2 is greater than 1.96, then a significant deviation from the normal curve is indicated at the 95% confidence level.

Rainfall Characteristics

The rainfall data obtained from NASA Power Data for 40 years (1985-2024) were added for each year to give the total annual rainfall received in the study area. The mean was determined by summing all annual rainfall data and dividing by the number of years, thus:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \quad \text{.. (Eq. 5)}$$

The standard deviation measures the dispersion of rainfall values from the mean. It was computed as:

$$SD = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_i - \bar{X})^2}$$ ………………………………………… (Eq. 6)

A linear trend line was calculated and plotted using Microsoft Excel (2013) for monthly and annual rainfall (mm) in the area. Linear regression was used to determine the linear trends of the rainfall in the area, and changes in rainfall were calculated.

Linear Regression Trend Analysis is given by:

$$Y = a + bX$$ ………………………………………………...(Eq. 7)

where: Y = annual rainfall,
X= year
a= intercept,
b= slope.

Slope is calculated using: $b = \frac{n\sum XY - \sum X \sum Y}{n\sum X^2 - (\sum X)^2}$ ………………………..……………….(Eq. 8)

If $b > 0$, upward trend; if $b < 0$, downward trend.

RESULTS AND DISCUSSIONS

Socio-demographic Characteristics of Respondents

Table 2 summarizes the socio-demographic features of the respondents. The majority (37.9%) were aged 36–45 years, followed by 25.4% aged 46–55 years, and 26.4% aged 56 years or older. Only 4.2% were below 25 years. This indicates that most respondents were adults with household and livelihood responsibilities. This is in agreement with the findings of Owusu and Asante (2020), who found that most participants in their study fell within the age group of 36-45.

Males constituted 62.4% of the respondents, reflecting the cultural context where men are more available for interviews, while females (37.6%) participated less due to sociocultural restrictions. Marital status results show that 86.8% were married, suggesting household-level perspectives in water use decisions.

In terms of education, 36% attained secondary education, 32.8% attained tertiary education, and 23.8% attained primary education, while only 5.5% had no formal education. This contrasts with the study conducted by Ramya, Reddy, and Kamath (2019), which found that the majority of those who harvest rainwater in their study area have no formal education. Occupation was dominated by farming (41.2%), followed by trading (31.8%) and civil service (24.1%). Household size was generally large, with 41.2% having 7–9 members and 36.3% more than 10. This is in agreement with the study of O'Brien (2014), conducted in semi-arid South Africa, which found that an average of 6 or more people live in a household in their study area. Monthly income levels varied, though most respondents (25.7%) earned between ₦31,000-₦70,000. This implies that the majority of the respondents earned below the National Minimum Wage in Nigeria. A study by Chuma (2022) also reported that RWH is embraced by the public regardless of their marital status, level of education and source of income.

Table 2: Socio-demographic Characteristics of Respondents

Parameter	Frequency	Percentage (%)
Age (years)		
18-25	13	4.2
26-35	19	6.1
36-45	118	37.9
46-55	79	25.4
56 and above	82	26.4
Gender		
Male	194	62.4
Female	117	37.6
Marital status		
Married	270	86.8
Single	20	6.4
Widowed	17	5.5
Divorced	4	1.3
Highest level of education		
No formal education	17	5.5
Primary	74	23.8
Secondary	112	36.0
Tertiary	102	32.8
Quranic education	6	1.9
Occupation		
Farmer	128	41.2
Trader	99	31.8
Civil servant	75	24.1
Artisan	9	2.9
Household size		
1-3	20	6.4
4-6	50	16.1
7-9	128	41.2
>10	113	36.3
Estimated monthly income (₦)		
<18,000	41	13.2
18,000-30,000	52	16.7
31,000-70,000	80	25.7
71,000-100,000	70	22.5
101,000-150,000	29	9.3
>150,000	39	12.5
Total	**311**	**100**

Source: Authors' fieldwork, 2025.

General Statistics and Characteristics of Rainfall in Dutsin-Ma

Table 3 presents the general rainfall statistics for the study area's monthly rainfall (May to October), the period during which the area experiences rainfall.

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Table 3: General Statistics and Trends of Rainfall in Dutsin-Ma (1985-2024)

Statistics	May	Jun	Jul	Aug	Sep	Oct	Annual
Mean	58.94	115.20	208.35	236.20	153.53	28.28	757.9
Std. deviation	43.18	64.08	143.00	64.17	73.05	16.11	136.8
Skewness (Z_1)	1.463	1.994	4.491	1.940	2.408	1.475	0.209
Kurtosis (Z_2)	1.397	1.397	1.397	1.397	1.397	1.397	-0.351
Minimum	4.89	32.71	98.60	131.75	47.26	1.05	465.26
Maximun	181.79	343.81	987.95	503.00	474.36	89.03	1018.28

Source: Author's Computation (2025)

The results of the normality tests (Z_1 and Z_2) show that all the months' rainfall data series were accepted as indicative of normality at the 95% confidence level. As a result, the data were used without any transformation. This finding is in agreement with the results obtained in the studies of the occurrence of droughts in the Sudano-Sahelian Ecological Zone (SSEZ) of Nigeria by Abaje, Ishaya and Usman (2010), where effective rainfall in this region was within 3 months or less. The mean annual rainfall for the 40 years (1985-2024) is 757.99 mm, while the highest mean monthly rainfall distribution is 236.20 mm (August), and the lowest mean monthly rainfall is 28.28 mm (October), as indicated in Table 4.2. Standard deviation is 136.8 mm, the range of rainfall is 553.0 mm, and the minimum and maximum rainfall were 465.2 and 1018.2 mm, respectively. The month with the highest amount of rainfall is August, while April received the least amount of rainfall.

The rainy season usually lasts from April to October, approximately six (6) months (Figure 2). The area receives an annual rainfall total of 1,257.32mm. These results relate to the findings of Liberty and Bello (2022), who reported that rainfall arrives in April and ceases in October in Dutsin-Ma; the highest amount is recorded in August.

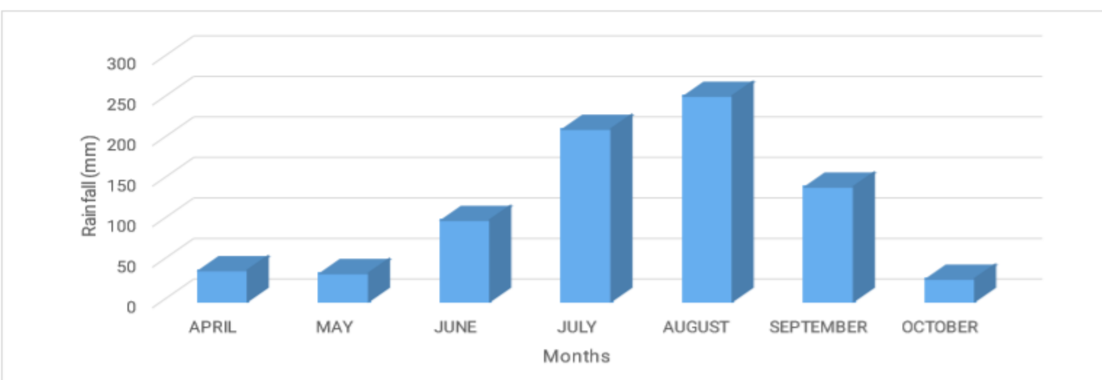

Figure 4.1: Mean Annual rainfall amount in Dutsin-Ma
Source: Author's analysis, 2025.

Trend of Annual Rainfall in Dutsin-Ma (1985-2024)

There is interannual variability in the amount of rainfall from year to year in Dutsin-Ma. The coefficient of variation from year to year is 3.56% and an increasing rate of 2.21mm per annum (Figure 3). The increasing trend of rainfall in Dutsin-Ma contrasts with the findings of Bello and Msheliza (2016), who reported a decreasing trend of rainfall in Gombe State. Also, Abaje, Ishaya and Usman (2010) reported that rainfall yield in Kafanchan is declining, and Logah, Obuobie, Ofori and

Yeboah (2013) reported a decline in mean annual rainfall for the period 1981-2010, with high rainfall shifting to the South-western corner of Ghana. This finding agrees with the study of Abubakar, Abaje and Tukur (2024), who revealed that there has been an increase in annual rainfall in recent years in Katsina State. This increasing rainfall trend implies that it will improve the amount of water that can be harvested to augment domestic water needs and also improve agricultural productivity, particularly crop production.

The plotted standard deviation for the annual rainfall (Figure 3) shows 14 anomaly years; 7 years (1994, 1998, 2007, 2019, 2020, 2021, 2022, 2023 and 2024) were wetter than the normal condition while 7 years (1999, 2003, 2005, 2008, 2010, 2012 and 2013) were drier than the normal condition signifying low rainfall years. All 7 years that were drier than the normal condition were found between 1999 and 2014 of the study period. Four years of wetter rainfall years are in the recent past (2019 to 2024). With this result, it is also clear that rainfall amounts have increased in recent years, which is also an indication of climate change.

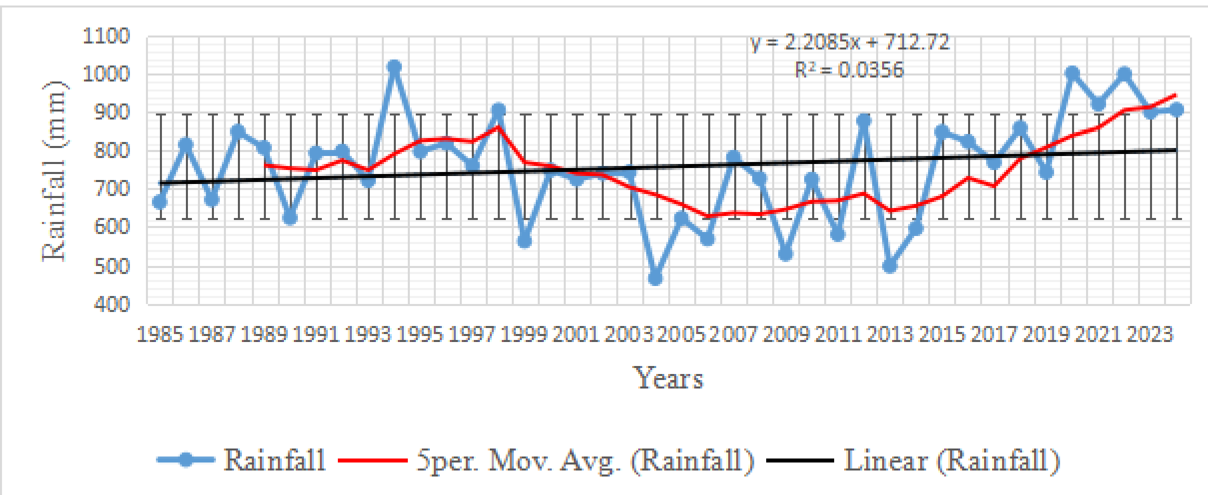

Figure 3: Trend of annual rainfall in Dutsin-Ma (1985-2024)
Source: Author's Analysis, 2025.

Sources of Water Supply

Table 4 presents seasonal variation in water sources. During the rainy season, respondents relied mainly on hand-dug wells (29.6%), water vendors (29.9%), and rainwater harvesting (20.6%). Boreholes contributed 12.5%, while 3.5% and 3.9% obtained water from streams/dams and piped supplies, respectively.

In contrast, during the dry season, reliance shifted predominantly to water vendors (43.7%) and hand-dug wells (21.2%). No respondents used harvested rainwater, mainly due to inadequate storage facilities. This finding highlights the seasonal dependence on rainwater and underscores the role of storage limitations in its continuous use. This is in agreement with the study by Edokpayi, Enitan, Mutileni, and Odiyo (2018), which reported that due to erratic supply of potable water to households in Vhembe Districts, residents often resort to alternative sources such as rainwater, springs, and boreholes. This aligns with the findings of Musa and Aileku (2017), who reported that households in Minna largely depend on alternative sources such as vendors due to unreliable public supply.

Similarly, Suleiman (2020) observed that groundwater sources dominate domestic water supply in Kano metropolis, with limited contribution from pipe-borne systems.

Table 4: Sources of Domestic Water Supply in Rainy and Dry seasons

	Rainy season		Dry season	
Source	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
Borehole	39	12.5	73	23.5
Stream/dam	11	3.5	21	6.8
Hand-dug well	92	29.6	66	21.2
Rainwater (RWH)	64	20.6	0	0
Water vendor	93	29.9	136	43.7
Tap water	12	3.9	15	4.8
Total	**311**	**100**	**311**	**100**

Source: Author's fieldwork, 2025.

Awareness and Practice of Rainwater Harvesting

Awareness of RWH was very high, with 98.4% of respondents confirming knowledge of the practice (Table 5). The dominant channel of awareness was self-discovery (85.5%), followed by family and friends (10.3%). Only a few respondents cited community programs (3.2%), government initiatives (0.6%), or NGOs (0.3%) (Table 5).

Regarding current practice, 82.6% reported actively harvesting rainwater, while 17.4% did not (Table 5). This suggests that awareness largely translates into practice, though barriers remain. This is in agreement with the study of Edokpayi *et al. (2018), who reported that more than half of the respondents who* participated in their study say they harvest rainwater for their domestic use as an alternative source of water.

Table 5: Awareness, Source of Awareness and Practice of RWH

Variable	Frequency	Percentage
Awareness of rainwater harvesting		
Yes	306	98.4
No	5	1.6
Channel of awareness		
Self-awareness	266	85.5
Family/friends	32	10.3
Community programs	10	3.2
Government initiative	2	0.6
NGO's	1	0.3
Current practice status of RWHS		
Yes	257	82.6
No	54	17.4
Total	**311**	**100**

Source: Author's fieldwork, 2025.

Method of Rainwater Harvesting System Practiced

From the results of the analysis, most of the respondents practiced rooftop rainwater harvesting systems (94.7%), while 4.5% of the respondents practiced underground storage (cistern) methods. Others (less than 1%) practiced run-off harvesting and other methods (Table 6).

Table 6: Method of RWH practiced

Variable	Frequency	Percentage
Rooftop harvesting	234	94.7
Runoff harvesting with ponds	1	0.4
Underground storage (cistern)	11	4.5
Others	1	0.4
Total	**247**	**100**

Source: Author's fieldwork, 2025.

Uses of Harvested Rainwater

The uses of harvested rainwater are presented in Table 7. Laundry/washing (48.2%) and cooking (23.0%) were the dominant uses, followed by bathing (15.2%). Only 1.9% used harvested rainwater for drinking, reflecting concerns about quality. A small proportion (3.5%) used it for watering animals and gardening. This is in agreement with the study of Edokpayi *et al*. (2018), which found that most of the participants in their study used harvested rainwater for laundry and cooking purposes.

Table 7: Household uses of harvested rainwater

Uses of harvested rainwater in household	Frequency	Percentage
Drinking	5	1.9
Bathing	39	15.2
Laundry/washing	124	48.2
Cooking	59	23.0
Cleaning toilets/bathrooms	21	8.2
Watering animal/gardening	9	3.5
Total	**311**	**100**

Source: Author's fieldwork, 2025.

CONCLUSION AND RECOMMENDATIONS

The rainfall pattern in Dutsin-Ma town is seasonal, concentrated within a short rainy period and followed by prolonged dry months. Although annual rainfall is moderate and highly variable, the intensity of rains during peak months provides sufficient runoff that can be captured and stored. Therefore, rooftop rainwater harvesting (RWH) has measurable potential to supplement domestic water supply in the area. Residents generally recognize water scarcity as a major problem and view rainwater as a useful supplementary source. However, rainwater is still perceived mainly as a secondary water source due to concerns about storage capacity, water quality and lack of technical knowledge.

Rainwater harvesting is practiced at the household level using simple methods such as rooftop collection with gutters and storage in drums, tanks, or containers. The systems are mostly informal and small-scale, limiting the volume of water captured and stored.

Given that the study found that Dutsin-Ma receives sufficient seasonal rainfall to support rainwater harvesting, it is recommended that the government and urban planning authorities integrate rainwater harvesting systems into building regulations and urban development policies. This can include making rooftop rainwater harvesting structures (gutters, downpipes, and storage tanks) a mandatory component of new residential and public buildings to maximize the utilization of seasonal rainfall.

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