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The Perceived Impact of Climate Change on the Livelihoods of Smallholder Farmers in Kwazulu-Natal Province, South Africa

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Abstract: Smallholder farming is an important livelihood strategy for rural households in developing countries. Climate change and variability threaten the sustenance of livelihoods and hinder efforts to eradicate poverty and food insecurity. Although perception studies on climate change and coping mechanisms have been conducted in KwaZulu-Natal Province, little has been done on livelihood analysis. This study uses the Sustainable Livelihood Framework for livelihoods analysis of smallholder farmers in the uMkhanyakude district of KwaZulu-Natal Province in South Africa. Survey data were collected from a sample of 400 smallholder farmers in two local municipalities of the district, using a stratified random sampling procedure. Focus group discussions were used to augment survey data. Descriptive statistics were generated to analyse quantitative data, while qualitative data were analysed through thematic analysis. This study found that climate change significantly eroded livelihood assets, posing a threat to the well-being of smallholder farmers. Persistent drought has led to poor crop and livestock productivity, compelling households to rely heavily on food purchases. These findings underscore the urgent need to safeguard the livelihoods of smallholder farmers in the face of climate change. This study recommends that policymakers should focus on policies that enhance the resilience of livelihood assets for farming communities to minimise climatic risk.

Keywords: climate change; smallholder farmers; Sustainable Livelihood Framework; thematic analysis; uMkhayakude district municipality

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1. Introduction

Climate change is a threat to both the biophysical and socioeconomic environment. The impacts of climate change pose significant challenges to critical economic development sectors, including agriculture, fisheries, forestry, tourism, manufacturing, and health [1,2]. The adverse effects of climate change will hamper global efforts to achieve the 2030 Agenda for Sustainable Development, especially Sustainable Development Goals (SDGs) aimed at eradicating poverty and hunger (SDG 1 and SDG 2).

The agricultural sector in sub-Saharan Africa plays a vital role in the lives of smallholder farmers and is particularly susceptible to the impacts of climate change [3]. The effects of climate change on the agricultural sectors across the African continent will vary [4]. Central, Western, and Southern African regions are expected to face more frequent hot and dry seasons [2]. In addition, farmers in these regions face many risks, including market shocks, pests and diseases, conflicts, poor governance, and economic instability [5].

The adverse effects of climate change manifest through alterations in rainfall patterns and rising temperatures, leading to prolonged droughts and reduced crop and livestock

productivity [2]. Sub-Saharan Africa is expected to experience increased flooding in low-lying areas, while dry conditions will accelerate desertification [6]. The author of [7] asserts that the negative impacts of climate change will result in the loss of livelihoods for smallholder farmers in countries where agriculture is the primary source of income. Consequently, these detrimental impacts pose significant risks to smallholder farmers' food security and well-being, who possess limited adaptive capacity due to resource constraints [5]. Moreover, the challenges facing smallholder farmers are compounded by their marginal location, restricted access to climate change information, and low adoption rates of technological advancements [8]. As a result, farmers in such circumstances tend to reactively adapt, which needs to be improved to mitigate the losses caused by climate change [9].

South Africa is highly vulnerable to the negative impacts of climate change because of its over-reliance on climate-sensitive sectors, high poverty, and inequality rates [10]. In South Africa, approximately 17.5% of households participate in agricultural activities and practice subsistence agriculture to supplement their dietary requirements [11]. The authors of [12] reported that climate change is a leading driver in the abandonment of subsistence farming in rural areas in South Africa. Thus, climate change has created unfavourable conditions for small-scale farming. Climate change is expected to increase vulnerability to food insecurity and exacerbate poverty in rural communities [13,14].

South Africa is classified as a semi-arid country, receiving an average annual rainfall of approximately 450 mm, significantly lower than the global average of 860 mm [15]. Over the years, recurring droughts have been a prominent feature in various regions of South Africa, spanning from the late 1970s to 2017 [16]. For instance, between 2014 and 2016, the country experienced its most severe drought in decades, leading to the declaration of five provinces as drought disaster areas [15]. This drought resulted in livestock deaths, crop failure, and high food prices [17]. Furthermore, drought in the country is expected to evolve and become severe in the near-future [15].

Climate change in recent decades has resulted in outbreaks of biotic and abiotic stressors that negatively affect plant yield and quality [18]. Biotic stressors such as pests have increased, and this negatively affects plant growth. Among abiotic stressors, heat stress is one of the most detrimental constraints, limiting crop production by disturbing its normal growth, physiological, and developmental processes. According to [19], it is predicted that global climate change will result in increased yield losses of agricultural crops caused by environmental conditions.

In South Africa, climate change studies have mainly focused on farmers' perception and adaptation to climate change [8,14,20–22]. Moreover, there are very few studies that have looked at the impact of climate change on the livelihoods of smallholder farmers, and most of these studies have not focused on KwaZulu-Natal but on other regions in South Africa [17,23]. These studies cannot be generalised to include the uMkhanyakude district for two reasons. Firstly, farmers' livelihoods tend to differ across regions because of the ecological orientation of the regions. Secondly, regional climatic variations mean that the impact of climate change would be experienced differently across areas in the same region. The differences in climatic variations in the same region show the need for local studies on the impact of climate change on farmers' livelihoods. Against this backdrop, the aim of this study was to investigate the impacts of climate change on the livelihoods of farming households in the uMkhanyakude district of KwaZulu-Natal. An understanding of the adverse effects of climate change on the livelihoods of rural people is crucial in the design of appropriate and targeted climate change policies.

2. Conceptual Framework

Over the last three decades, the sustainable livelihoods approach in various forms has influenced development research and practice [24]. Multiple organisations, including the Department for International Development (DFID), United Nations Development Program (UNDP), and CARE International (CARE), have embraced the sustainable livelihoods

approach in their efforts to alleviate poverty [25]. The DFID, for instance, has utilised this framework as a planning tool for development initiatives and to assess the effectiveness of ongoing programmes, aiming to identify opportunities for supporting the livelihoods of agricultural communities [26].

The Sustainable Livelihood Framework (SLF) is based on the notion that individuals create diverse and complex livelihood portfolios undermined by climatic, political, and economic uncertainty [27]. Smallholder farmers rely on various capital assets to achieve their desired livelihood outcomes (Figure 1). These assets encompass human, physical, natural, social, and financial resources. Livelihood assets, also known as capital assets, represent the strengths of smallholder farmers, enabling them to engage in a range of activities to attain their livelihood objectives, known as livelihood strategies. Livelihood strategies are dynamic processes that involve decision making, as well as actions aligned with the aspirations of smallholder farmers over time [28]. The external environment, which encompasses factors such as patterns, seasonality, and shocks that individuals face but have limited control over, is referred to as the vulnerability context within the SLF [25]. In this study, the SLF was employed to identify the livelihood strategies of smallholder farmers, assess their household capital assets, and examine their livelihood outcomes. This study uses the SLF to evaluate farmers' perceived effect of climate change (i.e., rainfall patterns, drought, and floods) on their livelihood assets.

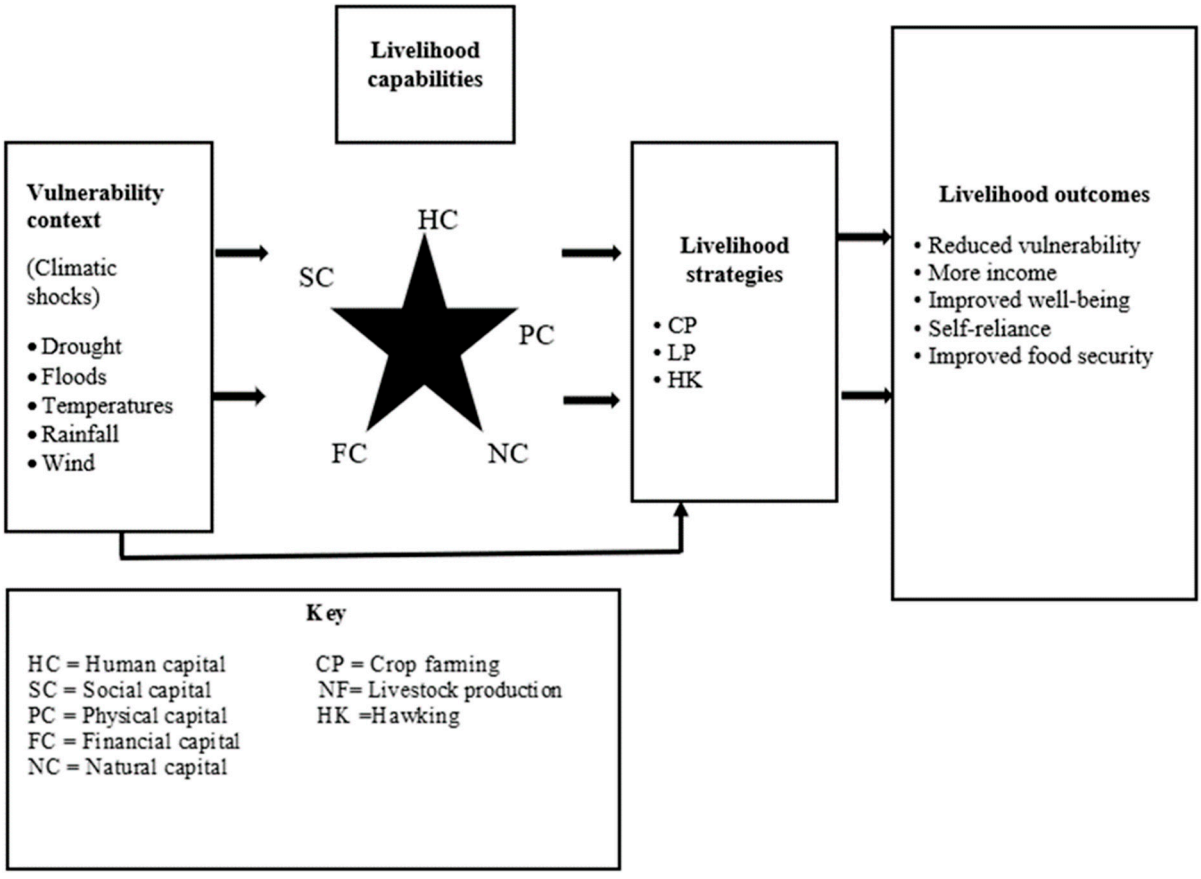

Figure 1. The Sustainable Livelihood Framework. Source: Adapted from the Department for International Development [26].

3. Materials and Methods

3.1. Study Area

The uMkhanyakude district municipality is in the northern part of KwaZulu-Natal Province in South Africa (32, 014489; −27, 622242) [29]. The district borders the Indian Ocean in the east, Mozambique to the north, the Kingdom of eSwatini in the northwest, and

uThungulu and Zululand districts in the south and west. There are five local municipalities in the uMkhanyakude district: Jozini, uMhlabuyalingana, Hlabisa, Mtubatuba, and Big Five False Bay (Figure 2). UMkhunyakude is a rural district with Mtubatuba and Jozini as major local towns. The district covers a surface area of 12,818 km^2 and has about 625,846 people with a population density of 46 per km^2 [29]. In terms of size, uMkhanyakude is the second-largest district in KZN. Out of 11 districts in KZN, the uMkhanyakude district was purposively chosen. The uMkhanyakude district is one of the poorest municipalities in KZN and the area has been extremely devastated by climate-induced changes [30].

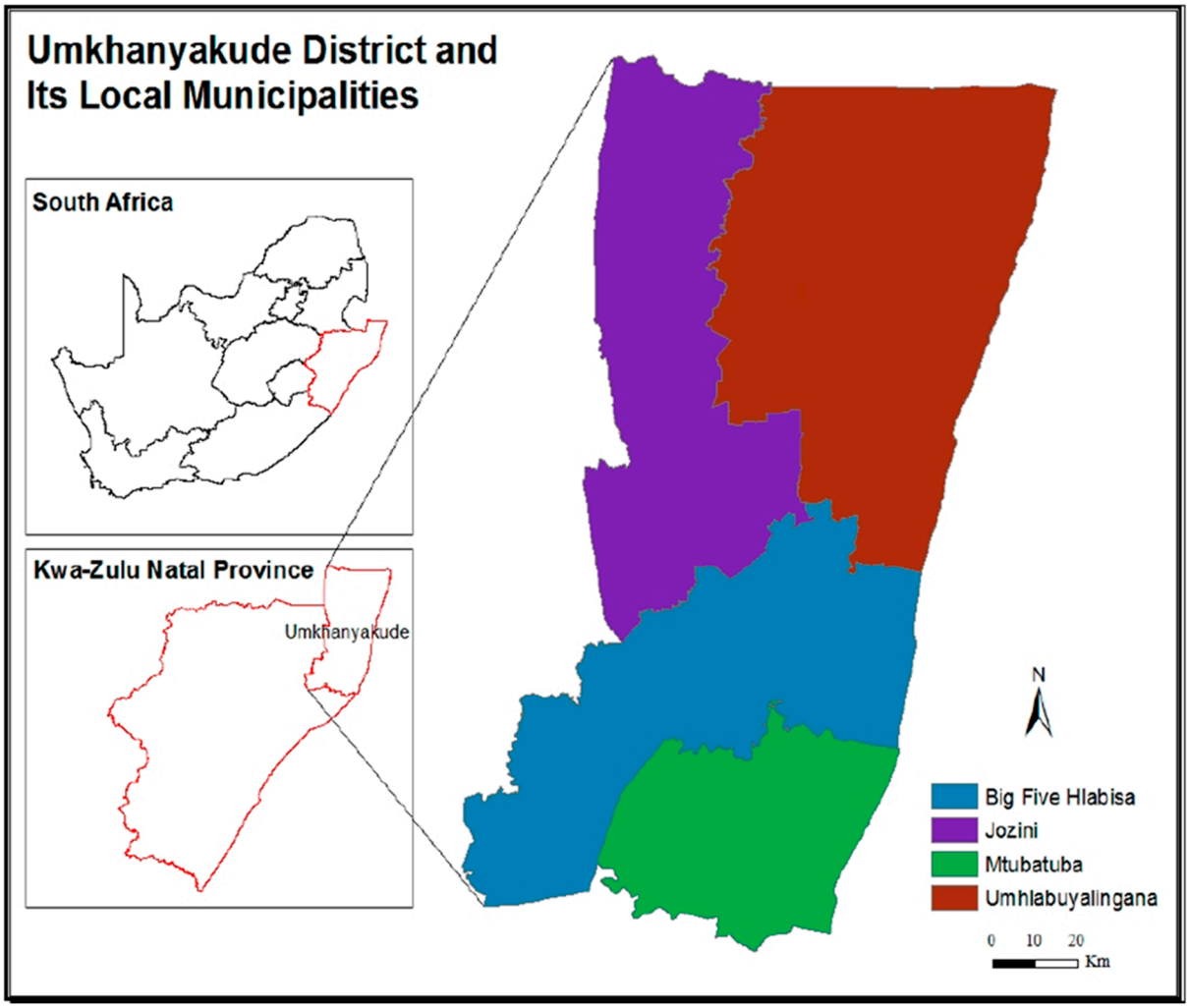

Figure 2. Location of study area—uMkhanyakude district municipality of KwaZulu-Natal.

3.2. Sampling Procedure

The study of [31] provides guidelines on how to determine sample sizes based on population size, margin of error, and confidence levels. The selected local municipalities (LMs) had 84,198 households, based on the guidelines, and population sizes of 10,000, 100,000, and 500,000 had corresponding sample sizes of 370, 383, and 388, with margins of error of 5% and 95% in confidence level. Accordingly, a sample size of 400 households was considered adequate for this study. A stratified random sampling procedure was used to select participants. In the first stage, 50% of the wards in each local municipality were randomly selected. In the second stage, farming households were randomly selected within the targeted wards of Jozini LM and Umhlabuyalingana LM (Jozini LM has 20 wards while uMhlabuyalingana LM comprises 18 wards).

A structured questionnaire was used to collect quantitative data between November and December 2020. The survey questionnaire was designed to capture data on demographics, crop production, household assets, livestock ownership, support services and farmer training, land ownership, food security, and climate change perception and adaptation. This study focused on smallholder farmers engaged in both crop and animal production. In this study, enumerators visited the sampled households and interviewed the household head. Questions in the questionnaires were translated from English to isiZulu (local language). This ensured clarity with the questions in the questionnaires. Enumerators asked questions in isiZulu and filled in the questionnaires on behalf of the farmers.

In this study, focus group discussions were used to gather in-depth information on farmers' experiences of climate change, adaptation strategies, and the effect of climate change and variability on their livelihoods. Qualitative data from the focus groups were used to supplement quantitative data in the questionnaires. As recommended by [32], each focus group consisted of a maximum of 12 farmers and this number is considered appropriate for maximum participation.

3.3. Data Analysis

Thematic analysis was used to analyse qualitative data. According to [33], thematic analysis is a method for identifying and analysing patterns of meaning in a data set. It shows the dominant themes that best describe the subject under investigation [34]. According to [34], thematic analysis involves interpretation and impressionistic and textual analysis of qualitative data. The thematic approach is subjective and considers the respondents' lived experiences and how they infer meaning from the subject under investigation.

The transcriptions of the qualitative data from the focus group discussions (FGDs) were imported into ATLAS.ti for analysis. ATLAS.ti is a software programme commonly used for qualitative data analysis, facilitating the organisation, coding, and exploration of textual data.

The textual data were read repeatedly to gain deeper insight into the transcripts. Labels that appeared more than once were coded, and similar codes were organised into categories. Each category was then defined, and four main themes emerged from the data: cropping patterns, livestock production, wild plants and animals, and water availability. A potential setback when using thematic analysis arises when there is a misunderstanding of the data due to loss of information during translation, and this results in findings that are not coherent with the data [34]. Constant interaction with the respondents, debriefing, and continuous observations are some of the mechanisms used to improve the quality of the data [35]. The quantitative data from the survey were coded and analysed using STATA Version 15. Descriptive statistics, such as frequencies and percentages, were computed to analyse the data. The findings were then presented in tables and pie charts to provide a clear visual representation of the results.

4. Results and Discussion

The results and discussion are presented in the following sections. The next sections elaborate on the livelihood strategies adopted by smallholder farmers, the effect of climate change on capital assets, and how climate change affects livelihood outcomes.

4.1. Livelihood Strategies in the uMkhanyakude District

According to [36], livelihood strategies comprise a combination of activities that farmers undertake to achieve their livelihood outcomes (income or food security). Table 1 presents the common livelihood strategies in the uMkhanyakude district. The results in Table 1 show that crop production, livestock production, and hawking are the common livelihood strategies in the uMkhanyakude district. Crop and livestock production were identified as the primary livelihood strategies employed in the study area. These findings are corroborated by the uMkhanyakude district Integrated Development Plan (IDP). It is reported that approximately 95% of households in the district rely on agriculture as

a means of sustenance [29]. The prevalence of such livelihood strategies suggests that a significant portion of households in the district are susceptible to the impacts of climate change, including shifts in temperature and rainfall patterns, given their dependence on rainfed agriculture.

Table 1. Livelihood strategies in the uMkhanyakude district.

Livelihood Strategy	Number of Households	Proportion (%)
Crop production	220	55
Livestock production	155	39
Hawking	25	6
Total	**400**	**100**

Source: 2020 survey data.

4.2. The Effect of Climate Change on Capital Assets

Household livelihood assets serve as a foundation for households to develop and implement strategies to improve their livelihood outcomes [28]. Households' capital assets include human, physical, financial, and social assets.

4.2.1. Human Assets

The findings indicate that women are more likely to be vulnerable to the negative effects of climate change than their male counterparts. The results in Table 2 show that women constitute the majority, accounting for 72% of smallholder farmers in the study area. This finding aligns with the study conducted by [37], which also observed women as the primary participants in smallholder farming. This suggests that women are particularly susceptible to the adverse effects of climate change due to their reliance on agriculture for their livelihoods.

Table 2. Human and physical assets of smallholder farmers.

Variable Code	Variable Description and Measurement	Mean	Standard Deviation	Proportion
Human				
GENDER	Gender of household head (Male = 1)	-	-	0.28
AGE	Age of household head (years)	55.77	12.36	-
EDUCAT	Years of schooling	7.14	4.74	-
TRAINING	Access to training (Yes = 1)	-	-	0.55
FARMING_EXPERIENCE	Number of years in farming	17.02	13.81	-
H_ADULTS	Number of adult-equivalent members residing in the household (continuous)	4.25	3.76	-
Physical				
TARRED_ROAD	Distance to tarmac road (km)	3.01	0.13	-
TLU	Tropical Livestock Units	8.13	12.23	-
TOT_ASSETV	Value of household assets (Rands)	95,342.13	135,639.7	-

Source: 2020 survey data.

The findings also indicate that, on average, smallholder farmers are 55.77 years old and have 17 years of farming experience, implying that old people dominate smallholder farming. On average, each household has four adult-equivalent members who assist in farming. Households with a sizeable group of working-age family members possess a greater labour capacity for agricultural production. Such labour could be used to diversify household income by venturing into off-farm activities/employment that may not be affected by climate change.

On average, household heads in the study areas had attained 7.14 years of schooling, implying that most farmers did not progress to secondary education. Education is crit-

ical in achieving higher livelihood outcomes as it provides opportunities for farmers to engage in off-farm activities, thus diversifying their climate-sensitive agricultural-based livelihoods. Furthermore, education enhances farmers' ability to read and analyse climate change information, which can assist them in adapting and achieving better livelihood outcomes [38].

Approximately 55% of the smallholder farmers reported receiving agricultural training. Farmers mentioned that training workshops focused on topics such as conservation agriculture and climate change adaptation, and they had effectively applied the knowledge in their farming practices. Training programmes improve agricultural skills, and farmers who have received training on climate change are more likely to implement adaptation strategies, thereby increasing agricultural productivity. These extension services thus lead to higher income due to higher yield. Non-governmental organisations were the primary providers of such training. Other studies [39,40] have also found a positive relationship between agricultural training and climate change adaptation.

In the focus group discussions, farmers reported that temperature changes have negatively affected their productivity. High summer temperatures have forced farmers to reduce working hours in the morning, which has a negative impact on the size of land that they can work on. Over the years, farmers highlighted that there has been an increase in the incidence of violent storms during the summer seasons. These violent storms are often accompanied by lightning strikes, resulting in the deaths of older family members. In turn, the loss of family members negatively impacts farming activities.

4.2.2. Physical Assets

According to [41], physical assets are capital goods households use to construct and contrive a livelihood. Such assets can be public goods (i.e., roads and water infrastructure) or private goods (i.e., tractors, implements, and houses). Farmers in the two study areas identified homes, farm implements, and access to transport as important physical assets needed to achieve livelihood outcomes. Transport, as a physical asset, is widely considered a key component in agricultural development around the world. It is the only way for food produced on the farm to be transported to households and markets. Furthermore, it integrates agricultural markets, strengthens communication among regional and economic groups, and unlocks new potential focusing financial sectors [42]. Table 2 shows that, on average, households are located 3.01 km from a tarmac road. This indicates that households' proximity to markets and other institutions (such as government departments) might play a role in supporting smallholder farming. On average, each household's combined value of assets is R95 342.13. Households that are well endowed with assets are likely to use their resources to adapt to the adverse effects of climate change, thereby improving their livelihood outcomes.

Extreme weather events like floods can significantly affect physical assets such as roads, disrupting farmers' ability to access markets. For example, in the focus group discussions, farmers explained that they experienced extreme flooding in the year 2000, which damaged roads, houses, and crops. As a result, their livelihoods were negatively affected.

Farmers who owned boreholes were also struggling to obtain water. In recent years, farmers explained that floods were not a problem in the uMkhanyakude district. The main challenge was drought. The drought in the area forced households to buy tanks to harvest water upon rainfall, thus putting an extra financial burden on a population with high unemployment levels. The lack of water threatened production, household food security, health, social well-being, and livelihoods. Women bore the burden when it came to water shortage for domestic use since they had to travel long distances to obtain water and wait in queues for lengthy periods.

Livestock is another important asset that supports rural livelihoods and household well-being. It serves various functions for rural communities and is integral to their livelihoods, serving commercial and non-commercial purposes [43]. Livestock rearing, including cattle, provides a source of income and serves as a measure and store of wealth

for households. Extreme weather events (such as drought) negatively impact on livestock productivity and limit farmers' ability to make a living. For example, the 2015/16 drought in uMkhanyakude resulted in livestock mortalities, and farmers had yet to recover from the devastation during the study period. Farmers argued that the health and quality of their remaining livestock had deteriorated dramatically, negatively impacting their trading prospects and the productivity of draught power. Increased water scarcity, forest depletion, and declining pasture availability and quality affected livestock production. Fodder shortages due to drought compelled farmers to sell their livestock at uneconomically low prices. A respondent in the focus group captured the situation as follows:

> *'The rains do not pour the way they used to 20 years ago and our animals suffer. The yesteryear's rains will fill dams and our animals will drink water from nearby dams and rivers. Yooh! Now animals must travel a long distance to get drinking water because dams and rivers have dried up'. (Focus Group 1)*

4.2.3. Natural Assets

Smallholder farmers in the study area rely heavily on natural assets, such as land and water, for their livelihoods. These resources are vital for agricultural activities and are key to the farmers' overall well-being. Rivers, boreholes, and dams are the most common water sources in the uMkhanyakude district. Table 3 shows that most land (50%) is allocated to households by the local authority. On average, smallholder farmers in the study area can access 1.31 hectares of land. The majority (74%) of the farmers indicated that they were satisfied with the size of their land holdings.

Table 3. Natural, financial, and social assets of smallholder farmers.

Variable Code	Variable Description and Measurement	Mean	Standard Deviation	Proportion
Natural				
LAND_SIZE	Land size in hectares (ha)	1.31	1.20	-
LANDALLOC	Land allocated by traditional authority (Yes = 1)	-	-	0.50
LANDTENURE_SATISFA	Land tenure satisfaction (Yes = 1)	-	-	0.74
LAND_INHERIT	Land inherited from family members (Yes = 1)	-	-	0.33
Financial				
TOTAL_INCOME	Total annual income (Rands)	55,674.49	32,568.76	-
CREDIT	Access to credit (Yes = 1)	-	-	0.53
SAVINGS_GROUP	Membership in savings group (Yes = 1)	-	-	0.64
GOV_GRANT	Access to government grant (Yes = 1)	-	-	0.87
Social				
FARM_ASSOC	Membership in farmers' association (Yes = 1)	-	-	0.35
TRUST	Number of people household head can revert to in times of need	4.7	5.3	-

Like other rural communities in sub-Saharan Africa, the livelihoods of smallholder farmers in the uMkhanyakude district rely heavily on rainfall for agricultural activities. Below-average rainfall in the area has resulted in decreased soil moisture and a subsequent decrease in crop yields, necessitating farming households to depend heavily on food purchases. Farmers perceived that rainfall patterns had changed and became unpredictable, negatively affecting their farming operations. This observation aligns with the explanation provided by [44] that smallholder farmers experience notable reductions in crop yields due to shorter planting seasons and unpredictable rainfall patterns. High temperatures were also a cause for concern as they increased evapotranspiration and exacerbated soil moisture loss.

Farmers perceived that the condition of arable land in the study area had deteriorated over the years. Continuous seasons of drought resulted in limited soil cover as the topsoil is easily washed away with heavy rainfall. This has resulted in soil erosion, making it

difficult to plant in some fields. Focus group participants also pointed out that they had to shift to drought-resistant crops such as cassava due to the prevailing dry conditions. However, some discussants argued that although they had to change to new crops, such crops did not replace maize, the staple crop. They still had to buy maize meal and samp from the shops. Further elaborating on this assertion, a focus group participant captured this as follows:

> *'We have two fields in our household and we are no longer using them because we do not receive enough rains in this area. We are now using a backyard garden because it is easy to irrigate.. In previous years, we used to grow maize in summer, but all that has changed because we do not receive enough rain. Most households in this area have resorted to planting cassava because it grows even if we do not get the rains that we expect'. (Focus group 2)*

Forest resources are a critical natural asset that households depend upon for a living. Forest resources such as wild plants and animals have provided food and nutrition security to African communities for centuries. Dwindling forest resources reduced households' chances of obtaining raw materials for constructing houses, agricultural working equipment, and wooden cutlery, among other products derived from the forest. A focus group member elaborated:

> *'I grew up in this community and got married here.. Our fathers used to hunt wild animals, and we never struggled to get meat. However, things have changed; my grandkids hardly get rabbits in the bush, and there is not enough food for the rabbits to reproduce. On the issue of wild fruits, this area is known for producing marula beer in this district. Previously, we used to harvest enough to make beer and people will come from other areas to buy marula beer from us. However, that is no longer the case; it is dry here, and we no longer get a satisfactory harvest, which has affected our income. During January and February, we used to harvest mopani worms from marula trees, and the worms have decreased; this has affected us since we used to get money from selling the worms'. (Focus group 2)*

Rural households depend on streams and rivers for water for various livelihoods, such as the irrigation of crops and fishing. Changing rainfall and temperature regimes have impacted the availability of various forest resources in the area, including wild fruits, timber, and wild animals. Wild fruits and animals, in particular, act as coping mechanisms when food is scarce and a supplement when there is a food surplus. The study area's forest resources are also under climate-induced pressures such as wildfires.

4.2.4. Financial Assets

Climate change negatively impacts financial assets. Financial capital assets, which encompass cash, savings, wages from employment, access to credit sources, remittances, and government social grants, play a crucial role in helping households achieve their livelihood outcomes. These assets serve as a buffer for rural households against the various stressors associated with climate change.

Table 3 shows that 87% of the households were social grant beneficiaries. The South African government provides social grants to qualifying poor households to cushion them against poverty and food insecurity. During the focus group discussions, farmers expressed that during favourable seasons, they utilised the funds obtained from social grants to purchase essential household items like cooking oil and soap, which were beyond their production capabilities. As a result of the prevailing drought conditions, farmers revealed that they had to rely on social grants for food purchases to sustain their livelihoods.

About 53% of households indicated that they obtained credit between August 2019 and August 2020, mainly from stokvels (A stokvel is made up of a collective of individuals who pool their resources together and contribute a predetermined amount of money each month with the goal of achieving a specific target. At the end of the financial year, members receive dividends based on their contributions.). or savings groups. Such credit

is usually used to buy farm inputs during crop growing. Harsh climatic conditions in the previous years resulted in poor yields, and farmers could not sell surplus produce to pay back the loans. Table 3 indicates that 64% of smallholder farmers were in savings groups. Farmers mentioned that during the 2015/16 drought, they used a considerable proportion of their savings to purchase fodder for livestock. They argued that the savings were diverted from household responsibilities such as buying school uniforms for children and renovating houses, thus depriving households of necessities. The average monthly income of households is about R4639.50. On average, a household in the sample has four adult-equivalent members whose income levels are low to support their food requirements. According to the Bureau for Food and Agricultural Policy annual baseline report [45], a food basket for a family of three people in South Africa costs R2 932. These estimates imply that low-income households with larger family sizes will struggle to procure a food basket that will allow them to eat an adequately diversified diet.

Moreover, the adverse employment and income effects because of COVID-19 will negatively impact on household income. This, in turn, will likely impede the progress made in achieving food security over the past decade. Excessive rains from tropical cyclones and drought will compound the plight of smallholder farmers and further erode their livelihoods.

4.2.5. Social Assets

Social assets entail social resources that households rely on to meet their livelihood outcomes. Social assets play an important role in unlocking the potential benefits of other capital assets, particularly in facilitating collective action activities where a group of individuals collaboratively work towards achieving a shared objective [46]. These networks are among households and are based on trust and social ties. Farmer engagement in associations, interpersonal connections, networks, and linkages are among the social resources that households utilise to support their livelihoods. Social assets can be formal and informal. Table 3 shows that about 35% of the sampled farmers were members of a farmers' association. Farmers involved in associations indicated that they attended training in their farmer groups, and livestock farmers, in particular, used associations to share information about livestock diseases and treatment methods. Farmer groups were also used to buy farm seeds, fertilisers, and chemicals in bulk. On average, households had five community members they could revert to in times of need. These findings point to weak social networks in uMkhanyakude. This also suggests that farmers may not receive assistance during times of crisis. The low participation of farmers in associations reveals a fragmented social network in the district, which could hinder farmer development and adaptation to climate change. The report of [47] demonstrated that farmers who enhance their social capital improve access to information and knowledge of new strategies to improve productivity under climate change, thereby improving their livelihoods.

The findings from the focus groups revealed that in the immediate aftermath of a climatic disaster, farmers survive by drawing support from social networks. However, with the intensity and regular occurrence of natural disasters like drought, social cohesion alone is not enough. Relief programmes during or after the drought also creates disputes between beneficiaries and non-beneficiaries. Consequently, the tensions between farmers loosens social bonding. A focus group member elaborated:

> *'After the drought, we were told to register our names, and we did as recommended by the extension officers. However, it is not everyone who registered that received the inputs and the criteria used were not clear to everyone. Moreover, this has created conflicts among farmers'. (Focus group 1)*

4.3. Livelihood Outcomes of Smallholder Farmers

The authors of [48] define livelihood outcomes as the benefits of engaging in livelihood strategies. These outcomes encompass various aspects, such as income generated from selling agricultural goods and achieving food and nutrition security. About 35% of the

sampled farmers reported having experienced regular food shortages between August 2019 and August 2020, while 54% reported having experienced occasional food shortages in the same period. This implied that households were experiencing challenges with outcomes from undertaking livelihood strategies, which contributed to declining incomes. Declining household incomes in the study area were attributable to climatic change. Focus group discussions revealed that yields from crop farming had significantly been reduced in the previous years. This negatively affected income derived by smallholder farmers from the sale of agricultural products. The persistent drought in the area also decreased yields from Mopani worms, which are usually used in summer as a source of protein and a meat substitute. Some farmers in the area also practiced gardening to supplement household dietary requirements. Persistent drought and poor municipal water supply forced households to abandon household gardens.

5. Conclusions and Recommendations

This study has used the sustainable livelihoods approach adopted from the SLF to investigate the perceived impact of climate change on the livelihoods of smallholder farmers in the uMkhanyakude district. Smallholder farmers depend on an array of capital assets to construct and contrive a living. The results suggest that climate change has eroded the capital assets that smallholder farmers depend upon to create a livelihood. The majority of the smallholder farmers were women, and by implication, they were the most vulnerable to climate change. Crop production and livestock production were the main livelihood strategies in the study area. Drought has been a prominent feature in the uMkhanyakude district. Persistent drought has resulted in decreasing yields, thus forcing households to rely heavily on food purchases rather than on their production. Climate change has also resulted in the dwindling of forest resources, which has negatively impacted the income of local households. Forest depletion and deteriorating pasture quality have negatively affected livestock production. Ultimately, climate change was found to decrease household incomes and increase food insecurity in communities that were dependent on rainfed agriculture. Based on the study results, it can be concluded that smallholder farming is an important livelihood strategy in the district and the research indicates that agriculture-based livelihoods are highly susceptible to climatic changes. This study recommends that policymakers should focus on policies that enhance the resilience of livelihood assets for farming communities to minimise climatic risk. Since drought is a major problem in the district, this study also recommends that local extension agents should facilitate the introduction of drought-resistant crops and encourage rearing drought-tolerant livestock breeds.

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