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RESEARCH ARTICLE

THE EFFECTS OF CLIMATE CHANGE ON CROP PRODUCTION AMONG SMALL SCALE FARMERS IN KANONGESHA COMMUNITY OF MWINILUNGA – ZAMBIA

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ABSTRACT

Globally, there has been an increase in the effects of climate change. This has also affected the agricultural sector and crop production in Kanongesha area of Mwinilunga District, Zambia. The aim of this study was to investigate effects of climate change on agricultural production. The objectives were to; identify the indicators of climate change in the area, determine effects of climate change on agriculture production and assess the adaptation strategies used by the local farmers. The method used to collect data was questionnaires and observation sheets. The target population for the study was 133 respondents. Data analysis was done using SPSS and Microsoft excel. The study revealed several climate change indicators which included; extreme weather events having the biggest with 32.3%, followed by unpredictable rainfall with 22.6%, then rising temperature with 25.6%, and the one with the lowest had 19.5% biotic stressors. Further, some effects of climate change on crops included crop loss with 35.3%, followed by drying of crops with 24.1%. The area also experienced proliferation of diseases, insects and obnoxious weeds with 21.1%. The small-scale farmers are willing to assist government deal with climate change crisis. However, there is need for support from government to effectively implement climate smart initiatives. A study could be done to look at the effectiveness of the climate change measures being used by small scale farmers to build their resilience to climate impacts.

KEYWORDS

Climate change, Agricultural production, Small-scale farmers, Adaptation, Resilience

1. INTRODUCTION

Zambia's Agriculture sector is increasingly becoming significant, second to mining which has been an economical pillar since independence (Muchinda, 2001). This sector has a huge contribution to national Gross Domestic Product (GDP), livelihoods and employment of the citizens in the country (Muchinda, 2001). However, small scale farmers are largely affected by climate change, which in-turn affect food security levels across the country.

Anthropogenic activities have altered global climate system in various ecosystems as well as people's livelihoods (De Pinto, 2019). Majority of the poor are greatly affected by climate change impacts. It was also noted by and most of the small holder farmers across the country depends on rain fed agriculture, with increasing temperatures and droughts experienced in some parts of the country (Meybeck, 2018). Climate change refers to significant and long-term alterations in global or regional climate patterns, primarily driven by human activities, particularly the emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide (IPCC, 2014). Further, in a review paper on impact of climate change on global agriculture - challenges and adaptation it was indicated that climate change poses a significant threat to global agriculture, negatively affecting crop production, and various ecosystem services (Prajapati, et al.,2014). These changes have a big effect on food security, people' livelihoods and the sustainability in the ecosystem. Weather and climate change have a huge bearing on agriculture production globally (Gupta, 2020). Further, It's been noted various effects of climate change on the rural poor in Zambia. Additionally, past studies have revealed various impacts of climate change on the agriculture sector, thereby leading to a decline in food security levels (IISD, 2007; Lobell, 2008; Kurukulasuriya and Mendelsohn, 2006; Kunda, 2022).

Therefore, there is need to find ways of mitigating the effects of climate change by advocating for the right measures. In Zambia, crop and livestock production is the major source of livelihood which contribute to food security for the majority of the citizens (De Pinto, 2019). Assessing the effects of climate change on crop production in Kanongesha community was the aim of this study. It was guided by the following objectives; identify the indicators of climate change in the area, determine effects, and analyze the measures used by small scale farmers to adapt to effects of climate change on agricultural production.

2. METHOD AND MATERIALS

2.1 Research Design

The research used a mixed research approach, were both qualitative and quantitative methods were used.

2.2 Target Population

The targeted population was small-scale farmers found in Kanongesha area of North Western province. The population consisted of people of various occupation and ages. The number of registered farmers as indicated in the community register were 320, and only 200 were actively engaged in farming activities, where a sample size of 133 respondents was picked. The sample size was determined using Yamane (1967) at 95% confidence level and P = 0.5.

$$n = \frac{N}{1 + N(e)^2}$$

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Where;

n= sample size

N=population size

e = margin of error

2.3 Data Collection

Questionnaires were used as important tools in gathering the required information. It is important to collect information from the people on the ground, to get their views, opinions, and lived experiences. With this approach the researchers were able to collect the intended data, but also to ensure that even those who had challenges in language could have an opportunity to contribute information (Mabasa and Makhubele, 2016).

3. Results and Discussion

3.1 Demographic Information of Respondents

As indicated the sample was composed of both male and female respondents. A total number of 57 females and 76 males participated in this study as shown in Table 1.

Table 1: Demographic characteristics

Characteristics	n= 133	%
Gender		
Male	76	57.1
Female	57	42.9
Education level		
Tertiary	27	20.3
Secondary	36	27
Primary	57	42.9
No formal education	13	9.8
Age distribution		
20 – 29	24	18
30 – 39	38	28.6
40 – 49	55	41.4
50 and above	16	12
Length of stay		
0 – 5	27	20.3
6 – 10	30	22.6
11 – 15	18	13.5
16 – 20	22	16.5
21 and above	36	27.1
Occupation		
Working	26	19.6
Retirees	13	9.8
Business	18	13.5
Farming	76	57.1

There was good representation for each gender in the study. This could mean that both female and male respondents were household heads. Most of the people who have settled in this place are from Kabanda and Mudanyama. The population was composed of retirees, and those who were engaged in various economic activities like farming.

The dominant respondents in the study were those aged between 40 - 49 years old followed by those who were between 30-39 years. The smallest group of respondents came from those who were above 51 years old. When considering their level of education, it is clear that most of the people in the area had a fair level of education. The results have shown that above 70% of the respondents had some formal level of education. However, we also have those who did not have any formal education 9.8%.

Most of the respondents had stayed in this area for a reasonable number of years. About, 27.1% of the respondents had stayed in the area for more than 20 years. These were the respondents who were older and mostly grew up in the area. Further, about 42% of the total number of respondents had stayed in the area for 15 years and less. This means that the area was receiving new settlers from time to time.

3.2 Agricultural Activities by Small Scale Farmers

The small-scale farmers found in the area were engaged in various livelihood activities that supported their survival. The most embraced economic activity that local people were involved in was crop farming with 34.6%, followed by livestock farming with 24%. The lowest practiced activity that was being practiced was fish farming with 7.5% as shown in Figure 1.

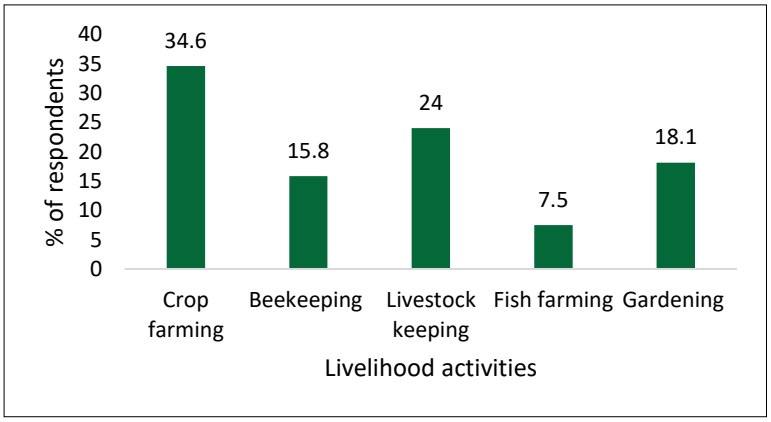

Figure 1: Livelihood activities

3.3 Crop farming

There were various crops that were grown by the local farmers for food consumption and for sale for them to raise some income. These findings are in line who indicated that crop and livestock production is the major source of livelihood which contribute to food security for the majority of Zambians (De Pinto, 2019).

3.4 Livestock farming

The farmers were also keeping various livestock in the area that helped them survive in case of droughts. The livestock that were commonly kept by the majority of small-scale farmers included; chickens, goats, and cattle. These were a good fall back especially when certain individuals had poor harvests, they could decide to sale some livestock and get the money and use it to solve the pressing needs. Livestock rearing is one of the economic practices supported by (De Pinto, 2019).

3.5 Beekeeping and fish farming

North western province is well known for beekeeping practices, as one of the economic activities that was being implemented by the local farmers. However, apiculture has not been spared by climate change, affecting the incomes of beekeepers due to reduced production. Some of the beekeepers indicated that bees had left their hives.

However, nature-based solutions are considered key for building community resilience (IPCC, 2014). Further fish farming was something that was being practiced in the area. Although, the drought had affected this activity in that some ponds had dried up. This activity was also vital in providing the much-needed nutrition for the people, as well as the income.

3.6 Climate change indicators

The area had various climate change indicators that were being experienced. For example, farmers were experiencing higher temperatures in the area with 25.6% responses. The most experienced indicator was extreme weather conditions with 32.3% and the lowest was biotic stressors with 19.5%, (Figure 2).

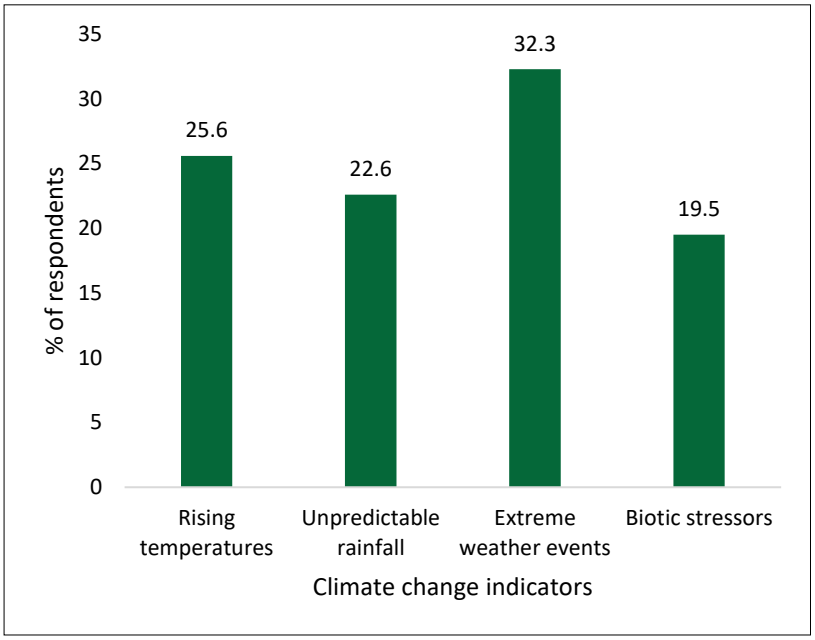

Figure 2: Climate change indicators

3.7 Rising temperature

The community was also experiencing extreme heat, some farmers indicated that high temperatures were becoming unbearable from time to time. This was considered a sign that climate change was having its effects. These results agrees with the findings of IPCC who revealed that surface temperatures have increased by half, or more over most of Africa counties with the 1995 to 2010 period seeing significantly higher surface temperature anomalies compared to the prior 15 years (IPCC 2007). Un predictable weather patterns may lead to high levels of food insecurity and poverty in the community, as yields are greatly affected which in-turn impact negatively on household income (Mbuli 2021). The high temperatures have also led to some streams drying, thereby having reduced water levels in the area. This confirms studies done by (Bond 2008) who revealed that, falling water levels and subsequent reduced oxygen and increased salinity levels strain the fish stocks and other river and lake fauna (Hulme 200 and New 2006)

3.8 Unpredictable rainfall

The amount of rainfall that is being received by the farmers has also reduced significantly. Some farmers have indicated that sometimes the rain is received in certain parts, and not others, thereby affecting the production levels of food (Beilfuss, 2012). This often affect effective planning and planting as well as scheduling various farming activities on the farms. It is confirms that uncertainty in climate change impacts makes it difficult for farmers to effectively plan their farming operations because most of them depend on rain fed kind of agriculture practice. Further studies have described a general reduction in rainfall for the past 40 years, along with increased variability in rainfall year-to-year, and an increase in extreme precipitation events (Hulme et al., 2001; IPCC, 2007; Kirtman et al., 2013; De Pinto, et al., 2019)

3.9 Extreme weather events

The area has also experienced some extreme events such as floods and some storms, that have left crops destroyed and the death of livestock. A study done by GRZ are confirms this indicating that floods are common frequent and severe in recent decades affecting many sectors, droughts can also be devastating and have long lasting effects on people (GRZ, 2007). In Zambia it is noted that about 70 per cent of the workforce is dependent on agriculture as reported by World Bank and a large portion of the country especially in areas covering the plains of river Zambezi, which are mainly vulnerable to rainfall variability (World Bank, 2014). Floods may have severe consequences on the citizens of the country, for example the flooding experienced in 2006-2007 rainy season had almost 1.5 million people affected as noted by (GRZ, 2007). Typical impacts from a major flooding event include; collapsed houses and buildings, destruction of infrastructure, waterlogged agricultural fields, destruction of crops, and increase in human diseases (GRZ, 2007; Leary, et al 2007). Some of these diseases have been severe and have killed livestock, confirming the findings by Kunda who stated that livestock have died because of different kinds of diseases e.g. chicken gets diarrheal, and cattle got sores occurring especially, when experiencing higher temperatures (Kunda, 2022). There is also evidence of increased disease incidence among livestock, particularly cattle, during times of extremely high temperature (Leary, 2007). According to Kunda changing growing seasons also have effects on crops and livestock in the area. This affect the planting season which is delayed but also having difficulties in planning (Kunda, 2022).

3.10 The Effects of Climate Change

The area had also experienced a number of effects due to climate variation occurring in the area. One of the biggest effects experienced in the area was crop failure and loss with 35.3% responses, followed by drying of crops with 24.1%. Pests and diseases were some of the challenges that the farmers in the area experienced with 21.1%. Various pests and diseases were reported in the area. The effect that had the smallest number of responses was reduced soil fertility with 7.5% (see Figure 3).

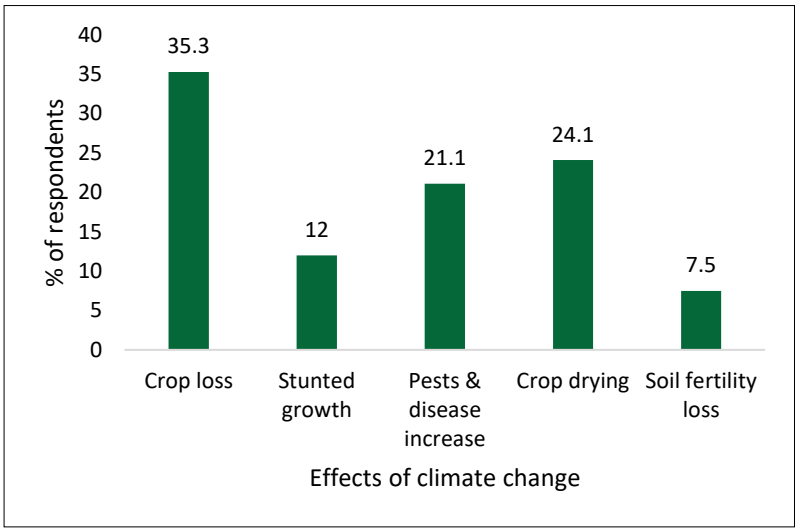

Figure 3: Effects of climate change

3.11 Crop Loss and failure

The interview with key informants revealed that the area experienced a loss in crops and livestock in the past 4 years. The losses were big, because crops failed to grow due to prolonged drought, especially in the last farming season 2023-2024. Some women interviewed stated that they experienced prolonged drought, which resulted in the drying of crops in some cases the farmers lost all the crops. Others were fortunate, some crops recovered after the rains resumed, but still the yield was poor. Among various effects experienced in the area is crop loss and failure. This happened especially when the area experienced drought. Several research has indicated diverse effects of climate change on society and its inhabitants (Apata et al., 2009; ODI, 2007; Wolfe et al., 2005). Kunda added that most smallholder farmers are vulnerable to climate change risks due to their dependance on rain-fed agriculture, resulting from lack of access to financing and affordable modern equipment to facilitate irrigation (Kunda, 2022)

The production is also affected with the loss of crops especially when the area is flooded and it has been noted that small-scale farming sector that solely depend on rainfall are more vulnerability to climatic shocks, this in–turn affects agricultural productivity (Mbuli, 2021)

3.12 Stunted Crop Growth

Stuntedness in growth was also experienced in the area. This could be attributed to high rainfall in some areas, this could mean washing away of fertile soils, leaving the land unproductive that could not support effective crop growth. Also, the amount of heat and disease attack resulted in stunted growth for maize and other crops. According to the farmers the maize and other crops could not grow well, and they could not produce cobs, this is in agreement with similar observations (Kunda, 2022).

3.13 Proliferation of Diseases, Insects and Obnoxious Weeds

In an interview with farmers, some mentioned the outbreak of new diseases that were not seen in the past. However, there is also an increase in some insects such as army worms, now they appear every year in the area than in the past. Some regions have experienced an increase in thorny weeds that are new in the area. These have affected and reduced crop production especially for maize and beans. Some key informants interviewed indicated that there was a reduction in edible grass which was grazed on by the cattle and goats in the area. As new insects, diseases and weeds over-take the field, farming output is affected and hence threatening survival of farmers. Additionally, livestock especially chickens die, thereby reducing the number of birds and other livestock in the area, hence affecting food security. Also, pasture scarcity, since low rainfall leads to no grass for animals hence starvation and delayed gemination. Kunda supports this stating that rotting of crops is another challenge that is experienced in rural areas (Kunda, 2022).

Further, this loss will have a big bearing on the national economy which will be affected negatively. The researcher stated that many African countries, have their economies largely based on weather-sensitive agricultural productions systems like Nigeria, are particularly vulnerable to climate change. Also, this is futher confirmed by increasing temperature and precipitation slightly with the already dry season may encourage diseases and insect pests. Demand for more use of pesticides increases because of increasing insect population, which causes more harmful effects to the ecosystem as well as human society (Malla, 2008; Kunda 2022 et al ; Dinar 2006; Mendelsohn et al 1994).

3.14 Adaptation Measures (Strategies)

Additionally, there was various adaptation strategies practiced in the area and the most common was crop diversification with 25.6%, followed by growing of drought resistant crops with 17.3%, then proper livestock management with 14.3%. The smallest number of respondents for good water management with 2.3% (see Figure 4). This was something that was being promoted but most of the local farmers did not have the capacity to practice it. Further, practicing irrigation and rainwater harvesting is something that was key in communities to enhance irrigation and also harvesting water using dams. Climate change adaptations has been seen to have significant impact on farm productivity in (Nigeria Apata, 2009).

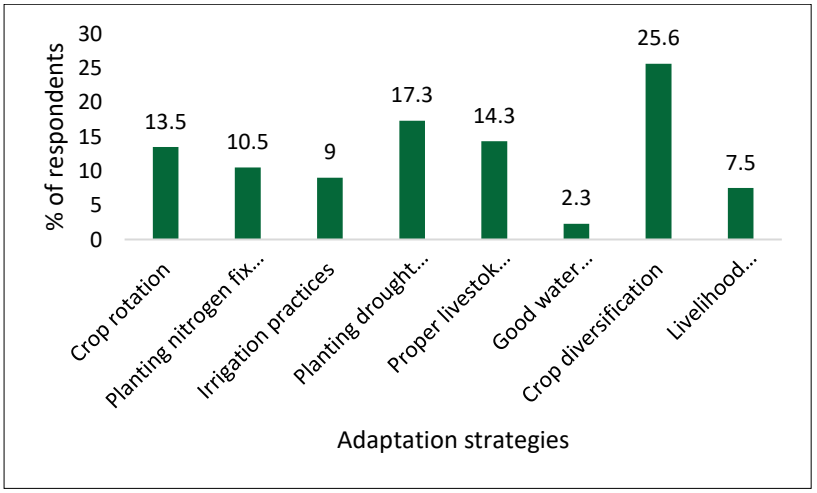

Figure 4: Adaptation strategies

3.15 Planting of nitrogen fixing crops and trees

Several farmers in the area are now planting trees such as ***Acacia species*** to help fix nitrogen so as to improve soil fertility. The trees also provide various benefits to the local farmers such as fuel and animal fodder. According to the study, this can lessen the need for chemical nitrogen fertilizers, which have a powerful global warming effect, but also expensive to acquire (Prajapati 2014). Agroforestry therefore not only mitigates global warming, but also helps farmers adapt to the often-devastating effects of climate change, such as floods, droughts, and unpredictable rainfall patterns (Kunda, 2022).

3.16 Crop diversification, Intercropping and crop rotation

A study conducted by Kunda on the impact of climate change on small scale farmers in Samfya District of Luapula Province, Zambia revealed various adaptation strategies that included intercropping and crop rotation (Kunda, 2022). The farmers have also been planting crops that are early maturing and disease resistant as a way of adapting something greatly supported by researcher who indicated that having both early and late maturing crops when planting may allow the farmers to have a good harvest after the farming season. This has led to many farmers using organic fertilizer which is cheaper and is performing almost the same as synthetic fertilizer. These practices also greatly supported by (Prajapati 2014; Kunda, 2022).

3.17 Planting Drought Resistant Crops and Seed

The farmers have also started growing crops that are drought resistant such as casaava, were farmers have fields of different sizes. Some of the farmers have started harvesting leaves of cassava which they are using as relish. The researcher revealed that farmers adopted several livestock that were somewhat resistant to droughts (Kunda, 2022).

Additionally, several adaptation strategies have been identified including crop diversification, water management, adoption of climate-resilient agricultural practices, being essential to enhancing the resilience of agricultural systems to climate change. However, adaptation efforts are being hindered by lack of information on how smallholder farmers are experiencing and responding to climate change (Mbuli, 2021). The researcher hinted that climate change is jeopardizing to small scale farming especially for communities with compromised resilience and adaptive capacities. IPCC added that adequate irrigation systems to enhance adaptive capacity of society was a challenge (IPCC,1998). Several devastating effects of climate change on crops and animals have been mentioned (Ngondjeb, 2013). However, the researcher observed that climate impacts were also experienced in marine species (Mishra and Sahu, 2014).

4. Conclusions

The study revealed that farmers in Kanongesha areas of Mwinilunga have been impacted negatively by the effects of climate change. Most of these small-scale farmers grow various crops such as maize, which is considered one of the major crops in the area. Other crops include, groundnuts, sweet potatoes, and beans. There are various impacts that have been experienced due to climate change such as rising temperatures, high number of pests, weeds and diseases for crops. Additionally, various measures have included things like conservation farming, irrigation farming, growing of drought resistant plants and used of seed that can be able to produce crops in conditions which are not conducive.

Recommendations

Diversification should be promoted so that the farmers could have a fall back, if other crops fail. Further, studies can be done to look at the indigenous practices being practiced by farmers to mitigate the effects of climate change in the area.

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