Climate change and water insecurity in rural uMkhanyakude District Municipality: an assessment of coping strategies for rural South Africa

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Abstract

The vulnerability of Africa to climate change extremes and eventual impacts is extremely high due to the weak coping strategies prevalent in the continent. The peculiarity of South Africa to these vulnerabilities, especially for water security, is an issue of socioeconomic and policy issue. Based on the premises of human security, the study assesses the coping strategies of rural communities in South Africa, focusing on uMkhanyakude District Municipality, KwaZulu-Natal province, given the effects of climate change-induced water scarcity on the area. The study employed a multilayered descriptive mixed method triangulation approach. It focused specifically on the connection between water and climate change and the adopted everyday vertical and horizontal coping strategies. The findings revealed a strong correlation between the behavioral and traditional coping strategies in the study area, water depletion/scarcity, and climate change. It also showed that government institutions are reactionary in their response to climate change-induced impacts. The study, therefore, recommends a pre-resilience mechanism that makes institutions and individuals proactive rather than adopting a reactionary post-resilience strategy in response to the effects of climate change-induced water security.

Key words: climate change, coping strategies, human security, rural, South Africa, water security

Highlights

- Water reuse seems to be the most common community strategy.
- Community response is largely traditional and behavioral (such as water reuse, rainwater harvesting, and water rationing) largely due to the poor socioeconomic standing of most households within the area.
- State institutions are reactionary rather than proactive in their intervention strategies.
- Climate change is exacerbating water stress in the area.

INTRODUCTION

The global challenges of water security in view of climate change have grown in complexity in recent decades. Within the scientific community, there is a consensus as to the existence of climate change and the significant hydrological alteration it would evoke. However, there is less certainty on the direction, magnitude, and trends of these impacts at the local, regional, or global levels (Ludwig et al. 2014). Cisneros (2015), among others, asserted that the consequence of climate change would predominantly be water-related. Despite the continuous efforts by actors at the global, regional, national, and local levels on mitigation and adaptation to climate impacts, especially on water, the...
situation of water insecurity seems to increase rather than diminish. This holds true more for Africa, as the continent is adjudged extremely vulnerable to climate change largely due to its fragile coping strategies characterized by poverty, over-dependence on rainfed livelihood options, government incapacities, wars, and ethnic infighting, among others (Patrick 2020). Schewe et al. (2014) submitted that climate change would considerably affect renewable water resources and aggravate regional and global water scarcity problems. Similarly, Falkenmark (2013) posited that climate change is likely to increase the frequency and intensity of extreme hydrological events. The responses in terms of coping mechanism and strategies of individuals and societies alike to these uncertainties, especially in African communities, are in most instances blurred.

The paper presents an assessment of coping mechanism for climate change-induced water scarcity in uMkhanyakude District Municipality, South Africa using three broad themes (community perceptions, community coping, and individual response strategies). The rationale is to give an overview ‘first take’ analysis on group and individual agencies in the face of the environmental challenges faced by individuals, households, and the community. It provides open avenues for future research on particular aspects of identified coping strategies in rural South Africa. The paper provides a novel perspective on the ‘everyday’ response mechanism adopted by rural communities to water insecurity issues. The central question the study seeks to answer is ‘what is the response/coping mechanism of rural communities to water insecurity in rural South Africa?’ The rationale is to guide policy formulation that will propose realistic solutions to practical challenges of climate change adaptation and human security. The study is an exploratory study that focuses on the practical realities of climate change’s impact on water for rural community dwellers from a human security prism. The rationale is to assess the response mechanism, lack of knowledge of, and services for rural South Africans who will largely bear the brunt of the impacts.

SNAPSHOT OF THE PROBLEM

South Africa as a case in point vis-à-vis water security has become a research concern. The country, located in the southernmost part of Southern Africa, is considered a water-scarce country and has one of the world’s lowest run-offs (Council for Scientific and Industrial Research [CSIR] 2010; Oxfam 2010). It is among the 30 driest countries globally, with about 40% less rainfall than the global average (SA Government 2015, Patrick 2019). Thus, the country’s annual rainfall at 464 mm is below the global average of 860 mm (Oxfam 2010; Lucas et al. 2015). In 2010, the Council for Scientific and Industrial Research (CSIR) observed that

’South Africa is faced by a crisis of water supply due to the combined effect of low rainfall, high evapotranspiration, an expanding economy and a population growth whose water demand does not conform to the distribution of water supplies.’ (CSIR 2010: 8)

Due to the uniqueness of South Africa vis-à-vis climate change variation, CSIR (2010) asserted that

‘… less rainfall and a temperature increase will likely lead to a significant decrease in the levels of ground and surface water while the rise in the frequency of storms and other weather events will lead to the damage of storage facilities and infrastructures. The combined effect of these situations will

1 George et al. (2016) conceptualized coping strategy as specific behavioral and/or psychological actions undertaken by people as responses in an effort to reduce, minimize, or endure a stressful event. It corresponds to the idea of ‘response and survival’ from a real or perceived form of threats to ones’ survival. This study conceptualizes coping strategies as the short-term immediate cognitive and behavioral responses undertaken by individuals, households, and/or communities to declining natural resources (in this case, water resources).
have a significant impact on the quality and quantity of water in water storage reservoirs and river systems.' (CSIR 2010: 29)

Therefore, while water shortage and stress are projected to affect most countries in Africa by 2050, a significant number of these countries, including South Africa, are expected to experience water stress and water scarcity as early as 2025 (Madzwamuse 2010). This projection is believed to have come in even earlier, as the country is already experiencing water stress in most of its major cities. The UNFCCC (2011) predicted that Africa would experience increased water stress and conflict, as average temperatures across the continent continue to rise while rainfall declines. In line with this position, over 35% of the average 1.2 billion people in Africa are already without access to safe drinking water. Rodda et al. (2016) asserted that while 663 million people continue to use unsafe drinking water globally, over 50% of these numbers are residents in Africa. Similarly, while 600 million were without access to water globally as of 2010, about 240 million (approximately 40% of the total) are in Africa (Cisneros 2015). The effect of water security will hereby be influenced considerably by the peculiarities of an area, its geographical location, the condition of water availability and use, the resilience of the ecosystem to climate variability, demographic changes, prevailing management, and the allocation system, as well as the existing institution and governance structure (UN Water 2013).

Adeleke et al. (2014) argued that South Africa’s approach to climate change has been toward establishing a governance framework. Recent examples include the National Development Plan, 2011; Carbon Tax Policy, 2013; National Planning Commission Medium Term Strategic Framework, 2009–2014; and Department of Environmental Affairs National Climate Change Response, 2012, among others. Ziervogel et al. (2010, 2014) argued that these policies are yet to be translated into everyday practice among the South African populace, especially in the rural communities.

It has also been observed that 5 of the 19 water management areas in South Africa have experienced water shortages, while 10 of the 19 areas broke even, only 4 of the 19 areas have surplus water (Bormann 2014). Action Aid (2016) further posits that with more than 25% of water supplied never reaching its final consumers and 6.4% stolen by unauthorized users, over 6,500 rural communities are faced with acute water shortages. The study also reported that an estimate of 30% of the country’s towns is already experiencing a water deficit. An additional 13% were expected to experience water shortages by 2021, while a further 12% will likely join within 10 years. The study also observed that 82% of the country’s 120 rivers are considered threatened by water scarcity/stress, 11% vulnerable, 27% endangered, 44% critically endangered, and 18% least threatened by climate change and water security challenges. The study projects a 17% gap in water supply and demand by 2030, with cities like Johannesburg, Pretoria, Cape Town, and Durban experiencing the most significant challenge in water management. It has also been projected that by 2050, there will be a rainfall decrease of 5–15% throughout the growing seasons in the interior parts of South Africa. This is due to a reduction in soil moisture and run-off, a 10–30% decrease in river run-off and water availability, and an increase in evapotranspiration by 40%, leading to reduced outflows from water reservoirs (Kusangaya et al. 2014).

While Borman (2014) and Kusangaya et al. (2014) project a continuous decline in the quality of available freshwater for the nation, the Department of Water Affairs (DWA) (2013) asserted that domestic water consumption over the last decade in South Africa increased from 22 to about 27% of the total national water consumption in South Africa. Hence, the demand for water over the next decade is projected to grow by 1.2%. Ziervogel et al. (2014) argued that to reconcile the water supply and demand gap in South Africa, it is imperative to increase available water supply by about 2.5 km³ and decrease water withdrawal by 0.57 km³ by 2050. Though this intervention may slow the imminent water stress, it is argued that water demand would exceed supply annually through 2035. This is because the country is on the verge of experiencing a 17% gap in water supply and demand by 2030 if no imminent action is taken. This gap in water supply/demand will equate to a water shortfall of approximately 2.7 billion cubic meters. Similarly, Plessis (2017) posited that
while the country is experiencing a multifaceted water crisis, it will experience a doubling of its total requirement for water in three decades due to continuous demographic growth, economic development, and urbanization. Hence, more emphasis needs to be placed on water conservation and usage to ensure water security.

The variables for the adoption of a coping strategy in the event of water insecurity include, among others, the evaluation of the situation, as well as the available resources at one’s disposal. These coping strategies are conscious impromptu, cognitive, and/or behavioral responses to sudden societal and environmental threats in avoiding and reducing vulnerabilities (Berman et al. 2015). Ojala (2012) argued that these responses are impacted not only by psychological well-being but also by the social (and economic) engagement of individuals and households. As Hendrix & Salehyan (2012, 2014) and Patrick (2020) argued, the sudden and abnormal alteration in the expected pattern of resource availability for individuals is capable of reducing the motivation for engaging in legal endeavors and increasing the morale for antisocial engagement as a coping mechanism. This implies that the probability of individuals engaging in expected behaviors in conformity to societal values and norms will be reduced due to the uncertainty in accessing available resources.

In the face of climate change impact on water, studies by Deressa et al. (2010), Okonya et al. (2013), and Mengistu & Haji (2015) identified household and individual coping strategies to include the switch from plant to livestock ownership, crop diversification and change in planting dates, migration, reduction in current consumption and rationing of resources, as well as the sale of assets, among others. The gap in these studies is that little attention is placed on exploring the traditional everyday responses by individuals and households to climate change impacts. These traditional behavioral responses include activities such as water reuse, rainwater harvesting, and water rationing, among others.

Mukuhlani & Nyamupingidza’s (2014) study of coping strategies during water scarcity situations in Bulawayo, Zimbabwe, identified negative and positive coping strategies adopted by government, communities, and households. The positive coping strategies include water shedding to stabilize the shrinking dam water levels, water trucking, walking long distances to fetch water, buying water from other communities and water vendors, and buying water containers to store water. The negative coping strategies include conflict, vandalism, and abuse, among others. Their study indicated that conflict, as a coping strategy, occurred due to the inconsistency of water supply, especially during the peak of water shortage and rationing. In the same vein, SAMWU (2015) and Magubane (2015) argued that the illegal connection of water and corruption are among negative coping strategies devised within the study area. These situations lead to the illegal trade of water transported by water tankers and the non-delivery or diversion of water in some areas, thereby posing a challenge to the municipality’s intervention strategies. In the same vein, Frankson (2015) asserted that over 237 million liters of water per day are lost to illegal connection, unreported leaks as well as vandalism.

Similarly, the peculiarities of individuals in terms of their worldview, belief systems, and other unique characteristics determine their responses when faced with difficult situations such as climate change-induced water scarcity (Osbahr et al. 2010). Therefore, the choice of one coping strategy over another is reliant on the characteristics of the individuals and/or households as well as the magnitude and scale of the event (George et al. 2016; Patrick 2020). The strategies employed by each household will be determined by their socioeconomic characteristics in terms of the gender of the household head, income, access to resources, and asset, among others (Deressa et al. 2010; Mengistu & Haji 2015). Hence, hydro-climatic variability and socioeconomic alterations interact and reinforce society’s coping strategies (Zheng & Byg 2014).

On the premises of these assumptions, this paper discusses the coping strategies/mechanism adopted by rural communities in South Africa in view of the impact of climate change on water security.
DATA AND METHODS

Methods

This paper is an extract from a more extensive study on climate change and water security issues in rural South Africa (see Patrick 2019). There has also been a recent publication that dwelt extensively but solely on conflict and the likelihood of conflict as a coping mechanism (see Patrick 2020). This current paper subsumes the previous publication and discusses the entirety of the coping strategies (traditional and behavioral) adopted in the event of climate change-induced water scarcity in rural communities in South Africa. In this case, conflict is discussed in passing only as one of the behavioral mechanisms adopted in the event of climate change-induced water insecurity.

A concurrent, convergent mixed methods approach combined with a multilayered sampling method was used for the study. The concurrent, convergent mixed method allowed for the blending of both the qualitative and quantitative research approach in the same study concurrently so as to allow for a broad and in-depth understanding of the research phenomenon, which could have been impossible should one approach be used (Creswell & Plano 2011; Creswell 2014). The multilayered sampling method allowed for a purposive selection of the larger sampled area based on the criteria of the study. In this case, areas recorded as being affected by climate change-induced water scarcity using metrological and organizational data. A simple randomized sampling of participants within the larger purposively selected population is subsequently made (Patrick 2019). The study conducted 8 focus group discussions, 12 interviews, and 384 from the 450 survey questionnaires distributed in uMkhanyakude District Municipality (comprising Jozini, Hlabisa uMhlabuyalingana, Big Five Bay, and Mtubatuba). The choice of the study area was informed by the fact that the area is one of the hardest-hit climate change-induced water scarcity areas in South Africa, coupled with it been the poorest municipality in KwaZulu-Natal province, South Africa (Ntsaluba 2014; SA Human Rights 2014). The data were triangulated with organizational data and analyzed using descriptive and thematic content analysis. The interviews, questionnaires, and focus group discussions were structured in English and isiZulu and administered by the author alongside three research assistants knowledgeable in the language and familiar with the study area's topography and culture. The entire data collection phase was done in person at different time intervals from March 2017 to September 2018.

Data from the South African Metrological Organization, CSIR, Department of Environmental Affairs, and Department of Water Affairs South Africa were used to gauge temperature and rainfall variation in the study area. The motivation for triangulation was to ensure data reliability and coherence with other bodies of scientific evidence. Ethical approval was received from the University of KwaZulu-Natal, and the KwaZulu-Natal Department of Disaster Management provided the gatekeeper's letter.

Study area

Figure 1 shows the area, where the study was conducted. uMkhanyakude District Municipality is in KwaZulu-Natal province. The municipality is the second-largest in the province and is located in the Northeastern part of the province with a total average area of 13, 855.35 km^2 (Frith 2011; Statistic South Africa 2011; Hodgson and Khumalo 2016). The district municipality is largely rural and has a population estimate of 625,846 people and a population density of 45.17 per km^2 (Statistic South Africa 2011; Kabuyaga et al. 2017). The area is part of the former homelands in South Africa, which were predominantly characterized by the negligence of the apartheid government pre-1994 in providing basic service delivery (Mpanza & Govender 2017; Neves 2017; David et al. 2018). The municipality ranks 51 of the 55 most socioeconomically deprived municipalities in South Africa and is adjudged one of the poorest municipalities in the country. Its population is largely
youthful, uneducated (over 25% with no formal education), and predominantly dependent on agriculture to support livelihood (Statistic South Africa 2011; Patrick 2019).

FINDINGS

The impact of climate change on water

The South African Weather Service Report’s (2016), Department of Agriculture and Forestry (DAFF)’s (2015, 2016), and South African Irrigation Institute’s (SABI) (2016) data on uMkhanyakude show extreme variation in rainfall and temperature as indeed most areas in South Africa. These variations in rainfall increase the propensity for drought in the study area. Oxfam’s (2010), Herrfahrtd-Pahle’s (2013), and DAFF’s (2016) studies also affirmed the increase in temperature and rainfall variations due to climate change. These studies corroborate the paper’s findings that water security within the study area is affected by climate change. The implication of temperature and rainfall variation on water security for the study area is thus a decline in water availability within the area.

Residents in the study area confirm through their experiences and observations variations in temperature and rainfall, the consequence of the decrease in rainfall, as well as an increase in temperature within the study area. Extracts summarizing the views of the study participants are presented in Table 1.

While the World Health Organization (2011, 2014) reports estimate that a minimum of 7.5–15 liters is required per person for basic survival and hygiene, the situation of enough water to meet daily requirements within the study area is of concern. The study findings show that a significant majority of the households representing 79.4% of the sampled population do not have adequate water for the entire year. More aptly, interviewee 1 captured the situation as:

‘You see, like climate change, it is either we get heavy rainfall and sometimes with the scorching sun (weather). This affects us as a community since we are using Umfolozi River. We at the end find out that there is no water there. Therefore, there we are, left with no water to use. The river is a primary source of water in this area. So, yes, it affects us severely.’ (Interviewee 1, September 2017)
This spells a serious challenge for most people within the study area. Most of the sampled population affirm the fact that water is always never enough for drinking and domestic use. Most claimed to have suffered momentous water shortage at least once at a point in time within the last 5 years, while some experience a situation whereby there is no water in their water source\(^2\) spanning from a day to several days and even months. In view of this position, it is pertinent to note that there is a significant variation in water availability and access between rural and urban/township areas in South Africa. Studies such as Hellberg (2017), Masiya et al. (2019), Thompson et al. (2018), and Smith (2021), among others, all attest to the fact that service delivery, especially water services, is unevenly skewed in favor of the urban areas at the detriment of the rural communities in South Africa. This is also closely related to the historical inequality experienced by the former homelands in South Africa in the sense that the government concentrated on service delivery in the urban areas (David et al. 2018; Von Fintel 2018).

**Community response to water insecurities**

The study’s results show that steps taken in the face of water insecurities range from doing nothing as a community to going as far as contributing financially to alleviating the water shortage situation as well as probable conflicts it ensued. The study’s data are saturated with respondents, indicating that the community as a unit engages in vertical and horizontal efforts and agency in managing water shortages and conflict situations. The vertical agency implies the engagement of the people with the government in the form of a ‘bottom-to-top’ and ‘top-to-bottom’ approach. In contrast, horizontal agency connotes the interaction between and among community members. Jepson et al.’s (2017) conceptualization of the *hydro-social process*, whereby the modification and manipulation of water flow and quality influences agency, which in turn influences and reinforces water issues, supports this finding.

Vertically, the community engages with the municipal officials and those in the position of authority. This is captured by a respondent stating that ‘We talk to our municipality and ask them to

| Changing pattern of rainfall | The consequence of the decrease in rainfall | Increase in temperature within the study area |
|-------------------------------|--------------------------------------------|---------------------------------------------|
| ‘The rate of rain we have has decreased than before. The rain is sporadic nowadays.’ (Respondent 94, Survey Questionnaire, September 2017) | ‘More dryness, less water in our rivers and dams’ (Respondent 313, Survey Questionnaire, September 2017) | ‘The dam water evaporates rapidly’ (Speaker 1, FDG 1, October 2017) |
| ‘It is almost as though it is relatively the same for most days. You see, since from January we haven’t had much rain until now (October). This is becoming a usual thing in recent years.’ (Speaker 1, FDG 4, November 2017) | ‘In particular, there has been a shortage of rain, and as a result, there has been less water that we are receiving ... and because probably our sand is too sandy; it makes it easier for the water just to go down. In fact, it is very quick because the rain patterns have changed, as we have noticed. It has been a dramatic change because of the patterns of rain’ (Interview 9, November 2017) | ‘Listen ... staying close to the point. You see when it rains here in this area. Say, for instance, it rains today, the water fills up, but the following day the water would completely evaporate in the dam’ (Speaker 2, FGD 1, October 2017) |

Source: Adapted from the study data (Author).

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2 By water source, we imply that the supply channel individuals employ in securing water for daily use. For the study area, these water sources include taps, boreholes, community water reservoirs, rivers/lakes, and government/commercial tanks.
intervene’ (Respondent 66, Survey Questionnaire, September 2017). While dialogue and consultation between the community and institutions/municipal officials are encouraged, this strategy is, in most cases, futile, as some respondents lamented about the frustration the process emanates. This is captured by one of the respondents who asserted that ‘We are trying as a community, but there is no difference. Our councilor is just a decoration. I wish I could throw him into the deep dam’ (Survey Questionnaire, September 2017).

Another respondent puts it as thus: ‘There is nothing done by the community because even the councilors are incompetent in helping us even if we report to them’ (Respondent 92, Survey Questionnaire, September 2017). The frustration cited here results from poor management and a lack of a tangible plan by those saddled to manage the availability and accessibility of water resources for individuals and households within the area. This again is captured as this, ‘I have never seen attempts from the community to calm the situation/resolve it (in terms of water shortages or the conflicts that ensue). It has never happened. The municipality does anything for us. We haven’t had any programs of water-saving within the community’ (Interviewee 5, October 2017).

From the above, Oxfam’s (2010) assertion of South Africa’s water management system as a ‘time bomb’ awaiting explosion can be fully understood within the context of the study area. Further corroborating this assertion, another comprehensive perspective on the flawed management system on the part of the government is captured as:

‘…because of our poor management, we are still losing a lot of water from springs and from rainwater. You find that the rivers will flow into the sea during the rainy seasons because there are no engagement storage facilities for harvesting the rainwater for the darker days. So that when the water resource is no longer available, then you can always tap into that water storage facility. We are just losing a lot of water into the sea, which is very poor on our side.’ (Interview 11, November 2017)

In instances where the relevant authorities intervened, the complaint was that these interventions were in most cases short-lived as noted as follows: ‘Councillor tried, by all means, to bring water tankers to the community. He has stopped because we are in the rural area here. So, nobody cares about us’ (Survey Questionnaire, September 2017).

On the horizontal level, the community works together in several instances in alleviating the challenges of water shortages. This includes, among others, community contribution in paying for the delivery of water tankers, buying diesel for the borehole machine, as well as joint manpower in alleviating the challenges of water shortages. Closely related to this measure is the rule for water rationing and the code of conduct devised by the community for water allocation. In relation to this, rules are made to avoid unnecessary confrontation around water sources and uses. These rules are negotiated through social networks in a bid to guarantee access to available water for everyone. These strategies can amplify or reduce the impacts of climate change on water and create social relations influenced and determined by community engagement.

There are also instances where the community carries out collective menial actions, such as digging and drenching rivers and dams, collectively to mitigate water shortages. This is captured in the extract as follows: ‘When there is no water or less water, we go to Mkuze River to dig down so our small river can have water’ (Survey Questionnaire, September 2017). While these measures are steps taken by the community, some respondents also noted that there seem to be no concrete steps taken within their area in mitigating water shortages or conflict arising because of water shortages. In the event of an outright conflict over water within the study area, the data showed that a few approaches are adopted in an attempt at conflict resolution and management. Most of the respondents mentioned community dialogue/engagement as a water/conflict resolution mechanism within their area. This is summarily explained by respondents 113 and 125 as follows: ‘We sit as a community and solve matters’
The community meetings are handled by traditional rulers who solve the conflict (Respondent 125, Survey Questionnaire, September 2017).

As reiterated by respondent 125, the community meetings are organized by the traditional leaders who ensure that these matters are amicably resolved. Community meetings are organized twice a month except for emergency cases, where the community head can call for a special meeting. Issues affecting the community are discussed together, and the course of action is reached mostly by consensus.

Individual response to water insecurities

Investigating the individual efforts to mitigate water insecurities, the study finding shows that a significant majority posits that they have left their fate to chance when faced with the situation of water shortages in the area. Some lamented the availability of dilapidated water infrastructures that have become monumental symbols of government/society’s incapacity to provide essential services for the people. A resident captures this notion as thus: ‘we have taps in our homes, but they have become the part of the decoration because it has been more than 15 years without water. My brother is over 15 years now, and he has not seen water dropped from that tap since his birth. Now, we just continue to live and trust that one day, it may be better (signs) … I doubt that too’ (Survey Questionnaire, September 2017).

On the other hand, some participants claimed to make personal arrangements such as buying water from water vendors in ensuring the security of water within their households when faced with diminishing water resources. The data show the situation of residents resorting to buying water to meet their daily household water demand as a standard alternative in the study area. This, in many respects, shows the negligence of the local authority. In several instances, the data show that residents find themselves in situations of limited alternative but to buy water from water vendors, which are in most cases at ridiculous and inflated prices. A respondent puts it as thus: ‘People sell water from the dams because they have cars. And it cost too much, but we have no option but to buy’ (Respondent 66, Survey Questionnaire, September 2017). The motivation for the increase in water prices is fueled by the impact of climate change on water security, leading to scarcity and high demand for water in the area. This extract captures the view and experiences of most respondents, as they reiterated that residents within the community act individually and collectively in few instances by buying water from water tankers. The socioeconomic situation of the most household makes this mechanism a herculean task. Buying water becomes only at the prerogative of the relatively economically stable households to which there are few.

Furthermore, households unable to access water from water tankers also engage in other practical actions to ensure that they have water within their households. One of the actions of these categories of households is aptly captured from the extract of interviewee 6 as ‘We collect the rainwater with buckets. It has been years now since we last received water from the municipality. Say since 2011, so it has been many years’ (Interviewee 6, September 2017). This rainwater harvesting method is identified as a viable option carried out by most rural households in South Africa and Africa in general.

In instances where there is no rain or supply of water by government-sponsored water carriers, households use other means. In most instances, those from less privileged households walk long distances from their households to their water sources using carry-able water cans. This is shown in Figure 2. It is also interesting to note that the water carrying tasks are done by mostly women and young girls in the study area. While this is not the focus of this paper, this brings to bear the gender roles/dynamics prevalent in most African societies attributed to the girl child.

In gauging possible individual responses to water insecurity situations in their households and community in general, the data indicate that a significant number of individuals and households would
likely engage in protest as a singular or combined response in the event of water insecurity situations. Figure 3 shows the graphical distribution of likely actions respondents would engage in should water become an unbearably scarce commodity in their communities and households. One hundred and fifty-four respondents accounting for 41.3% of the sample population were likely to engage in protest/demonstration action to show their grievance of the situation. Forty-seven respondents amounting to 12.6% of the total sample were likely to assault government properties and officials. Forty-three respondents making up 11.5% of the sample were likely to migrate to other municipalities with a better water situation. Sixty-five respondents making up 17.4% of the sample were likely to buy water at a higher price, while 32 respondents making up 8.6% of the sample were probably going to do nothing if the water situation became worse. Cumulatively, 62.1% of the sampled population were likely to protest and assault government properties either as a solo or combined action if the water condition worsened. As Patrick (2020) discourses on conflict as a coping strategy observed, residents would resort to violent protest simply put as ‘we would “ToiToi” in the event of water insecurity situations. Even in communities that were yet to experience protest actions motivated by water shortages, the popular view was that this would probably change if the situation were to become any worse. This notion was captured by interviewee 5 as follows: ‘There has not been protest towards the government yet, but it could perhaps happen. I don’t know perhaps on the other side it has occurred but, on our side, no’ (Interviewee 5, October 2017).
The data also indicate that while other nonviolent viable responses were possible, as indicated by respondents ready to dialogue with the authority, others insisted that dialogue would not automatically resolve the matter. These people believe that the government only understands the language of violence, and only violence can push the government into action. In the face of this reality, one would understand why most respondents would engage in protests/demonstrations.

**Figure 3 |** Pictorial representation of responses on the probable actions in the face of water shortages. The descriptive graph shows participants’ responses in the study on what their likely action would be the water security situation in the study area become more severe. After responses were collated from the data collected during the fieldwork phase, five likely response actions respondents will embark on should water become scarce are protest/demonstration, assault on government properties/officials, migrate, buy water at higher prices, or do nothing (in the sense of resigning to fate). While a majority will do these acts as a sole response, others will do a combination of two or more of the acts in response to water scarcity in the study area. **Source:** Author (see Patrick 2020: 9–11).

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**Strategies for water preservation**

The need to preserve water while preventing wastefulness in the face of diminishing water resources cannot be oversimplified. This is necessary to ensure household water security. While there are multiple strategies for water conservation, the data show that the prominent and most used method in avoiding water shortages by households in most rural communities is the reuse of water. It is interesting to note that the trend for water reuse for ‘non-drinking purposes is becoming an increasingly common phenomenon across all quarters in Africa in addressing the challenges of water shortages. Within these communities, this strategy has become a cultural practice in households to ensure water conservation and use in a bid to avoid water wastage. Practically, all the residents within the study area practice this strategy to ensure that household domestic and agricultural water needs are met. The scarcity of water in these areas implies that residents guarantee that the water resources available in this light are judiciously utilized. Given the circumstance of water scarcity, this strategy is adjudged the most efficient and appropriate. In explaining how the water reuse strategy operates in most households, respondent 66 indicated that ‘We fill our tanks with water brought by government
through water tankers. And after using water in house chores, we keep it for irrigation of vegetables. We also use the water used to wash dishes and bath water is used to clean the floor’ (Survey Questionnaire, September 2017).

Furthermore, water rationing is also generally adopted as a conservation strategy within the study area. This is closely linked to the water reuse strategy, as it implies strict adherence to water allocated for different activities in the household. The opinions of the sampled population are summarized from an extract from the survey that: ‘… we are using 2 buckets of water per day so that we can have water for most of the days. We don’t use more than 2 buckets no matter what’ (Survey Questionnaire, September 2017). To ensure the operationalization of these strategies, respondent 11 related that ‘There must be a measure on how much water amounts each person uses a day to avoid water shortage in our home. This helps a lot’ (Survey Questionnaire, September 2017).

Rainwater harvesting is also indicated as another viable option available for most households in securing water for household use. As Figure 4 depicts, households in the area devise local means of rainwater harvesting by constructing water canals on rooftops connected to water containers (tanks, buckets, and reservoirs) through pipes linked from the rooftop. The limitation of this strategy is that it is only viable on days with rain. Factoring the impact of climate change in general, the periodicity of rainfall in the study area poses a challenge to this methodology. However, conserving as much water as possible during rainfall is pivotal for household use.

Other coping strategies people adopt due to little or no water in the study area are the engagement in delinquency behaviors viewed as a negative coping mechanism in the event of water scarcity (Patrick 2020). These include cases of vandalism, theft, and general corruption. The experience of theft was reiterated in the excerpt from respondent 43 as ‘People try to steal water from those who have a little water. And when we are protesting, some individuals destroy community property’ (Respondent 43, Survey Questionnaire, September 2017). Respondent 121 puts her own experience as thus: ‘They forcefully break into our houses and steal water from our tanks in our absence or at night’ (Respondent 121, Survey Questionnaire, September 2017). Another issue illustrated as common practice in these communities is the issue of the diversion of water by officials responsible for supplying water to the communities. The case of nepotism among municipal officials is pronounced in many cases in the study area. This form of corruption is captured by respondent 356 as follows: ‘The drivers of the municipality water tankers who are supposed to deliver water to the community sell the water or give it to their relatives and loved ones’ (Respondent 356, Survey Questionnaire, September 2017).

Figure 4 | Rainwater harvesting in the study area with the author showing how it works. The figure shows the rainwater harvesting technique used in the study area. In most households visited, a water tank is strategically placed close to the rooftop, and then a funnel-like water path from the house roof is constructed to connect to the water tank. The author is seen pointing toward the funnel and pipe connected from the roof to the water tank. Source: Author (taken during fieldwork) (2018).
These views capture some of the negative coping mechanisms/strategies observed in the study area. These behavioral responses to water shortages though negative in many sense may become a norm if the water scarcity situation continues to deteriorate within the study area.

Early warning system

In gauging the preparedness of state/municipal institutions with regard to providing preemptive warning in a bid to ensure the preparedness and adaptation of local communities to extreme climatic events, the data indicated that 72.3% of the samples were never warned at any point in time of an impending extreme event. Hence, when climate-related disasters happen, the majority of the residents are mostly unprepared. This situation is aptly described from the extract of interviewee 6 as thus:

‘Our municipality does not notify us if there will be a drought/flood. We just see things as they come/happen. And when we request water from the councillor, he says there is no water. We often hear on radio that every drop of water is important, and we should save water. But what will our councillor.’ (Interviewee 6, October 2017)

Interviewee 11 revealed the rationale for the lack of preparedness on the part of a significant majority of the sampled population. This interviewee reiterated the situation from the viewpoint of the unpreparedness of government as follows:

‘Truly speaking, I think one of the lessons that we (in this sense, the government institution responsible for action) found is that as much as the drought being a slow-onset disaster, we as a province do not have a drought management plan which we are required to provide.’ (Interviewee 11, November 2017)

The vulnerability of households to these extreme weather events is compounded by management practices that deal with the symptoms (in the sense of the impact) of the phenomena rather than the vulnerability emanating from them. Thus, this practice produces a reactionary tendency rather than proactiveness in curtailing the long- and short-term impact of water scarcity and extremes such as drought in the study area. Again, this is captured in another excerpt as:

‘We found ourselves being reactive to an impending situation. We had to apply a lot of immediate interventions that were required. The fact that there are no early detection or sort of an early warning system in place to detect early that there is a water problem so that we can be able to implement those interventions way before they become a crisis. So, our monitoring processes were non-existent. If we monitored that there is little rain, especially, we should accept and learn that there is limited rain because of climate change.’ (Interviewee 11, November 2017)

DISCUSSION

The findings from the study findings triangulated with secondary data present an overwhelming reality. Grafton et al. (2013), Kusangaya et al. (2014), and Du Plessis (2017) argued that the effect of climate change on the domestic supply of water has a ripple effect on livelihood and food supply, among others. The increase in interannual variability due to the impact of climate change across South Africa is already affecting rainfall and water availability in many quarters. The immediate and further implication of this observation by the respondents implies that the situation of insufficient water for household use is expected to increase in frequency and magnitude within the study area. The
issue of climate variability and the inadequacy of infrastructure make the situation even more severe for most communities in South Africa (Herrfahrtd-Pahle 2013). This situation is only expected to worsen with population increase and economic growth (Grafton et al. 2013; Tapela 2012). Within the context of South Africa, Loftus (2015) emphasized that for most rural areas, a significant amount of all the water infrastructure provided in the immediate aftermath of the apartheid regime became non-operational a few years down the line due to low capacity for maintenance and simple repairs in most cases. Again, this is similar to Le Gouais & Wach (2013) observation, who argued that over 25% of water installation in Tanzania became nonoperational 2 years after their setting up.

From the data expounded in the previous section, the results from this study show that communities within the study area broadly adopt traditional and behavioral coping strategies in solving water shortages in the event of climate change. This is largely due to the poor socioeconomic standing of most households within the area. While these traditional strategies are by and large remote and less efficient, the findings indicate that residents use multiple coping mechanisms in ameliorating water shortages within the study area. The findings show that water reuse seems to be the most common strategy used by residents. A significant majority of the residents also have, over the years, devised means within their household resources to save surplus water for dry days. While rules, such as water rationing, ‘first-come, first-serve’ water access, among others, are applied for water access in some quarters in a bid to decrease the propensity of conflict, the findings show that these rules are only applied in few areas. This finding is validated by the outcome of Adeniji-Oloukoi et al. (2013), who explored the coping strategies among households with regards to climate-induced water shortages in Nigeria. The study findings argued that the socioeconomic characteristics of households largely exerted an influence on the coping strategies adopted to water shortages within local communities.

Gandure et al.’s (2013) study in Gladstone, Free State province, also stated that socioeconomic characteristics and political and historical factors underpin households’ coping strategies. Within the rural community investigated, the socioeconomic feature of the households is varied. Hence, their responses to water scarcity also vary. Households with sufficient income and assets can buy water from water tankers, construct private reservoirs for water storage, as well as drive long distances to ensure water security. Poorer households also devise coping strategies that align with their economic status, such as storing water in small containers, water rationing, and walking long distances to provide water for their households. This study’s findings indicate that residents must walk several kilometers in a bid to secure water for household use. Some are forced to buy water from water tankers, while some use cars and wheelbarrows in driving or walking long distances in search of water. In communities where rules are applied for water access, the study result shows that water is distributed based on certain agreed principles and rules of engagement. This includes rules on ‘first-come, first-serve,’ queuing, and water rationing (restricting certain volumes of water for each household). It is, therefore, safe to claim that the economic standing of individual households determines the degree of vulnerability to climate change-induced water scarcity, as well as the resources available for coping.

The study results also indicate that preemptive warning before climate change extreme events, such as drought, occur is largely non-existent for a substantial mass of people in the study area. Hence, most residents are in most cases caught off guard and in spur-of-the-moment when disasters induced by climate change occur. In most cases, the capacity for providing such early warning information is either weak or limited. Katinka et al. (2017) contended that early warning information in most cases does not trickle down to end-users who need it. Given this observation, Ziervogel et al. (2014) asserted that while South Africa has developed national climate change responses, in theory, the practical reality is that these are yet to be translated into mainstream adaptation in everyday practice, especially at the local levels. Similarly, Gain & Gupponi (2015) claimed that the vulnerability of households to water extremes leading to water scarcity is rooted in the institutional incapacity of
the state to provide such resources. This situation for South Africa is embedded in poor management and planning for sustainable development.

The notion of agency leading to hydro-social processes capable of determining water quality and flow in the study area is also captured by Gossling et al. (2016) and Jepson et al. (2017). The assertion of protest as a form of expression is supported by several studies (Tapela 2012, 2013, 2015; Mackay 2015; Powell et al. 2015). These studies all observed the increase in service delivery social protest motivated by the decrease in South Africa availability and access to water. Again, Tapela’s (2012, 2015), Cornell et al.’s (2019), Harris & Hern’s (2019), Kesting’s (2019), and Patrick (2019, 2020) studies argue that protests in South Africa are used as a political language of communicating societal grievances to the authorities. While du Plessis (2017) argued that water scarcity-induced conflicts are likely occurrence in the event of little or no actions from authorities on core societal needs, there has been a continuous growth in the number of violence and protest actions motivated by water scarcity in South Africa (Gleick & Heberger 2013; Vuuren 2013).

In this case, most institutions are without a proper futuristic blueprint in the event of water stress and extremes. Hence, governments have been, in most instances, reactionary rather than proactive in their approaches to water management and disaster reduction (Patrick 2019, 2020). The findings from this research are concomitant with Gain & Gupponi’s (2015) study in this regard. The study posits that the incapacity of institutions to provide necessary services, as well as its inability to manage or plan water resources for sustainable social and economic development, affects water security. Therefore, if the government is to become more proactive and water management practices and policies are improved upon, it is possible to be better prepared in a drier climate.

CONCLUSION

The overall aim of this study was to assess the coping strategies in terms of general and immediate responses and mechanisms employed by rural communities in the face of the impact of climate change on water security. Within the discourse, coping strategies are largely conditioned by the degree of vulnerability of individuals and/or groups to climate change-induced impact on human and environmental resources. In the same vein, Dari (2013) postulated that the higher the degree of vulnerability, the lesser the capacity to cope, and the higher the tendency to adopt a temporal mechanism for coping. Therefore, vulnerability and capacity to cope are hinged on structural, infra-structural, and super-structural elements of the community. This paper assessed the impact of climate change on water security as well as the responses of rural communities in the face of declining water resources within uMkhanyakude District Municipality, KwaZulu-Natal, South Africa. Based on the study findings, the paper concludes that while the temperature is on a steady rise, rainfall and water availability are declining. The response mechanisms of rural community dwellers within the study area are traditional and behavioral. These include individual and community collective water management strategies, water conservation and preservation, and collective and individual financing, among others. The study also observed that the institution/authority saddled with water management is rather reactionary than proactive in their resilience approach. Therefore, government institutions and individuals must devise more proactive coping strategies to water insecurity situations.

CONFLICT OF INTEREST

None declared.
DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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