

Measures to Mitigate Climate Induced Threats in Promoting Good Health and Social Well-Being of Small Scale Crop Farmers in Nega Nega Community of Mazabuka District, Zambia.

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ABSTRACT

Empirical evidence has shown that billions of people, particularly those in developing countries, Zambia inclusive are facing shortages of water and food as a result of climate threats. The climate threats are also perceived and predicted to be a greater risks to health and lives of people affected. The situation is predicted to worsen in the future if no measures are taken. This implies that concerted global action is needed to enable developing countries to adapt to the effects of climate threats. Therefore this research was undertaken primarily to explore measures that can be used to mitigate climate induced threats in promoting good health and social well-being of small scale crop farmers in Nega Nega community of Mazabuka District, Zambia. This research was undertaken using a qualitative interpretive phenomenological design. The design was appropriate as it helped to obtain detailed insights on perceived measures from 30 purposively selected indigenous small-scale crop farmers Interviews were the main source of data supplemented by document review. The main findings of this research were that, in order to combat the effects associated with climate shocks in Nega Nega community, famers should begin to practice the using of irrigation systems and planting of drought resilient crops such as beans and cassava. The research also found that farmers should embrace afforestation as this has been scietifically proven to help reduce climate changes' effects. Small scale crop farners perceived these measures to be smart agriculture practices and if well harnessed, they can positvely impact their health and social wellbeing. Equally, secondary data brings to light the importance of enhancing the capacity of rural economies to diversify, by promoting alternative income generating activities that are climate resilient. The research concluded that these measures are crtical because they speak to how humanity can overcome objectionable conditions such as climate induced threats that have the potential to jeopardize human existence on planet earth. This research recommends that the Ministry of Agriculture through agriculture extention officers should educate small scale farmers on smart agricure practice such as crop diversification, kind of crop for each soil type and irrigation. These practises have the potential to enhance productivity, optimise water management, and promote soil health, thereby mitigating susceptibility to climate-related disturbances.

Keywords: Climate induced threat, measures, good health, social wellbeing, small-scale crop farmer, Zambia.

BACKGROUND

Climate induced threats have been defined as the unprecedented intrusion of human beings into nature which has given rise to worldwide devastations (Kumar, *et al.* 2021). Literature shows that human activities which are predominantly related to energy production, industrial activities and those related to forestry, land use and land-use change have been cited to be among contributing factors to climate change (Edenhofer *et al.* 2014). For instance, according to the emissions gap report prepared by the United Nations Environment Programme (UNEP) in 2019, total greenhouse gas emissions in 2018 amounted to 55.3 gigatonnes of carbon dioxide (GtCO₂), of which 37.5 GtCO₂ are attributed to fossil CO₂ emissions from energy production and

industrial activities. An increase of 2% in 2018 is noted, as compared to an annual increase of 1.5% over the past decade for both total global greenhouse gas and fossil CO₂ emissions. The rise of fossil CO₂ emissions in 2018 is mainly driven by higher energy demand. Furthermore, emissions related to land-use change amounted to 3.5 GtCO₂ in 2018 (UNEP, 2019). Together in 2018, fossil-based and land-use-related CO₂ emissions accounted for approximately 74% of the total global greenhouse gas emissions. To put these percentages into context, a report by Intergovernmental Panel on Climate Change (IPCC) demonstrated that anthropogenic activities so far have caused an estimated 1.0 °C of global warming above the pre-industrial level, specifying a likely range between 0.8 and 1.2 °C. Thus, it is projected that global warming is likely to reach 1.5 °C between 2030 and 2052 if the current emission rates persist (IPCC, 2018).

The resultant implications of the above situation to humanity are shown in a report by IPCC (2007) which note that global climate change will impact on food and water security in a significant but highly uncertain manner in the coming years. Empirical evidence on climate change vulnerability and adaptation readiness of 192 United Nations countries concluded that food, water, health, ecosystem, human habitat and infrastructure are the most vulnerable sectors under climate attack while pointing out that Africa is the most vulnerable region to climate variability (Sarkodie and Strezov, 2019).

In the context of Zambia, Zambia National Climate Change Policy (2016) shows that , climate change challenges in Zambia are quite substantial due to its high dependence on climate sensitive natural resource sectors for food security, livelihoods and incomes. Empirical evidence shows that Climate shocks in Zambia are constantly increasing, thus pushing most people in rural areas especially small scale farmers into poverty (Ngoma,2021;Sianungu, 2015). Majority of the people in rural areas depend on rain-fed agriculture and must wait a long time before harvesting the crops that they have planted. The agricultural industry is the main source of income for rural communities, and climate change has become a serious worry. Most of these rural households are subsistence smallholder farmers who rely on rainfall for agricultural production (FAO, 2014). However, climate shocks surpass their coping abilities and erode their household assets. When household assets erodes, it can be argued that small scale crop famrers may not be able to meet basic needs such as food, water and shelter which are essential in promoting good health and social wellbeing of citizenry. According to Zambia National Policy on Climate Change (2016), it is widely recognized that climate change constitutes a significant and serious threat to sustainable development of any country, including Zambia.

In view of risks and challenges asociated with climate threats, studies have been conducted to find solutions. For instance, Kumar *et al.* (2018) conducted a study to assess the impact of drip irrigation on tomato production in a water-scarce region of India. The study revealed that the implementation of drip irrigation resulted in notable enhancements in water-use efficiency, crop yield, and reduction in water consumption when compared to conventional flood irrigation techniques. A recent study conducted by Guan *et al* (2022) investigated the impact of drip irrigation on maize yield in China. The findings of the study indicated that the implementation of drip irrigation resulted in a decrease in water consumption, as well as an increase in crop yield and water productivity. This suggests that drip irrigation is a viable and flexible technique that can be utilised in regions with limited water resources.

A study in China noted a practice of crop residue retention. Crop residue retention refers to the practise of retaining crop residues, including stalks, leaves, and stems, on the agricultural field subsequent to the harvest process, as opposed to their removal or incineration. In a scholarly publication titled " Residue management induced changes in soil organic carbon and total nitrogen under different tillage practices in the North China Plain" by Chao *et al* (2019) it was found that the practise of retaining crop residue has the potential to augment levels of soil organic carbon, enhance soil fertility, and bolster water retention capabilities. The aforementioned advantages contribute to the resilience of agricultural systems through the mitigation of soil erosion, facilitation of nutrient cycling, and enhancement of water conservation. Another study on the impact of crop residue retention on wheat yields in India was investigated by Dutta *et al* (2022). The findings of the study demonstrate that the practice of retaining crop residues on the soil surface has a substantial positive impact on crop yields and water productivity. This suggests that this practice can be effectively implemented in sustainable agricultural systems.

The positive effects of rainwater harvesting on crop yields and farm incomes in sub-Saharan Africa were emphasised in a study conducted by the International Water Management Institute (IWMI) (Adimassu *et al.* (2017). The research findings indicated that the implementation of small-scale rainwater harvesting methods, such as micro-catchments and rooftop water harvesting, had a significant impact on maintaining agricultural productivity and supporting livelihoods in regions facing water scarcity.

Arslan *et al.* (2015) conducted a study to investigate the effects of an array of potentially climate-smart agricultural practises, including reduced tillage, crop rotation, and legume intercropping, as well as the use of improved seedlings and inorganic fertiliser on maize yields in Zambia. The study integrated panel data from the Rural Incomes and Livelihoods Surveys with a novel set of climatic variables based on geo-referenced historical rainfall and temperature data to investigate the changing effects of these practises with climate conditions. The study findings indicate that minimal soil disturbance and crop rotation have no significant effect on these yield outcomes, but that legume intercropping substantially increases yields and reduces the likelihood of low yields, even under severe weather stress during the growing season. Further evidence in a study conducted by Abid and Mehdi (2020) shows that Farmers in Malawi adopted an increase in on-farm labour, drought-tolerant varieties, early sowing, and intercropping as key ex-ante adaptation strategies to mitigate the negative effects of extreme climate events.

Despite the notable findings by the previous studies on how to mitigate climate induced threats, these findings may not have addressed the challenges faced by small scale crop farmers in Nega Nega community during climate threats due to different geographical location, nature of climate threats, and farmers' capability. Therefore it was cardinal to carryout this research in view of finding measures that can be used to mitigate climate threats in promoting good health and social wellbeing of small scale crop farmers.

In substantiating the need to carry out this research, this was done in response to the observation that billions of people, particularly those in developing countries are facing shortages of water and food as a result of climate threats (Ngoma, 2021). The climate threats are also perceived and predicted to be a greater risks to health and lives of people affected (Sarkodie and Strezov 2019). The situation is predicted to worsen in the future if no measures are taken. This implies that concerted global action is needed to enable developing countries to adapt to the effects of climate threats (IPCC, 2007). The IPCC further predict serious effects including reduced crop yields in tropical areas leading to increased risk of hunger. For instance, small-scale farming is a common farming system in Zambia for people in rural communities like Nega Nega, thus, Climate shock is projected to limit the potential for growth in the agriculture sector hence leading to hunger and compromised health standards of farmers (Dailo,2023;Burke *et al* , 2016;Dailo, 2023; Sianungu, 2015; Food and Agriculture organisation, 2015; Sideline et al, 2014; Lobel *et al*, 2011; Lobel, 2013). Despite the projected effects of climate threats, there was still scant information provided on the unique adoptaion measures to mitigate climate threats by small scale crop farmers in Nega Nega community hence this research which focused on measures that can be used to mitigate climate induced threats in promoting Good health and social well-being of small scale crop farmers.

From the theoretical point of view, this article adopted Resilience theory, propounded by Holling (1973). The theory holds that systems have the capacity to absorb disturbances, adapt to changing conditions, and transform in response to shocks and stresses. The theory recognizes that systems are characterized by dynamic interactions and feedback loops between different components, and that these interactions influence the system's ability to withstand and recover from disturbances.

According to resilience theory, systems can exhibit different types of resilience: engineering resilience, which focuses on the system's ability to bounce back to its original state after a disturbance, and ecological resilience, which emphasizes the system's capacity to adapt and undergo transformations to maintain functionality in the face of change.

Applying resilience theory to this research was appropriate due to its salient features which speaks to the way human beings can overcome changing conditions that are not favourable to their exitsnce. To this effect,

the theory is suitable when exploring measures that small scale crop farmers can embrace in response to climate shocks. The theory provides a lens to analyse the adaptive capacities of farmers, communities, and the overall socio-ecological system in the district. These interventions are perceived to promote good health and well-being of crop farmers because they fall within the aspirations of the sustainable development goals.

RESEARCH METHODOLOGY

Research design

The research was undertaken using a Qualitative interpretive phenomenological design mainly propounded by Martin Heidegger (1889-1976). This design was used because only participants who were farmers and had experienced climate shock in their farming endeavors were eligible to take part. This design is justifiable by the thinking that it can be used when you are trying to understand a phenomenon but cannot do so unless you have faced that particular situation. Therefore, this design helped to recruit only small scale crop farmers of Nega Nega community in Mazabuka district, Zambia and excluded large scale farmers and those that were not practicing farming.

Target population, sample size and sampling procedure

This research targeted small scale crop farmers of Nega Nega community of Mazabuka District, Zambia who had lived for more than 5 years in the community. The reason for this consideration was to help generate evidence from participants who had experienced different climate conditions for the period of 5 years or more hence the possibility of them providing lived experiences. Based on the aforementioned reason, it was only ideal to use homogenous purposive sampling in selecting 30 small scale crop farmers because this type of sampling gives an opportunity to the principal investigators to decide who should be part of research (Greener, 2018).

Instruments for data generation

This research relied on both primary and secondary data. Primary data was generated using interview guide and secondary data through document review. The interview guide composed of semi-structured questions. Interviews were appropriate for this research because through this tool, small scale crop farmers were able to share their perceived measures that can be used to mitigate climate induced threats in promoting Good health and social well-being of small scale crop farmers in Nega Nega community of Mazabuka District, Zambia (Creswell, 2014). Secondary data was generated using document review. However, this research only considered Zambia National Policy on Climate Change (ZNPCC) as only source of secondary data which was enacted in 2016.

Data analysis and Quality assurance

Findings of this research were analyzed using thematic approach. We closely examined the data to help come up with themes in line with the objective of this research which was to find measures for mitigating climate induced threats (Naeem and Ozuem, 2022). Themes were identified by highlighting material in the interview transcripts that were congruent with measures to mitigate climate induced threat. The researchers then selected each of the highlighted phrases and tried to ascertain what meaning can be put forward in the highlighted material. After identifying the themes, the researcher then embarked on the process of recording the themes and describing how they were interrelated (Elliot, 2018). Rewriting continued until the researcher felt that the themes and the relationship between the themes are identified as accurately as possible (Lingard, 2019). Data from document review was merged with primary data. However, only data that was closely related to the objective of this research was considered. Data quality assurance was based on four principals of trustworthiness: dependability, credibility, conformability and transferability (Kothari and Grag, 2014).

Ethical considerations

This research adhered to research ethics. Participation in this research was by consent. None of the participants was coerced to take part without their informed consents. As such, enough information concerning this research was provided to the participants in order to help them make a choice whether to participate or not. Anonymity and confidentiality was highly observed. This was done by not using the real names of the participants when presenting the findings. Instead, the codes to represent the real names of the participants were used.

FINDINGS AND DISCUSSION

Measures to mitigate climate induced threats in promoting Good health and social well-being of small scale crop farmers in Nega Nega

Findings revealed that Nega Nega community suffered from climate induced threats such as Prolonged drought, excessive flooding and unpredictable rainfall patterns and as such, participants felt that adopting irrigation system, planting of drought resilient crops, embracing afforestation and using available wealth of knowledge about good practices towards nature can help to mitigate climate related problems henceforth, promoting good health and social well-being of small scale crop farmers in the area.

1. Adoption of irrigation system

The study revealed that “adoption of irrigation” was one key strategy that farmers can use to combat effects associated with climate shock. The adoption of effective water management strategies, such as the utilisation of drip irrigation can help to boost food security amidst climate challenges. Below are the verbal responses supporting the adoption of irrigation as a mean of combating effects associated with climate shocks.

MSSF1 stated : *I encourage people to use irrigation even at a small scale because through this, they will be able to support their families. Right now, I'm selling tomatoes out of irrigation.*

MSSF18 observed: *farmers should not just rely on growing maize, they should also try gardening. Water is accessible here and they can do something out of it than waiting for the rains that have been failing us for so many years now.*

FSSF4 suggested: *I think government should come to our aid. Let them help us on how we can survive through the means of irrigations. We need to be empowered.*

Based on diverse effects associated with climate shocks on the livelihood of Nega Nega small scale crop farmers, some measures were suggested to combat these effects. The responses from the participants gave an impression that “adoption of irrigation” was one of the key strategies that farmers can use to combat effects associated with climate shock. Farmers mentioned that since their area had not been receiving rains normally, they can take advantage of irrigation as a supplement. They argued that the adoption of effective water management strategies, such as the utilisation of drip irrigation can help to boost food security in an event of decreased yield in Maize production. Responses of this study also gave an impression that very few farmers made mention that they had adopted effective water management technologies that prove to be more resilient and adaptable in the face of these climate shocks. The majority of the farmers complained of not having the knowledge and the capacity to adopt this technologies. Their appeal was that government through relevant authority such as agricultural extension officers should help them to implement innovative strategies as these are expected to alleviate the adverse negative impacts of climate shocks on their means of subsistence.

The above findings are in tandem with Kumar *et al.* (2018) who assessed the impact of drip irrigation on tomato production in a water-scarce region of India. The study revealed that the implementation of drip

irrigation resulted in notable enhancements in water-use efficiency, crop yield, and reduction in water consumption when compared to conventional flood irrigation techniques. Similarly, Guan *et al* (2022) investigated the impact of drip irrigation on maize yield in China. The findings of the study indicated that the implementation of drip irrigation resulted in an increase in crop yield and water productivity. This suggests that drip irrigation is a viable and flexible technique that can be utilised in regions with limited water resources.

To the contrary, findings on irrigation depart from the study conducted by Adimassu *et al* (2017) who found that the implementation of small-scale rainwater harvesting methods, such as micro-catchments and rooftop water harvesting, had a significant impact on maintaining agricultural productivity and supporting livelihoods in regions facing water scarcity. In the context of this study in Nega Nega community, rainwater harvesting was not mentioned as a measure to combat effects associated with climate shocks.

2. Planting of drought resilient crops

The study revealed that “Planting of drought resilient crops” is another strategy that farmers can use to combat challenges associated with climate shock. Majority of farmers mentioned that, crops like cassava, potatoes, beans, groundnuts and sweet potatoes are able to withstand prolonged drought as compared to Maize. Below are some verbal responses supporting planting of resilient crops as one way of combating effects in the context of climate shocks.

FSSF3 suggested: *Farmers should not only rely on planting maize. They should also try growing other crops that does not require a lot of water like beans, cassava and sweet potatoes. For me I harvested something because I did not just rely on maize alone.*

MSSF10 echoed: *Agriculture extension officers should teach us on drought tolerant crops just the way they used to teach us in Kenneth Kaunda days. They used to come here and teach us how to plant crops and the hit on what kind of crops we were to plant depending on soil type and landscape.*

MSSF28 suggested: *I feel for us to mitigate challenges associated with climate shocks, we need crop diversification by embracing different types of crops not only maize.*

FSSF9 mentioned: *Despite maize being our major crop, we also need to try other crops that can withstand drought because if maize fail you, atleast you are assured of harvesting something from other crops.*

Responses from farmers shows that planting of drought tolerant crops like cassava, potatoes, beans, groundnuts and sweet potatoes is the only way of promoting good health and social wellbeing of farmers. These kind of crops were perceived by participants to survive in an event of inadequate rains as compared to Maize which requires enough and regular rains. In the context of this study, it was observed that few farmers were able to practice this agricultural innovation and their experiences with drought tolerant crops demonstrated greater resilience and adaptability in the context of climate shocks. Those who attempted planting other crops argued that that in an event maize failed them, there were able to harvest something from other crops. Those who practiced crop diversification discouraged the culture of focusing on maize alone as this has a diverse effect on their health and social wellbeing especially during climate shocks. Farmers also mentioned that before planting any crop, it is cardinal to observe the soil type because some soil do not support certain crops.

The above findings is inconsistent with Arslan *et al.* (2015) who found that minimal soil disturbance and crop rotation have no significant effect on the yield outcomes, but that legume intercropping substantially increases yields and reduces the likelihood of low yields, even under severe weather stress during the growing season. To the contrary, Abid and Mehdi (2020) found that Farmers in Malawi adopted an increase in on-farm labour, drought-tolerant varieties, early sowing, and intercropping as key ex-ante adaptation strategies to mitigate the negative effects of extreme climate events.

3. Afforestation

The study also revealed that “Afforestation” is another measure that can be used to combat effects associated with climate shock in trying to promote good health and social wellbeing of farmers. A number of farmers complained that all the trees in their area were cut down either for charcoal purposes or by those planting sugarcane. It was revealed that trees play a pivotal role in the rain formation process.

MSSF26 suggested: *In order to prevent drought, we need to plant more trees in this community. Most of the trees were cut down and this could be the contributing factors to the challenges of rains here because in areas where there were trees, we have been seeing it raining but here it is a challenge. Again it is up to God to bless us with rains or not.*

MSSF15 echoed: *we need more trees to prevent the blowing of wind because this area is plain. All the trees have been cut down by those that are planting sugarcane and those burning charcoals.*

FSSF28 suggested: *Planting trees is important because the time we were growing, we had no problems with the rains because we had a lot of trees.*

FSSF9 mentioned: *Trees are very important in supporting the rains. The time we were growing, we did not have challenges of rains in the area. I have lived for more than 50 years in this area and I have observed that from the time people started cutting down trees, rains became a problem. We need to go back to our original root of having trees and this can be done by government encouraging people to plant trees. We need to see agricultural officers come here and teach people the importance of planting trees.*

Based on verbal responses from the participants, Nega Nega community had limited trees and this was caused by sugar plantation as well as charcoal burning. Limited or absence of trees in Nega Nega community heavily affected the rainfall patterns because there were not enough trees to hold the wind and also to complete the process of transpiration. Nonetheless, a few farmers had adopted the practice of Agroforestry which involves the deliberate integration of trees within agricultural systems, either in combination with crops to enhance the diversity and resilience of the agricultural landscape.

Resilience theory by Holling (1973) also holds that systems have the capacity to absorb disturbances, adapt to changing conditions, and transform in response to shocks and stresses. Systems can exhibit different types of resilience: engineering resilience, which focuses on the system's ability to bounce back to its original state after a disturbance, and ecological resilience, which emphasizes the system's capacity to adapt and undergo transformations to maintain functionality in the face of change. Resilience theory suggests that systems with high resilience are characterized by diversity, redundancy, flexible governance structures, and the capacity for learning and self-organization. In the context of this study, planting of trees would mean that farmers are trying to put the community to its original position of having enough trees that can be able to support the formation of rainfall.

In view of the given information about Nega Nega community, Zambia National Policy on Climate Change enacted in 2016 outlines some of the policy measures that need to be implemented in order to alleviate climate induced threats in promoting good health and social wellbeing of small scale crop farmers and the general citizenry. Key measures to be considered among others include; 1. Adaptation and Disaster Risk Reduction which aims at promoting and strengthening the implementation of adaptation and disaster risk reduction measures to reduce vulnerability to climate variability and change. 2. Strengthening the mechanism for identifying risks and hazards in order to facilitate planning and early warning. In the context of Nega Nega community, early warning on the occurrence of climate induced threats would have served as a reminder to small scale farmers that they needed to embrace other strategies of farming. 3 Promoting stakeholders participation and partnerships that integrate climate change in natural resources management at all levels. Participants in this research also argued that there was need for small scale crop farmers to be good stewards of their own environment to avoid being contributors of climate induced threats 4. Enhancing the

capacity of rural economies to diversify, by promoting alternative income generating activities that are climate resilient. This research also revealed that small scale crop farmers needed to avoid the culture of relying only on maize production which may not be sustainable during climate induced threats for instance drought especially to those who do not embrace irrigation system. 5. Promoting public education and awareness to enhance the capacity to address climate change. For enstance, the use and adoption of irrigation system as a technology.

In the context of public education and awarenes, this research found that despite Nega Nega community having been affected with climate induced threats such as drought, the majority of small scale farmers continued relying on traditonal methods of practicing farming which had negatively impacted their health and social wellbeing.

CONCLUSION AND RECOMMENDATIONS

The research findings have provided critical information related to climate induced threats mitigation measures which are vital in promoting good health and social wellbeing of small scale crop farmers of Nega Nega community,Zambia. The anticipation of this research was that by mitigating climate induced threats such as drought, flooding among others, the livelihoods of small scale crop farmers could be uplifted hence, an opportunity to live a dignified life. To meet the above desirable conditions for small scale crop farmers, the research established that the use of irrigation, planting of drought resilient crops and afforastation need to be harnessed by small scale crop farmers. Therefore, findings of this research, secondary data and theoretical underpinning are in congruent because they all speak to how humanity can overcome objectionable conditions such as climate induced threats.

In view of the substantive evidence obtained from the participants and document review, it is recommended that the Ministry of Agriculture through agriculture extention officers should educate small scale farmers on smart agricure practice such as crop diversification, kind of crop for each soil type and irrigation. These practises have the potential to enhance productivity, optimise water management, and promote soil health, thereby mitigating susceptibility to climate-related disturbances. The Ministry of Agriculture should also continue to promote and enhance resarch on climate shock related studies due to the fact that through research, innovative ways of doing farming can be found.

Competing interest

The authors have no competing interest.

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