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# The water accessibility of rural communities in the context of actual climate change: a focus on Sanyati District, Zimbabwe

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**ABSTRACT:** This study aims to examine the effects of climate change on access to and availability of water resources in rural communities, with a particular emphasis on Zimbabwe's Sanyati District. Using a quantitative research design, 230 questionnaires were applied to gather data between August and October of 2024 from residents. Simple random sampling technique was used to choose participants of the study. To evaluate past and current trends in climate, the research used scientific evidence documented in existing literature. Furthermore, the study used a descriptive survey methodology to assess climate change trends and their effects on rural communities' access to adequate water resources, based on the population's perception. Spearman's rank correlation coefficient was applied to determine the strength of the relationships between demographic characteristics of the population, their perceptions of climate change, and its impacts on water resource accessibility. Respondents noted observable changes in climate characterized by declining rainfall, rising temperatures and increasing incidence of droughts. Notably, the impacts of climate change on water accessibility were gendered, with women and those living with disabilities disproportionately affected. The research's findings underscore the urgent need for adaptive water management plans and regulations that tackle climate change's effects, while enhancing local resilience initiatives to ensure sustainable water access for communities in Sanyati. The study therefore recommends that there is need to promote community engagement and participation in decision making processes as this helps to build resilience and ensure the long-term sustainability of water resources in rural communities.

**KEYWORDS:** climate change, water stress, adaptation, vulnerability, drought, resilience, Zimbabwe

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## 1. INTRODUCTION

Witnessed changes in climate across the globe are a transformative trend within which, environmental experts are advocating for immediate action to address a myriad of interrelated problems (WHO, 2023; Hurtado et al., 2024). Sixty-one percent of Zimbabwe's populace resides in rural areas often relying on rainfed agriculture (ZimStat, 2022). Water accessibility in Zimbabwe's rural areas plays a significant role in sustaining livelihoods of rural residents. Water as a resource, is the source by which Africa's development can be driven (African Union, 2016). This underscores the importance of water

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accessibility in mainstreaming local efforts in realising several Sustainable Development Goals (SDGs) namely: eradicating poverty (SDG 1); ending hunger (SDG 2); promoting good health and wellbeing (SDG 3); providing quality education (SDG 4); addressing gender inequality (SDG 5); clean water and sanitation (SDG 6), and responsible consumption and production (SDG 12). Zimbabwe has not been an exception to the ravaging impacts of climate change, which has been attributed to both anthropological and natural causes (Goz, 2018; IPCC, 2023; Mata et al., 2024). Deforestation, overreliance on fossil fuels for energy production, unsustainable farming practices like monoculture and excesive use of fertizers, are amongst key anthropological factors that have made Zimbabwe susceptible to temperature fluctuations and erratic rainfall patterns (Chanza and Gundu-Jakarasi, 2020). These anthropological factors have been complemented by changes in weather patterns and geographical location, often categorised as natural causes of climate change. These changes in climate have negatively affected the accessibility of potable and non-potable water threatening food security, with the potential to create and sustain water related conflicts in Zimbabwe.

Zimbabwe upon gaining independence in 1980 adopted the 1976 Water Act which was grossly biased in providing the service in urban areas, disadvantaging rural residents. The formulation and adoption of the 1998 Water Act Chapter [20:24] sought to address mainly this inequality, by ensuring water accessibility was improved in underdeveloped rural areas (Malinga et al., 2017). The Water Act was complemented by the Zimbabwe National Water Authority Act Chapter [20:25], which saw the Zimbabwe National Water Authority (ZINWA) being the lead water authority exclusively responsible for water provision, supply and distribution. Regardless of the policy framework which has been put in place to ensure water accessibility in rural communities, surface water sources have proved to be seasonal. ZINWA has implored the need to invest more in ground water sources so as to improve on water accessibility.

The year 2018 saw the President of Zimbabwe His Excellency, Cde Emmerson Mnangangwa adopting Vision 2030 that seeks to attain an upper-middle income economy by 2030 (GoZ, 2018). At the core of this development thrust, lies water accessibility, a vital input in supporting various aspects of rural life, such as agriculture, health and economic development. In pursuing vision 2030, the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development crafted rural development 8.0, a model that seeks to eradicate poverty through rural industrialization and agricultural development nexus. The model anchors on eight pillars and or interventions namely: 1) presidential rural development programme, 2) presidential climate proofed input scheme, 3) presidential cotton scheme, 4) presidential blitz-tick grease scheme, 5) presidential community fisheries scheme, 6) presidential poultry scheme, 7) presidential goat scheme and 8) local interventions and innovations (Chimenya, 2022). The government noted that as a result of climate change, annual number of days with rainfall decreased, negatively impacting on annual received rainfall (Ndlovu et al., 2014; GoZ & UNDP, 2017). These noted changes if not addressed will jeopardise governmment efforts in realising the thrust of rural development 8.0. Similar changes in climate affecting water accessibility in Zimbabwe have also been witnessed in South Africa (Republic of South Africa, 2024). Most rural livelihoods have been threatened as a result of worsened water accessibility by climate change, with government exploring on resilient coping mechanisms aspiring to improve water reliability (ZimStat & UNICEF, 2019). Local adaptive capacities and coping mechanisms have been generally determined by geospatial and temporal variability (Brazier, 2015).

However, there is a dearth of literature focusing on the interplay between climate change and water accessibility in rural Zimbabwe, particularly focusing on Sanyati as a district. Much concerted research efforts heve been placed on coping mechanisms against changes being brought through climate change. This research seeks to address three primary objectives namely: 1) understanding the people's perceptions on water accessibility in the light of climate change, 2) identifying the impacts of climate change on water accessibility in Sanyati District and 3) recognising adaptation mechanisms employed by rural residents residing under Sanyati District. The study not only deepens our understanding on climate change—water accessibility nexus in rural communities in semi-arid regions, but also proffers practical coping mechanisms challenging conventional gender stereotypes and fostering inclusive policies and interventions in Sanyati and beyond. Succeeding the introduction is the literature review section which contextualises this study within the broader academic discourse and a section on study materials and methods follows. Subsequently, results are presented focusing on residents' perceptions on climate change, climate change impact on water accessibility and the strategies for enhancing resilience to water scarcity. The paper ends with discussions and conclusion.

## 2. LITERATURE REVIEW

There is unequivocal evidence pointing to the fact that Zimbabwe`s geographical location presents major climatic challenges. Climate models run on Zimbabwe`s climate data reveal trends where most of the weather parameters have shifted from the longtime mean. Available evidence suggests that the country has experienced a wide array of changes in rainfall and temperature while extreme weather events such as floods, droughts, heatwaves and hailstorms are on an increasing trend. Rainfall patterns in the country have shown a downward trend, as exibited by various climate models used to analyze historical rainfall data. These models indicate a reduction in both the frequency and intensity of rainfall over time, highlighting the growing impact of climate change on the country's water resources.

According to the GoZ & UNDP (2017), the country has experienced nearly 5 percent decline in rainfall during the last century. Figure 1 depicts rainfall trends from 1980 to 2016. The report also argued that droughts have increased in frequency and severity, and this is heavily impacting on food security, livelihoods and other aspects of human and sustainable development. Mazvimavi (2010) argued that a decline of 10% or 100 mm in rainfall has been observed in the country. Brazier (2015) opined that rainfall pattern in Zimbabwe is now characterised by spatio-temporal variability, increasing uncertainty in timing and amount of rainfall received, while the frequency and length of dry spells during the rainy season have increased. Makaudze & Miranda (2010) and Ndlovu et al. (2014), argued that frequency of rain days has declined, resulting in droughts becoming a common phenomenon.

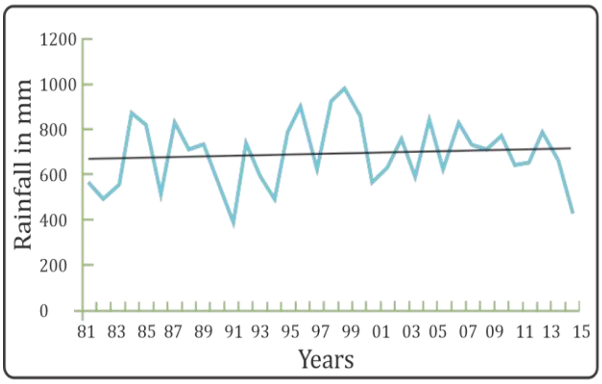


**Figure 1.** Zimbabwe average seasonal rainfall (mm) (1981- 2015).
Source: GoZ & UNDP (2017).

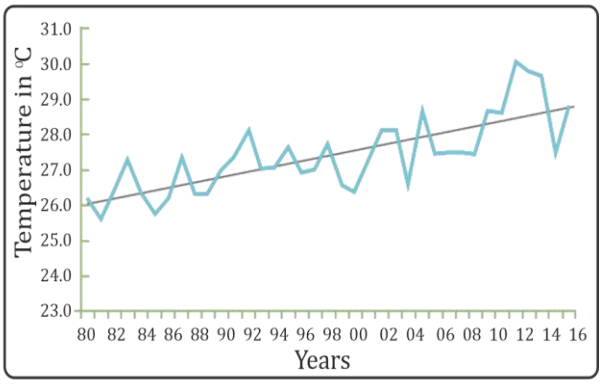


**Figure 2.** Zimbabwe's mean annual maximum temperature ºC (1980 to 2016).
Source: GoZ & UNDP (2017).

The country has witnessed a significant increase in hot days and a decline in cold days due to the impacts of climate change and climate variability (Brazier, 2015). According to the GoZ & UNDP (2017), historical temperature records show that the period from 1980 to 2015 has been the warmest since Zimbabwe started recording its temperature (Figure 2). Over the past few decades, rising global temperatures and shifting weather patterns have contributed to these changes, affecting ecosystems, agriculture, and water resources. This warming trend aligns with global patterns of climate change, largely driven by greenhouse gas emissions, deforestation, and other anthropogenic activities. The increase in extreme heat events poses challenges for food security, public health, and water availability, making climate adaptation strategies crucial for Zimbabwe's sustainable development.

Furthermore, the increased frequency of weather hazards associated with the changing climate is a growing concern in Zimbabwe. Mazvimavi (2010) acknowledged that frequency of droughts increasing due to growing variability in climate, is presenting formidable challenges amongst rural communities. According to GoZ & UNDP (2017) droughts are adversely impacting on water availability for domestic and industrial use and power generation affecting cities and non-agriculture sectors. Furthermore, the report opined that records have shown that Zimbabwe's rainfall is on decrease and the country is now characterized with frequent droughts. According to Mazvimavi (2010), the country's rainfall patterns are influenced by El Nino Southern Oscillation events, which have a 30% chance of causing drought. He reiterated that most parts of Zimbabwe are increasingly becoming drier due to changes in climate. Mwadzingeni et al. (2022) noted that cyclones and floods have become a common phenomenon in many parts of Zimbabwe as a result of climate change. They reiterated that cyclone Eline of 2000, Cyclone Dineo of 2017 and Cyclone Idai of 2019 were the most disastrous and fatal cyclones over the past two decades.

A growing body of literature supports the idea that impact of climate change on water accessibility effect women disproportionately. Research suggests that women are more likely to spend more time on water-collection tasks than men, indicating a gendered dimension to this issue (Geere & Cortobius, 2017; UNESCO, 2020; Fruttero et al., 2023). Several districts in Zimbabwe have been affected by variations in climate, although felt impacts seem to vary in relation to spatial location (Nyahunda & Tirivangasi, 2019; Frischen et al., 2020; Makuvaro et al., 2023; Mavesere & Dzawanda, 2023). Zimbabwe as of late has become more and more arid, characterised with less precipitation and severe warming (Mwadzingeni et al., 2022). This has established a positive corelation between climate change and water accessibility challenges, especially in regions IV, Va and Vb as depicted in Figure 3 (World Bank, 2020; Mwadzingeni et al., 2022). These noted changes concur with the observation made by UNEP (2024), where it argued that most African countries that had a water surplus are now experiencing water stress. Rural communities have been dealt with a severe brunt as noted by Amraoui et al. (2019), as most communities are best described with basic, limited, unimproved and surface water categories, as depicted in Table 1.

**Table 1.** Drinking Water Ladder.

| Drinking water ladder | Definition |
|---|---|
| Safely managed | Drinking water from an improved water source, which is located on the premises, is available for use when needed and devoid of disease-causing contaminants like fecal and priority contamination |
| Basic | Drinking water from an improved source provided collection time is less than 30 minutes for a roundtrip, including queuing. |
| Limited | Drinking water from an improved source where collection time exceeds 30 minutes for a roundtrip, including queuing. |
| Unimproved | Drinking water from an unprotected dug well or unprotected spring. |
| Surface water | Drinking water is directly collected from a river, dam, lake, pond, stream, canal, or irrigation channel. |

Source: WHO & UNICEF (2017).

Zimbabwe is spatially made up of five agro-ecological regions which were defined in 1960 (Chikodzi et al., 2013). Variations in climate saw the reclassification of these agro-ecological regions in 1984 and 2020, as depicted in Figure 3. The main reason proffered for the reclassification of these agro-ecological regions was noted changes in temperature and rainfall patterns in conventional agro-ecological regions. These changes have led to water stress evident in lakes, rivers and wetlands adversely affecting anticipated agricultural yield (Manatsa et al., 2020; Chimbiro & Soniye, 2023). There are quite a number of effects felt across rural Zimbabwe, as a result of climate variability, and these are not only limited to incidence of floods, uncontrolled veld fires, and droughts. These highlighted hazards have negatively affected water accessibility and reliability mostly in rural communities (Word Bank, 2020). Drying up of open water sources has affected even the distance local residents and domestic animals travel in rural communities in search for clean portable water (Assan, 2022).

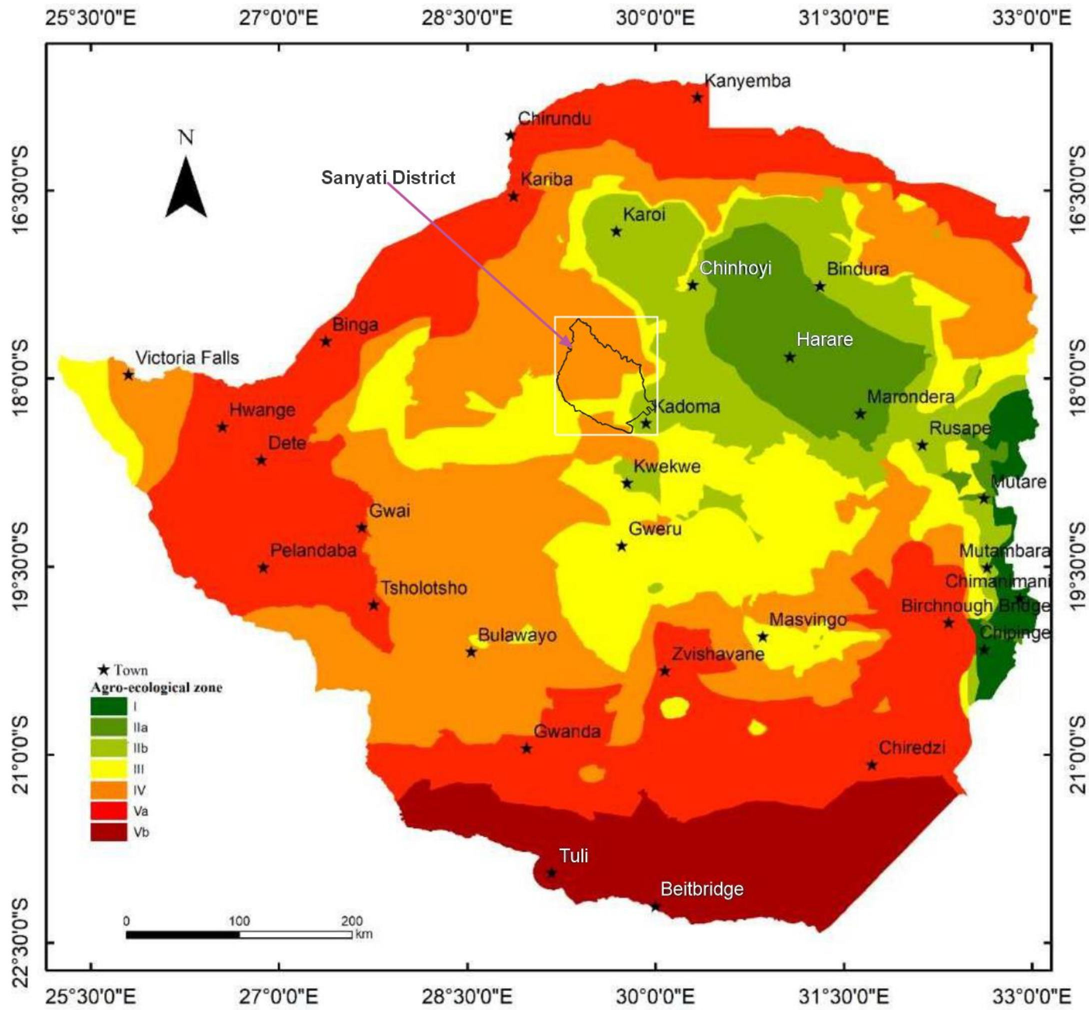


**Figure 3.** Revised Agro - ecological Regions of Zimbabwe.
Source: Manatsa et al. (2020).

The drinking water service ladder can best be used to describe different levels of access to drinking water, enabling data comparability on water accessibility and availability across diverse contexts. Climate change has worsened the water accessibility situation in rural contexts where a staggering 58% of local rural residents in Zimbabwe spend between 31 minutes to over 3 hours a day in one round trip, to and from a nearby water source (ZimStat & UNICEF, 2019). This observation is consistent with UNDRR (2021), which highlighted that in semi-arid Africa, 70% of the population rely on ground water source for domestic, economic and agricultural purposes. The ground water sources are greatly being affected by temperature and rainfall fluctuations, compromising on water accessibility in most rural communities (Fonjong & Zama, 2023). Distances being travelled by most rural residents in search for clean water in Africa has seen roughly 40 billion hours annually being lost to such an unproductive chore (UNICEF, 1999). These affected rural communities are collaborating with various stakeholders exploring on adaptation strategies (CARE International, 2022).

## 3. MATERIALS AND METHODS

### 3.1. The study area

The research was conducted in Sanyati District, situated at coordinates 17°57′00″S, 27°18′27″E within the Mashonaland West Province. The district spans over 4,832.98 square kilometers, comprising of 18 administrative wards and sustains a population of 139235 with a population density of 28.81

individuals per square kilometer (CSO, 2022). The location of the Sanyati District within Zimbabwe is showed in Figure 4. The district lies within the semi-arid areas of Zimbabwe, characterised by erratic rainfall patterns, leading to frequent food shortages (ZimVAC, 2009). Sanyati District falls within natural region III of Zimbabwe's agro ecological zone (refer to Figure 3). It receives a moderate mean annual rainfall ranging between 600-700mm, primarily during the rainy season from November to March. According to Mashizha et al. (2017), Zimbabwe's rainfall depicts significant year to year variability, with a standard deviation of 179 mm, exhibiting substantial fluctuations in annual rainfall levels. This high variability poses challenges for water resource management, agriculture, and climate adaptation strategies. The temperatures fluctuate between 28 and 32°C, occasionally experiencing severe dry spells and a relatively brief growing season.

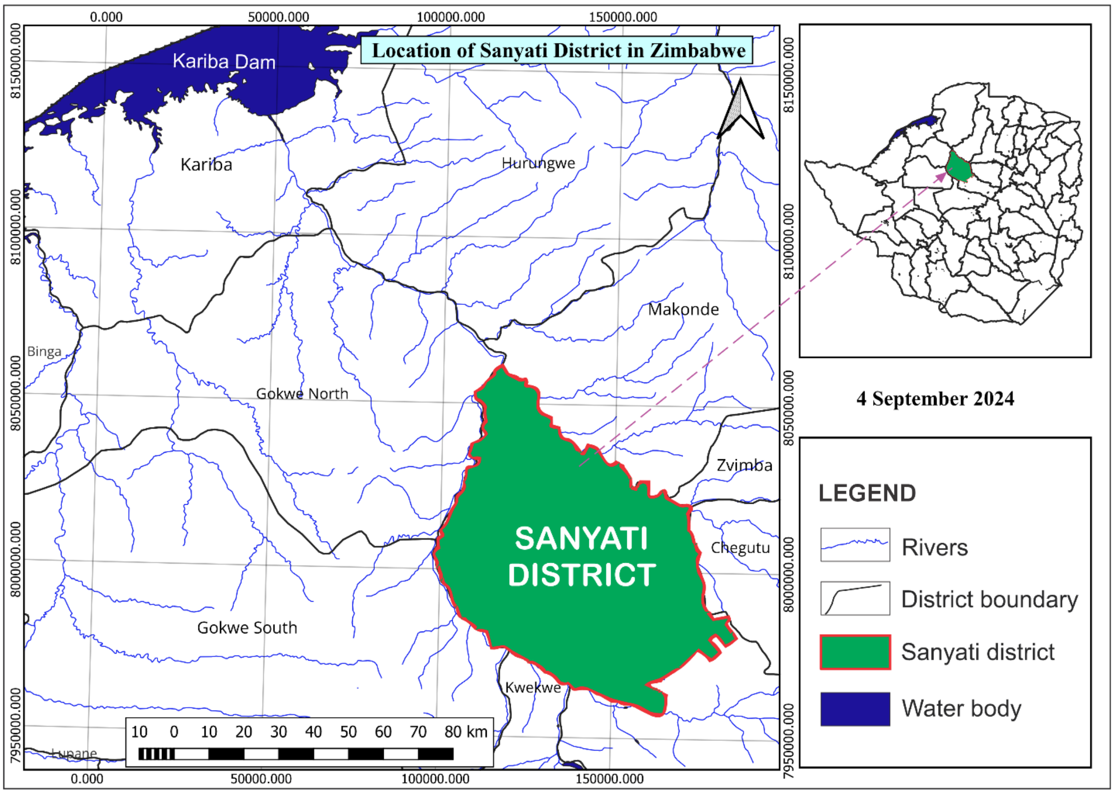


**Figure 4.** Location of the study area.

Sanyati District lies in the highveld, central plateau region of Zimbabwe. The general relief in the area is 1.250 m above sea level and interspersed with several hills which rise to about 1.300 m. The geology is mostly covered by the Mafic formation of the Bulawayo Group rocks (Boese-O'Reilly et al., 2004). The soils in the district vary from red loams to fertile lighter soils derived from schist and limestone, to granite and sandveld, with rich black soils in the vlei areas (Boese-O'Reilly et al., 2004).

The predominant vegetation in the area is mopani woodland, supporting the cultivation of crops like cotton, maize, soya beans, groundnuts, and sunflower. While cotton production dominates, the government is promoting the cultivation of small grains such as sorghum, millet, and rapoko. Notably, Sanyati District boasts rich gold deposits, fostering a landscape characterized by small-scale/artisanal gold mining activities.

### 3.2. Survey method

The study employed a descriptive survey methodology to assess the effects of climate change on rural communities' access to adequate water resources within Sanyati District. A total of 230 questionnaires were administered randomly amongst household heads to gather appropriate data regarding individuals' experiences and knowledge of climate change and water-related challenges in the region. The administered questionnaire had both open and closed ended questions focusing on demographic information, respondents` perceptions and awareness about climate change, proxy indicators of climate change, water resource availability and access issues, and adaptation mechanisms utilized by the residents to mitigate against the effects of water scarcity. Climate parameters that were considered in this research included rainfall, temperature, length of rainfall seasons and weather hazards such as floods, droughts and hailstorms. The interviews were conducted in person, necessitating the researcher to manually record responses provided by the respondents onto the questionnaires. Before commencing the interviews, participants were briefed on the logical objectives of the questionnaire and assured of the confidentiality of their identities. All participants engaged in the study voluntarily.

An in-depth statistical analysis was performed to discover the vital connections between the social and demographic characteristics of the population and their perceptions of climate change, as well as its impacts on water resource accessibility. Correlation analysis, specifically Spearman's rank correlation coefficient, was used to identify the intensity of the relationships between the considered variables. Spearman's rank correlation coefficient is a measure of the strength of the relationship between two variables that cannot be measured quantitatively (Spearman, 1904). Spearman's rank correlation coefficient is a nonparametric (distribution-free) rank statistic proposed as a measure of the strength of the association between two variables. The first step in establishing the value of $r_s$ for a set of $n$ bivariate data pairs was to rank the values of each variable. In this case, both were ranked from least to greatest.

The second step was to calculate the difference between ranks of corresponding observations calculated as $d_i = R_X - R_Y$, where the ranks of the values of $x_i$ are represented by $R_X$, and the ranks of the values of $y_i$ are represented by $R_Y$. In the third stage, squared rank differences were calculated - $d_i^2$. Once the values of $d_i^2$ were calculated, were then used along with the value of $n$, or the number of data pairs, in a general formula for Spearman`s rank correlation coefficient given as the following formula:

$$\mathrm{r_s} = 1 - \frac{6\sum d_i}{n(n^2-1)}, \tag{1}$$

where, $r_s$ represents the coefficient, and the number of points in the data set is represented by $n$. The square of the difference in the ranks of the two coordinates for each point $(x,y)$ is represented by $d^2$, and the expression $\sum d^2$ indicates that we should find the sum of each of these squares.

The Spearman correlation coefficient takes values from +1 to -1. Where $r_s$ value of +1 denotes a perfect association between variables, while $r_s$ of zero depicts no association between variables and $r_s$ of -1 indicates a perfect negative correlation between variables. Additionally, the closer $r_s$ is to zero, the weaker the association between the variables.

The results presented in the findings section exclusively consider coefficients that exhibit statistical significance above the 95% confidence level ($p < 0.05$). This stringent criterion ensures that the reported relationships are statistically robust and reliable, offering valuable insights into the interplay between climate change, water resources, and the rural community in Sanyati District. Furthermore, document analysis was utilised in this research to establish the historical context of Zimbabwe`s climate issues. Incidentally, document analysis was used to establish the climate change content by reviewing printed and electronic (computer-based and Internet-transmitted) material. Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge (Corbin & Strauss, 2008). Document analysis helped to compare people`s perceptions on climate change against scientific knowledge available on the subject to produce hybride research results.

## 4. RESULTS

This section presents findings obtained from 230 household respondents drawn from Sanyati District, Zimbabwe. It provides an overview of the demographic features of the respondents, the community's perceptions on climate change, proxy indicators for climate change, the effects on water resources and the adaptation mechanisms pursued by households in the area of study. By exploring these facets, the section provides light on the complex interlinkages between climate deviations and local livelihoods, providing valued insights into the adverse implications and responses within the study area.

### 4.1. Demographic characteristics

The demographic variables gathered in this study included information such as age, gender distribution of the respondents, types of family head, educational background, duration of stay in the area and family size. Table 2 provides an outline of the demographic profile of the whole sample, contributing valued insights into the diverse characteristics of the participants involved in the research.

**Table 2.** Demographic information on the sampled population.

| Demographic | Frequency | Percent |
|---|---|---|
| **Gender** | | |
| Male | 90 | 39.0 |
| Female | 140 | 61.0 |
| **Age class** | | |
| Below 30 years | 23 | 10.2 |
| 31 – 40 years | 39 | 16.9 |
| 41 – 50 years | 31 | 13.6 |
| 51 – 60 years | 55 | 23.7 |
| 60 years & above | 82 | 35.6 |
| **Type of family head** | | |
| Male headed | 117 | 50.8 |
| Female headed | 74 | 32.2 |
| Widowed male | 4 | 1.7 |
| Widowed female | 35 | 15.3 |
| **Household size** | | |
| 1 – 4 people | 113 | 49.0 |
| 5 – 8 people | 102 | 44.2 |
| 9 & above | 16 | 6.8 |
| **Level of education** | | |
| No formal education | 16 | 6.8 |
| Primary education | 51 | 22 |
| Secondary education | 129 | 55.9 |
| Tertiary education | 35 | 15.3 |
| **Years of residence** | | |
| Below 10 years | 19 | 8.47 |
| 10 – 19 years | 35 | 15.25 |
| 20 – 29 years | 47 | 20.34 |
| 30 – 39 years | 47 | 20.34 |
| 40 & above years | 82 | 35.59 |

Source: Authors (2024).

Table 2 illustrates a predominant gender distribution pattern generally in rural locations, where women characteristically form a greater segment of the population. In this study area, women make up a significant majority at 61%, while men represent 39% of the surveyed population. This gender distribution trend can be attributable to traditional beliefs and roles in rural communities, where women are often seen as the primary custodians and caretakers of rural households, while men are regularly engaged in employment opportunities in urban areas. This demographic insight underlines the distinct gender dynamics and societal roles that shape community structures in rural communities. Regarding the age distribution depicted in table 2, descriptive statistics reveals a higher number of respondents across older age clusters. Notably, there is a difference between the proportion of youthful individuals and the aging population. For instance, the study indicates that 10.2% fall below the age of 30, while 16.9% are aged between 31 and 40. In contrast, a significant rate of the population 23.7% and 35.6%, comprises individuals aged 50 - 59 years, and above 60 years respectively. This demographic trend can be credited to several factors, including the predominant phenomenon of rural-urban migration among the economically active age group seeking better opportunities in urban centers. Simultaneously, older individuals tend to retire to rural areas, leading to a higher proportion of elderly people in these areas. This demographic analysis underscores the complex interplay between age demographics, economic dynamics and migration patterns that shape the population distribution within the study area.

The average size of household in the studied area stands at 4.2 individuals. These survey findings concur with the 2022 Census conducted in Zimbabwe, which reported average household sizes of 4 (CSO, 2022), indicating consistency in household compositions across different research endeavors. Referring to Table 2, the data reveals that the majority of households (49%) fall within the cluster of 1-4 members, followed by 44.2% in the 5–8-member range whilst households comprising 9 members and above making up a small proportion at 6.8%. Household size serves as a vital indicator of the pressure exerted on available resources within a household. Larger household sizes characteristically imply increased susceptibility due to higher resource demands. Conversely, a larger household can also indicate a greater labor force available to enhance and manage water resources effectively, highlighting the dual role of household size in both resource utilization and resilience within the community.

In terms of education, a substantial proportion of the respondents had received some level of formal education, including primary (22%), secondary (55.9%), or tertiary education (15.3%), while only 6.8% reported no formal education. It is notable that the study area revealed a paltry percentage of individuals with tertiary education, chiefly due to the tendency of educated individuals migrating to urban areas in search of employment opportunities in industries. Moreover, the prevalence of individuals without tertiary education can be attributed to the limited presence or absence of tertiary institutions in rural settings. Education plays a key role in shaping respondents' perceptions of climate change, adaptation strategies – its diffusion and sustainability. An educated household head, for instance, can read and understand educational materials such as brochures distributed by extension officers and NGOs, which aim to educate residents on climate change realities, innovative ideas, and technological advancements. This educational exposure can enhance the adaptability and creativity of households, ultimately reducing their vulnerability to water scarcity. Scholars like Weir (1999) have highlighted the direct impact of education on farm productivity by enhancing labor quality. Similarly, Shultz (1975) underscores the significance of education in farm production, particularly in dynamic technological and economic landscapes, emphasizing its role in fostering agricultural innovation and productivity.

Regarding the number of years of residence in the study area, the research reveals that the majority (35.59%) of the households have been staying in Sanyati for more than 40 years. On the contrary, only a small proportion of respondents (8.47%) reported living in the study area for less than 10 years. The number of years staying in the area is likely to influence adaptation of a household. An individual with more years of residence has more knowledge of the environmental changes and has had more time to devise strategies to cope with the adverse implications of such changes. Additionally, such households are more likely to adapt better to the changing environment compared to community members with less years of experience. An increase in the number of years lived in an area is associated with lower levels of vulnerability and conversely, a decrease in the number of years lived in the study area is related to higher levels of vulnerability.

### 4.3. Residents` perceptions of climate change

According to Adger et al. (2008), people's perceptions are closely related to the perceived risks and opportunities arising from climate change, ultimately influencing their livelihood strategies and adaptive actions. A significant majority (80%) of the respondents recognized a departure from common weather conditions in Sanyati, while a minority (20%) observed no noticeable shifts in the climatic conditions (Table 3). These findings mirror those of the Republic of South Africa`s report (2024) which reported that 83% of residents in South Africa recognized changes in the local climate. The acknowledgment of changes in climate emphasizes the importance of community awareness and reaction to environmental shifts. Such perceptions serve as critical drivers for the formulation and implementation of adaptation measures tailored to mitigate the impacts of climate change on livelihoods and local ecosystems. By recognizing and responding to these evolving climatic patterns, communities can better prepare and safeguard their well-being against the challenges posed by environmental changes.

**Table 3.** Residents' perceptions on climate change.

| Response | Percent |
|---|---|
| No | 20.3 |
| Yes | 79.7 |
| **Total** | **100.0** |

The survey respondents highlighted various proxy indicators of climate change, notably citing shifts in weather patterns such as rising temperatures, dwindling rainfall, and increasing frequency in weather-related hazards like droughts. The direction and magnitude of these changes were quantified and analyzed for all participants, with the findings detailed in Tables 4 and 5. Regarding the air temperature shifts, a significant rate of respondents (80%) indicated a noticeable increase in temperatures, 10% reported a decrease and 5% noticed no significant changes in temperature trends (Table 4). These findings underscore the widespread recognition among respondents of the changing climate dynamics and emphasize the urgency for proactive measures to address and mitigate the impacts of these changes.

Results presented in Table 5 reveals that an overwhelming 92% of respondents observed a decrease in rainfall, while a mere 3.4% reported a perceived increase in precipitation amounts. In contrast, a small proportion of the respondents (2%), reported no noticeable changes in rainfall patterns, while another 2% were not sure about the trends on this parameter. These findings are consistent with those of Fonjong & Zama (2023) who found that 76% of the respondents acknowledged experiencing rising temperatures, characterized with longer dry than rainy seasons and early sunshine than expected. It is worthwhile to note that people's perceptions in the study area are in sync with the scientific evidence on the climatic patterns that were observed in Zimbvabwe.

**Table 4.** Changes experienced in air temperatures.

| | Percent |
|---|---|
| Increase | 79.7 |
| Decrease | 10.2 |
| No change | 5.1 |
| Not sure | 3.4 |
| No response | 1.7 |
| Total | 100.0 |

**Table 5.** Changes experienced in rainfall.

| | Percent |
|---|---|
| Increased | 3.4 |
| Decreased | 91.5 |
| No change | 1.7 |
| Not sure | 1.7 |
| No response | 1.7 |
| Total | 100.0 |

A Pearson correlation matrix was calculated to examine the relationships between social characteristics of the population and their perceptions of climate change variables (e.g. access to weather information, knowledge of climate change, level of education and years of residence). The matrix is presented in Table 6. We found a moderate positive correlation between access to weather information and knowledge of climate change, with $r = 0.419$, $p < 0.001$. Consequently, access to weather information increases the knowledge of climate change, that is, residents with access to a television set, radio or newspaper have higher chances of acquiring knowledge on climate change. We also found a moderate, positive correlation between level of education and knowledge of climate change, r = 0.447, $p < 0.001$. Accordingly, the more the higher the level of education, the higher the knowledge on climate change. Level of education and access to weather information had a moderate, positive correlation with r = 0.394, < 0.001. No other significant correlations were found.

Access to weather information has become indispensable in light of ever-increasing concerns surrounding climate change and variability. This information not only enables rural communities to anticipate and adapt to the adverse implications of climate change but also plays a crucial role in enhancing overall preparedness.

**Table 6.** Correlations Matrix showing the relationship between demographic characteristics and their perceptions of climate change.

| | Access to weather information | Knowledge of climate change | Highest education attained | Years of residence |
|---|---|---|---|---|
| Access to weather information | 1 | | | |
| Knowledge of climate change | 0.419** | 1 | | |
| Highest education attained | 0.394** | 0.447 | 1 | |
| Years of residence | -0.150 | -0.106 | 0.155 | 1 |

*Note* **. Correlation is significant at the 0.01 level (2-tailed).

In the context of this study site, a reasonable proportion (58%) of respondents have access to weather information, underscoring a moderate level of awareness regarding climate change (Figure 5). Moreover, a significant majority (66%) of respondents acknowledged the usefulness of the weather information they received (Figure 6).

However, there remains a resolute need for government intervention to improve the accessibility of weather information to a larger proportion of the population. It is imperative that this information is disseminated in a manner that is easily understood by individuals across all classes of the society. Implementing mechanisms to enhance the dissemination of weather information in a more user-friendly format can significantly boost community resilience and preparedness in the face of changing climatic conditions.

Regarding the sources of information owned by residents, it is evident that the most commonly cited mediums are "cell phones," indicated by 61% of respondents and "radio," constituting 58% of the surveyed population. Additionally, a sizable portion of respondents also rely on extension officers (37%) and information shared by their "families and friends" (25%). However, only an insignificant minority of individuals obtain information from "televisions" (15%) and "newspapers" (7%). This distribution of information sources reflects a prevailing trend in rural areas where the vast majority of the population live in abject poverty rendering the acquisition of televisions and newspapers financially unworthy for many. The widespread ownership of cell phones and radios can be attributed to their affordability and accessibility, making them indispensable tools for staying informed.

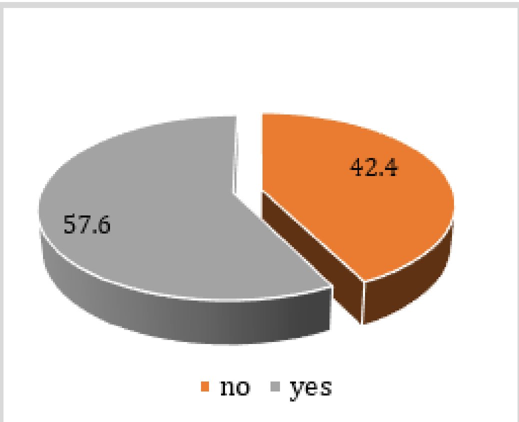


**Figure 5.** Pie chart showing people`s perceptions on access to weather information.

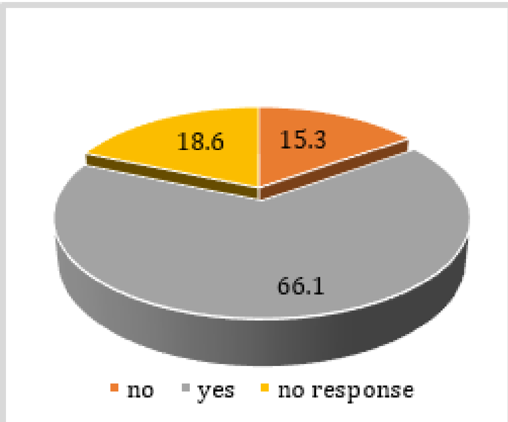


**Figure 6.** Pie chart showing people`s perceptions on the usefulness of weather information.

### 4.4. Climate change proxies in Sanyati

According to the feedback from respondents, the impacts of climate change in the study area are becoming increasingly apparent, characterized by rising temperatures, declining rainfall patterns, and an increased frequency of weather-related hazards. Notable climate change indicators identified by the study include a decrease in rainfall (92%), a rise in temperatures (80%), a reduction in the duration of rain seasons (92%), and a rise in occurrences of droughts (88%) (Figure 7). Responses regarding floods and hailstorms showed smaller decreases of these indicators (41% and 24% respectively).

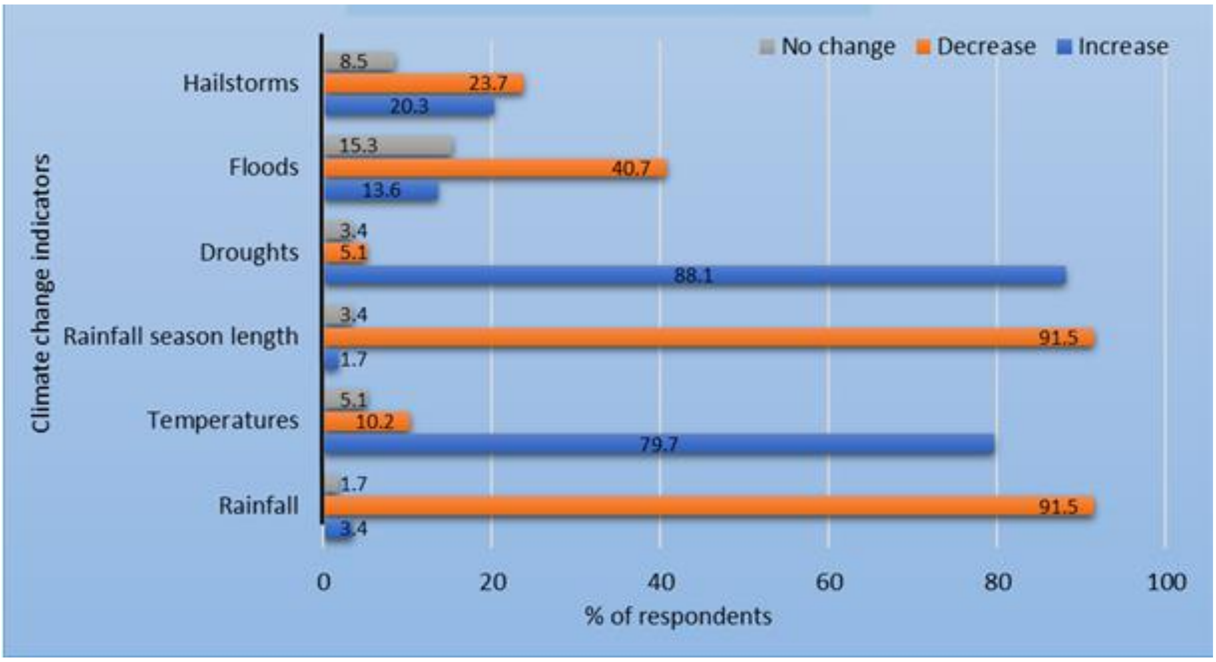


**Figure 7.** Proxy indicators of climate change as observed by the respondents.

These findings underscore the tangible effects of climate change on the local environment and people`s livelihoods. The overwhelming consensus on phenomena like reduced rainfall and increased temperatures highlights the urgent need for proactive measures to mitigate the adverse consequences of these changes. Understanding these key indicators can inform targeted interventions and adaptation strategies to strengthen resilience within the community. It is imperative to address these pressing climate challenges through informed policies and practices that safeguard both the environment and the well-being of residents in the study area.

### 4.5. Impacts of climate change on water access

The challenges caused by climate change on water resources manifest through water quantity and quality changes that are caused by climate factors mainly rainfall and temperature changes. According to Amraoui et al (2019), rural households in Southern Africa are the most vulnerable to climate change-induced drought and variability due to their high reliance on groundwater and groundwater-fed systems for potable water use. In Zimbabwe, ground water is a source of water for above 70% of the population (UNDRR, 2021). UNEP (2024) noted that many countries in Africa shifted from water surplus to water scarcity as a result of population changes coupled with the effects of climate-induced water stress. Water scarcity stands out in many research as a prominent challenge exacerbated by the impacts of climate change. Findings from this research, as highlighted in Figure 8, reveal a significant trend where the majority (72%) of respondents which reported difficulties in accessing adequate water resources for their day-to-day needs. This situation is primarily attributed to diminished precipitation patterns and the effects of global warming, resulting in an adverse water balance, particularly noticeable in agro-ecological regions 3 to 5. Moreover, a sizable proportion (59.3%) of the respondents indicated a worsening situation regarding access to water. Consequently, residents have observed an incremental decrease in adequate water accessibility over time. The repercussions of water scarcity have compelled a considerable rate of the population to endure longer distance in search of water sources.

The prevalence of water access issues underscores the perilous nature of the water scarcity problem in the study area. As climate change deepens, the strain on water resources is expected to exacerbate, posing serious implications for various sectors including agriculture and infrastructure. Addressing this challenge demands a multifaceted approach that integrates sustainable water management practices, community engagement and building climate-resilient livelihoods. By recognizing the specific regional vulnerabilities and implementing targeted interventions, stakeholders can work towards enhancing water security and building resilience in the face of evolving climatic conditions.

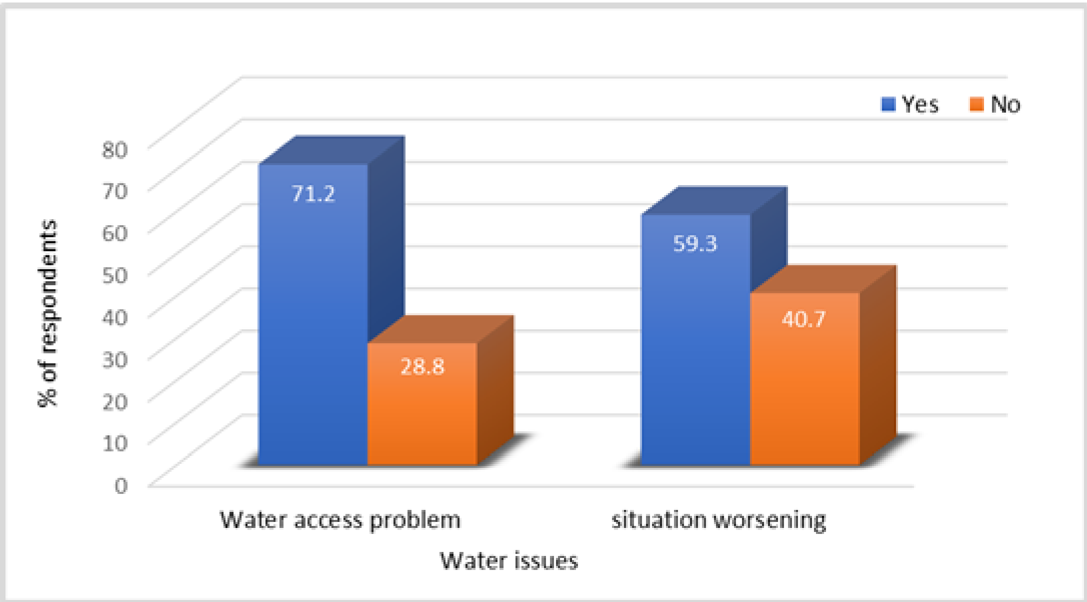


**Figure 8.** Residents` perceptions on water access.

**Table 7.** Correlation matrix showing the relationship between knowledge of climate change and water access challenges.

| | **Knowledge of climate change** | **Changes in water quantities per household** | **Changes in water quality noticed by household** | **Distance to a water source** | **Number of dried perennial sources** |
|---|---|---|---|---|---|
| Knowledge of climate change | 1 | | | | |
| Changes in water quantities per household | -0.488 | 1 | | | |
| Changes in water quality noticed by household | -0.137 | 0.339** | 1 | | |
| Distance to a water source | 0.561 | 0.295* | 0.121** | 1 | |
| Number of dried perennial sources | 0.458 | 0.122 | 0.018 | 0.341** | 1 |

*Note***. Correlation is significant at the 0.01 level (2-tailed).

Upon conducting Pearson correlation analyses between variables representing challenges induced by climate change, significant findings emerged. As depicted in Table 7, a strong positive correlation was established, $r = 0.561$, $p < 0.001$, connecting climate change to the distance individuals need to travel to access water sources. This implies that residents of Sanyati witnessed an increase in distance to a water source as a result of ever-increasing changes in climate. Furthermore, the study discovered a moderate positive relationship between the increase in the distance to water sources and the number of dried perennial water sources within the research area, $r = 0.341$, $p < 0.002$. Additionally, a Pearson correlation matrix was also computed to explore the relationships between climate change and the number of dried perennial water sources, as well as climate change and changes in water quantities per household. Subsequently, a moderate positive correlation was observed between the knowledge of climate change and the number of dried perennial water sources, $r = 0.458$, $p < 0.003$, together with a moderate negative correlation between climate change and changes in household water supplies, $r = -0.488$, $p < 0.004$.

Conclusively, the study findings indicate that shifts in climate patterns have catalyzed an increase in the number of dried water sources and a reduction in the available water quantities for households within the study area. These outcomes underscore the pressing need for proactive measures to address the escalating water challenges aggravated by climate change in the region.

Additionally, the study reveals a prevalent trend among respondents, showcasing that a substantial portion of individuals walking longer distances to access the nearest water sources. Specifically, the research indicates that a majority of residents travel distances exceeding 1.6 kilometers to reach the closest borehole/well or river/dam (Table 8). Drawing from UNICEF's guidelines from 1999, it is recommended that each household should have access to a minimum of 40 liters of water within a distance of less than 1.6 kilometers, reachable within a maximum 30-minute walk time carrying three buckets one way. However, in the study area, approximately 45% of the population must travel more than 1.6 kilometers to reach a nearby safe water source, and a significant 73% walk a similar distance to reach a dam or river. These research findings concur with those from ZimStat & UNICEF (2019) report which acknowledged that climate change is worsening the water accessibility situation. It noted that 58% of local rural residents spend between 31 minutes to over 3 hours a day in one round trip, to and from a nearby water source.

The study also reveals that as the distance decreases, there is a diminishing proportion of respondents complying with the UNICEF-recommended distance criterion, signifying that only a small fraction of the population can access water within the stipulated 1.6-kilometer range. The long distances traveled by people not only indicate heightened energy and time spent carrying out this task but also hint at potential implications for reduced productivity among the local population. Addressing these challenges calls for strategic interventions to improve water accessibility and mitigate the adverse impacts of prolonged water fetching activities on community well-being and productivity.

**Table 8.** Percentages of people walking various distances to a water source.

| Distance to water source | Borehole/Protected well (%) | River/Dam (%) |
|---|---|---|
| <500m | 15.3 | 5.1 |
| 500m-1km | 22.0 | 5.1 |
| 1km-1.5km | 18.6 | 16.9 |
| >1.6km | 45.0 | 72.9 |

### 4.6. Strategies for enhancing resilience to water scarcity

Climate change and its impacts on water resource access are complex phenomena that require realistic and effective adaptation and mitigation measures tailored to the specific biophysical and socioeconomic conditions of the communities concerned. To enhance resilience against the impacts of climate change on water resources, the communities within the study area have implemented a wide array of adaptation and coping strategies. Figure 9 illustrates the diversity of mechanisms adopted by the community to mitigate the adverse effects of climate change on water resources.

The study findings indicate that a significant majority (44%) of the population relies on storage tanks as a primary method of combating water scarcity, while a negligible portion (5%) have resorted to using river water for abating the effects of water scarcity. Additionally, 20.5% of individuals have opted for increased boreholes, 16% have embraced water rationing practices, and 9% have turned to water harvesting as their preferred approach to address water challenges caused by climate change.

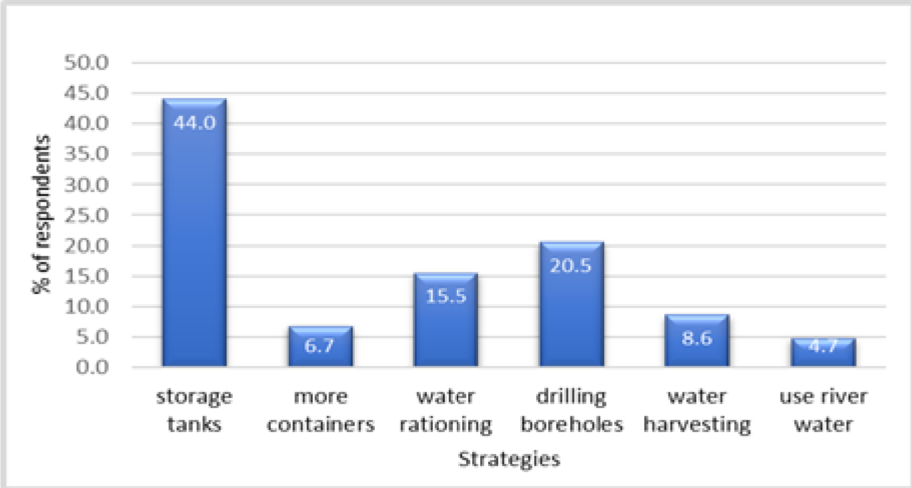


**Figure 9.** Strategies for building resilience used by the population in the study site.

These varied approaches highlight the community's proactive efforts to adapt to and cope with water scarcity induced by climate change. By diversifying their strategies and utilizing a combination of methods such as storage tanks, boreholes, water rationing, and water harvesting, residents are working towards building resilience and ensuring sustainable water access in the face of evolving environmental challenges.

## 5. DISCUSSION

The study explores various aspects, including demographic characteristics and inhabitants' perceptions of climate change. The demographic analysis shows a predominant gender distribution skewed towards women, highlighting traditional roles and dynamics within rural communities. The impacts of climate change on water accessibility appear to be gendered (Mudombi & Muchie, 2013; Tanyanyiwa & Mufunda, 2019; Fruttero et al., 2023). A 'gendered lens' on water accessibility resonates with socially constructed roles assigned with one's sex. The gender-based division of work has seen females in rural Zimbabwe spending most of their time, as compared to their male counterparts fetching water, an unpaid menial task (Geere & Cortobius, 2017). As climate change is affecting most rural livelihoods, men are migrating to urban areas seeking better employment opportunities, leaving women with the brunt of fetching water. Variations in climate has seen water accessibility for persons living with disability worse, when comparing experiences of people living with disabilities in urban and rural areas (UNESCO, 2020). Taking those who use wheelchairs for instance, they fail to easily access water from a borehole since boreholes are not wheelchair compatible. This gendered approach clearly depicts how climate change further compounds people`s ability to access water in rural Zimbabwe.

The study noted significant impacts of climate change on water accessibility in Sanyati. It highlighted those changes in climate has seen an increase in competing water needs amongst residents in rural communities. This is consistent with Chimbiro & Soniye (2023), who noted that water related ecosystems inclusive of rivers, wetlands and lakes have negatively been affected, resulting in local residents seeking alternative means of assessing water in response to water stress. Despite the looming challenges of water accessibility, rural communities in Sanyati have come up with adaptation strategies through collaborations. CARE International (2022) noted that rural communities in partnership with several stakeholders, have embraced on adaption strategies in combating water accessibility challenges. For instance, Mwenezi District, which is amongst the severely hot regions, has seen water harvesting initiatives being funded for, by collaborative stakeholders such as the Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement in partnership with the Swedish Embassy, European Union, UNDP, and the Foreign Common Wealth Development Office. This project in Mwenezi District has led to the construction of 120 underground cement tanks and a dam with the capacity to hold 45 000 $m^3$ of water (CARE International, 2022). This collaboration has enhanced transformational resilience, capacity building and the general improvement to water access. In addition, collaborations in Shurugwi (Vimbai Village) and Mudzi (Fombe Project) have enhanced community water access by drilling 3063 boreholes which benefited these districts.

**6. CONCLUSIONS**

This study emphasises how climate change has a major effect on rural people's access to water, particularly in Zimbabwe's Sanyati District. The primary research topic evaluates the impact of climate change on rural communities' access to and availability of water resources. The results of this study show that rural communities' access to and availability of water resources has been influenced by climate change. This was demonstrated by the fact that 71.2% of respondents stated that they had trouble getting enough water resources, mainly because of decreased precipitation and global warming, and that 59.3% of participants stated that their access to water had gotten worse over time, pointing to a concerning trend in water availability. The results show a strong correlation between the reduced availability of water resources for nearby communities and shifting climatic patterns marked by less rainfall, warmer temperatures, and more frequent droughts. The community's perspectives show a keen awareness of these changes, underscoring the pressing need for flexible approaches to efficiently manage water supplies. A significant majority (79.7%) of the respondents acknowledged noticeable changes in weather patterns in Sanyati, indicating a strong awareness of climate change impacts. This reasonates with the study’s quantitative approach supported by the use of Spearman’s rank correlation coefficient which illustrates to what extent demographic factors influence perceptions of climate change and its impacts on water access.

The study also reveals a predominat gender distribution in Sanyati District, with women constituting 61% of the surveyed population compared to 39% for men. This finding reflects traditional societal roles where women are often the primary caretakers of households. This therefore underscores the intertwined relationship between gender dynamics and water accessibility in the context of climate change highlighting the need for targeted interventions or tailored strategies that support the resilience of rural communities in Zimbabwe, particularly emphasising women’s roles in water resource management. The study reveals that Sanyati District communities have taken a proactive approach to reducing the effects of climate change by implementing a range of measures to increase their resilience to water scarcity. From the study, 44% of the respondents use storage tanks as their primary strategy to deal with water scarcity, while 20.5% chose to drill more boreholes and 15.5% have used water rationing procedures.

The limitations noted in this study, such as its dependence on local specificity, point to the necessity of more research to deepen understanding and guide focused solutions in various circumstances in Zimbabwe and other areas. While the study utilised a cross-sectional approach, future research would benefit more from a longitudinal research design, enabling changes being witnessed as a result of climate change and its impact on water accessibility to be tracked over time.

These research findings highlight the urgent necessity for climate-responsive water management policies in rural communities. Considering that women constitute the greater proportion of the surveyed population and are directly involved in water resources supply and management issues at household level, women should be empowered to participate in water governance and decision-making at both community and country level. Furthermore, there is need to push for the incorporation of decentralization of water governance in existing policies in order to promote local participation in water conservation and sustainable use. This is based on a widely accepted notion that community-driven initiatives are more likely to succeed because they foster a sense of ownership and responsibility among members of the community. In a bid to mitigate against water scarcity in the Sanyati District, this study recommends the following:

-Promote collaborative rural governance where local communities partner with the public, private sector and NGOs in borehole drilling programs in order to promote widespread utilization of groundwater resources.

- Expand access to affordable water storage tanks and this can be achieved through offering subsidized water tanks to low-income households.
- Providing training programs for women on sustainable water use and climate change adaptation strategies.
- Introduce affordable water purification technologies for rural communities in order to enhance access to safe water.
- Furthermore, it is imperative that policymakers create policies that support sustainable practices in the management of water resources while simultaneously lessening the effects of climate change.

For further research, the following research gaps should be considered:

- more research should focus on how climate change disproportionately affects women and how gender-specific adaptation strategies can be implemented effectively;
- there is a need for studies that analyze how government policies, economic conditions, and social structures influence climate adaptation and water security;
- future research should explore the use of GIS, remote sensing, and AI-based predictive models for real-time water resource monitoring and climate risk assessments.

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**Use of AI tools declaration**
The authors declare that they have not used Artificial Intelligence (AI) tools in the creation of this article.

**Conflicts of interest**
The authors declare that they have no conflicts of interest to.

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