

Mechanisms to Cope With Climate Change in Chiredzi District of Masvingo, Zimbabwe

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Abstract: The study examined climate change coping mechanisms in rural communities in Chiredzi District. Chiredzi rural district communities are experiencing effects of climate change in the form of droughts and high temperatures and low annual rainfall that has culminated in low agricultural productivity. The research objectives of the study were to explore the effects of climate change on human security, examining the coping mechanisms currently employed mitigate the effects of climate and to assess the sustainability of the coping mechanisms by villagers in the Chiredzi District. The study used a descriptive research design with a sample of 71 respondents ($n=71$) chosen using simple random sampling method. Primary data was collected using questionnaire with a five point Likert scale, focus group discussion and interviews. The research results indicated that to a very great extent climate causes floods, droughts, storms and cyclones, fires, heat waves, and epidemics that cause loss of life and properties and it was also indicated that climate change causes poverty, inequality, market failures, and policy failures, the study showed that to a very great extent people in Chiredzi District adopted changes in planting dates, changes in harvesting dates, multiple cropping, intensive manure application, intercropping, and expansion of cultivated land area as coping mechanisms currently employed to mitigate the effects of climate change. The research findings indicated that the coping mechanisms were sustainable to a very great extent in terms of increasing food availability and overcome food insecurity in the household and increasing household income. It further revealed that the coping mechanism were sustainable as there have resulted in improvements in household feeding patterns to a great extent. The coping mechanisms have also culminated in increasing the number of built, used storage facilities, and increase household assets. The researcher recommended that people in the district should stop engaging in deforestation and sand-filling of natural water bodies such as rivers as a result of stream bank cultivation, as all of which singly and/or complementarily leads to climate change, the rural communities should do afforestation in their areas, farmers in the district should select and cultivate new well-bred animal and crop varieties with high yield potential and quality, superior, integrative stress resistance and wide adaptability and also select and cultivate stress resistant varieties with specific abilities of resistance to drought, high temperature and diseases and pest invasion and communities should stop agricultural activities such as bush burning, fertilizer application, fermentation among others, as anthropological influencers they, contributes to climate change, instead they can practise zero-tillage and organic farming using organic manure.

Keywords: Coping mechanism, mitigate, effects of climate change.

INTRODUCTION

Chiredzi District of Masvingo Province in Zimbabwe is one of the low lying areas of Zimbabwe that are experiencing harsh effects of climate change. UNHCR [1] has recognized that its practical approaches and operations need to be located in a context of adaptation and mitigation. At the same time, migration is seen to be an integral part of dealing with climate change. Furthermore, as resource scarcity poses serious

risks for humans, the UNHCR argues that their operations need to be “as environmentally sustainable as possible” [1]. This means, that UNHCR practices need to include elements of mitigation and adaptation as well as environmental education [2]. Thus UNHCR environmentally projects include the use of environmentally-friendly sources of fuel, a greater reliance on solar energy, and environmentally-friendly shelter-construction (Jacobs, Altman and Hart, 2009).

Moreover, the UNHCR promotes “sustainable forms of agriculture in refugee camps” confronted with environmental degradation, and also factors in peoples’ vulnerability to climate change “when assessing the needs of populations of concern” [1].

Accordingly, development strategies need to address the increased vulnerabilities to climate change for poorer populations, which includes addressing existing social pressures, such as poverty, to reduce “immediate and long-term vulnerabilities” [3]. Climate change is, therefore, portrayed as a security concern in a similar way to the IPCC’s portrayal. With a changing climate, existing risks are seen to be the main source of insecurity for humans [4]. Certainly, the direct implications of climate change, such as natural hazards (storms, floods etc.), pose threats too many communities in the world as well [5]. Yet, Nhemachena and Hassan [6] argued that adaptation is considered a useful approach to reduce the vulnerability against these impacts. Existing risks being exacerbated by climate change, however, provide a different kind of complex and challenging problems for human communities, especially poorer ones, but also for achieving goals within the field of development [7].

According to O’Brien and Hochachka [8] coping strategies to climate change involves changes in agricultural management practices in response to changes in climate conditions. It often involves a combination of various individual responses at the farm-level and assumes that farmers have access to alternative practices and technologies [9]. African regions are characterized by recurrent environmental mishaps such as flooding, epidemics and drought, the magnitude and intensity of which have been on the increase over the last 100 years and consequently in the destruction caused by it [10]. Richards [11] added that the fact that the communities in this region have survived till today with a fast population growth rate is an indication that they have developed indigenous mechanisms and strategies to cope with these mishaps. Some of these actions combine elements of mitigation and adaptation [12]. Until recently, mitigation and adaptation considered to be two mutually exclusive strategies.

Some of the coping strategies used by farmers against climate change include irrigation, farm enterprise diversification, improved technologies and practices and water harvesting [13]. Indigenous adaptive measures being used by farmers to cushion the harmful effects of climate change include: changes in planting dates, changes in harvesting dates, multiple cropping, intensive manure application, intercropping, expansion of cultivated land area, movement to different site, mixed farming and use of wetland/river valley (e.g. Fadama) [14]. Furthermore, in separate studies, the Canada-Nigeria Climate Change Capacity Development project reports [15] and Farauta *et al.*,

[14] put forward the following emerging (modern) coping measures being used by farmers: planting of early maturing crops, use of chemicals example herbicides and pesticides, increased use of fertilizers, use of resistant varieties, processing to minimize post-harvest losses, and afforestation.

Adesiji and Obaniyi [16], averred that farmers use organic fertilizers, use of some plants to control pests, traditional erosion control, changing crop cycle, use of inorganic fertilizer, use of flood resistant rice. Planting maize, fruits and vegetables in mountain region have changed their cropping patterns to suit the climate as well as keep up with demand [17]. Farmers have avoided planting crops that are easily damaged by water in areas prone to flooding [18]. On the other hand, farmers in the mountain region are taking advantage of higher temperature and are trying crops like corn and vegetables [19]. Farmers replaced rice crops with sugarcane so as to cope with uncertain rainfall. Indigenous methods to ensure protection of the environment ranges from offering prayers for good harvest to use of organic fertilizer and pesticides [20].

The extent to which communities have designed and implement adaptation mechanisms is evident across African communities at large [21]. According to Thompson, Berrang-Ford, and Ford [18], across Sub-Saharan Africa, communities have extensive experience in dealing with climatic uncertainties and food security implications. Subsistence livelihoods have evolved a number of coping mechanisms to manage weather variability, including drought years and low crop yield [18]. Dealing with the impacts of climate change requires measures that will minimise losses or take advantage of the opportunities presented referred to as adaptation [10].

The Food and Agricultural Organisation (FAO) advances that adapting small-scale and rain fed agriculture to seasonal climatic variability can be ensured through effective quick-fix response strategies (autonomous adaptation) that are often the answer to short-term impacts of climatic variability [22]. Balaghi *et al.*, [23] who postulate that autonomous adaptation may take several forms in terms of soil and land management, water management and conservation of agro-biodiversity support this. Autonomous adaptation to climate change will rely mainly on technological progress (agricultural yield improvements in arid and semi-arid conditions), irrigation (water management at the level of agricultural plot, catchment 46 area and region) and land use according to agricultural suitability [24, 23].

Thompson *et al.*, [18] advance that “commonalities in coping are evident across diverse regions, involving a complex hierarchical decision-making process of sacrifice and use of support networks to endure periods of food insecurity [18]. These

strategies initially involve responses including alterations to diet to include more famine foods, and during times of acute and, or prolonged stress borrowing from kin, selling productive assets, and eventually migration [18]. As famine progresses, survival strategies thus become more desperate, whereby domestic resources are increasingly committed and potential for reversing the strategies become more constrained” [25, 26, 18].

In a study by Lobell, Burke, Tebaldi, Mastrandrea, Falcon, and Naylor [27], communities can cope with climate change, for example, by switching from producing corn to producing sorghum, whose lower water requirements and higher temperature tolerances are better suited to a warmer and drier climate [27]. However, this adaptation measure may be impossible to implement in many parts of the developing world [27]. For example, it assumes markets for millet in regions where only maize is eaten, and technology and expertise about how to process and consume sorghum in maize zones. Communities may nevertheless be forced, as they are today, to consume what they produce regardless of cultural preferences [27].

Another study by Bryant *et al.*, [28] of Canadian farmers showed that farmers’ responses vary when faced with the same climate stimuli, even within the same geographic area. Responses vary given the different agricultural systems and markets systems in which farmers operate as well as different individual characteristics and contexts such as personal managerial style and entrepreneurial capacity and family circumstances [28, 29]. This reflects the broad nature of adaptation where different mechanisms are applied in different scenario. Thus, indicating that there cannot be a one size fits all adaptation mechanism.

Many studies [31, 32, [30, 32] have be carried out in both developed and developing nations regarding climate change, human security and coping mechanisms in rural communities, however there are few studies regarding the same like Zimbabwe particularly on Mashonaland district where Chiredzi District is located. Also those few studies carried out regarding concentrated on the impact of climate change on food security. Hence, the researcher investigated climate change, human security and coping mechanisms in rural communities in Chiredzi District.

METHODS AND MATERIALS

Research Approach

This study adopted both a qualitative and quantitative methodology approach. A quantitative approach to research mainly focuses on quantifiable data in terms of numbers and measures that can be analyzed statistically. “Quantitative researchers are more concerned about issues of design, measurement and sample because their deductive approach

emphasizes detailed planning prior to data collection and analysis” [33]. In quantitative research validity is concerned with whether or not the study indeed measures that which it is intended to measure and reliability with whether the study can be replicated by another researcher in the same context [34]. In contrast, a qualitative approach to research, in collecting the appropriate data, is not interested only in numerical data that can be used for statistical analysis. In support of this statement, Neuman [33] states that qualitative researchers are more concerned about issues of richness, texture and feeling of raw data because their inductive approach emphasizes developing insight and generalization out of the data collected. For the purposes of this study, the research decided to utilize both quantitative and qualitative research methods. A quantitative approach was used in the research because quantifiable data in terms of numbers and measures that can be analyzed statistically was collected. “Quantitative researchers are more concerned about issues of design, measurement and sample because their deductive approach emphasizes detailed planning prior to data collection and analysis” [33]. In contrast, a qualitative approach was used in this study research, in collecting the appropriate data, concerning about issues of richness, texture and feeling of raw data because their inductive approach emphasizes developing insight and generalization out of the data collected.

Research Design

According to Gliem, and Gliem [35], “a research design is a blue print with detailed information and it is used as a guide in completing the research objectives stated”. The research design becomes a master plan that gives specific methods and procedures used in gathering and analysis of the collected data. In this research, descriptive survey research design was used on the study of on climate change, human security and coping mechanisms in rural communities in Chiredzi District. This design was chosen because it suitably addresses the research problem as well as the objectives. A well designed research has been of critical importance in finding a solution to the research problems because it enabled the researcher to get accurate and useful information [36]. Availability of accurate information enhanced reliable decisions to be made. The researcher kept this notion in mind when deciding on the best design to adopt for the purpose of this study.

Descriptive Survey Research

Descriptive research can be either quantitative or qualitative. Descriptive research design is one that will allow the researcher to collect data that is descriptive in nature and tells us more on what is going on [37]. This study was conducted using the descriptive survey approach. As a research design, the descriptive survey was used in obtaining information concerning the current status of a phenomenon. The method was chosen because it is more precise and accurate since it

involves description of events in a carefully planned way [38]. Furthermore, descriptive survey design allows observation of subjects in a completely natural and unchanged environment and yields rich data that leads to important recommendations.

Target Population

Bhattacharjee [39] defines a population as, “all people or items with the characteristic that one wishes to study”. Furthermore, Kothari [37], Neuman [40] and Majumdar [41] defines population as the large group of cases or universe or canvas or total of the items or units within a defined space (geographical or social) from which the researcher draws a sample about which information is desired. The study targeted households, officials from ministry of agriculture, Chiredzi local authority and donor agencies operating in the district.

Sampling Procedure

This refers to the techniques that will be used in the selection of cases to be considered for the research. Saunders *et al.*, [42] refers probability sampling as a sampling technique where the samples are gathered in a process that gives all individuals the chances of being selected. Random selection of the sample enables the researcher to generalize results from a sample to a larger population. The study used simple random sampling to select respondents representing households and a census for officials from organisations that was included in the study. During the simple

random sampling, the names of all the households from 3 wards (589) were written each on a small piece of paper and placed in box. The names were then pick at random. The use of simple random sampling implies that every member under the study will have an equal chance of being selected [43]. The major advantage of census is that it provides a true measure of the population therefore, no sampling error.

Sample size

Kothari [44] states that sampling frame is a physical representation of the target population which comprises of all units that are potential members of a sample. Neuman [40] defines a sample as, “a small set of cases a researcher selects from a large pool and generalizes to the population”. Furthermore, Silverman [45] avers that sampling, “allows you to estimate the representativeness of the cases you study, and thereby the degree of confidence in any inferences you draw from them”. The researcher obtained number of wards to draw the sample size by multiple total number of wards (22) in the district by 0.1 [46]. Hence the number of wards considered for drawing sample size was 3. Simple random samplings were carried out on the population of the 3 wards and then obtain 10% of the population. According to Saunders [47] 10% of the total population can be used to collect data where the population is large. In this case sampling was advantageous in that it saved time as well as financial and human resources.

Table-1: Sample size

	Population size	Sample size
Household representatives	589	59 (10% of population)
Ministry officials (agriculture and local government)	4	4 (census)
Development agencies officials (Action Aid and Christian CARE)	8	8 (census)
Total number of sample representatives		71

Research Instruments

These are tools used for the collection of data that is relevant for finding solutions to the research problem. Creswell [48] defines research instruments as tools or devices used to make measurement of responses. In this study the researcher used questionnaires, interviews and focus group discussion as data gathering tools so as to come up with results that can be generalized to the whole population.

Self-administered questionnaires

The primary instrument for data collection in this research was semi-structured questionnaires, which contained a mixture of close ended and open-ended questionnaires. Kumar [49] states that a questionnaire is a written list of questions, the answers to which are recorded by participants, in a questionnaire, participants read the questions, interpret what is expected and then write down the answers. Self-administered questionnaires were used to gather data because of their ability to enhance data collection from a big sample in a

short space of time. Advantages of this method is low cost ‘free from bias, respondent have adequate time to give well thought out answer, and large sample can be made. This instrument was also chosen due to the fact that it is easy to administer and also makes it possible for much data to be collected within a short time. The questionnaires were structured in accordance with the objectives of the study. The first section collected the demographics data of the respondents, whiles the remaining sections were divided accordingly into each objective.

Key interview informants

Daniel [50] argues that an interview is planned and directed conversation. Key informant interviews were conducted from 3 key informants, each from AGRITEX department, DA office and Veterinary services department representative to corroborate with farmers’ experiences, perceptions and knowledge regarding climatic changes. The research purposively interviewed the DA, as the office allowed interaction

with local community on every day basis assessing their livelihoods in the face of climatic changes. Information required from DA was, the number of households under treat of food insecurity, the extent to which the climate change have affected food security and coping measures that have been used for community to cope with climate changes. Information required from the AGRITEX officer and Veterinary officer include the effects of climate change on agriculture production (livestock and crop production), measures which have been used to cope with climate changes, challenges associated with coping strategies and their recommendations on the adaptive measures. Recommendations on possible strategies that can improve resilience capacity were also collected. The interviews allowed probing for information from interviewees.

Focus group discussions

The study conducted two focus group discussions. Focus group discussion is one of the most popular qualitative research methods. It is a discussion guided by the moderator according to the prepared interview guidelines [44]. The survey is carried out in several groups of 8 to 10 persons selected in accordance with the research aims [51]. In focus group discussions, the researcher can get information from non-verbal responses, such as facial expressions or body language. Information is provided more quickly than if people were interviewed separately. The research used focus group discussions to obtain information from the households' representatives in Chiredzi District.

Validity and reliability of the instrument

Polit and Beck [52], state that validity is the quality criterion referring to the degree to which inferences made in a study are accurate and well founded in measurement, the degree to which an instrument measures what it is intended to measure. Polit and Beck [52], state that reliability is the degree of consistency or dependability with which an instrument measures an attribute. Reliability is the ability of a research instrument to provide similar results when used repeatedly under similar conditions Kumar [49]. The data collecting instrument, the questionnaire, was reviewed by the supervisor to ensure that the questions to be asked are appropriate for the study participants. The questionnaire was pretested among fifteen participants for language appropriateness, average duration of administration and sensitivity of questions. The findings from the process were used to modify or reformulate questions to adapt to local conditions.

Data analysis and presentation

Data gathered was analyzed using both qualitative and quantitative analysis. Raw data from the field was edited and screened to avoid biased information. Quantitative data was analyzed using (SPSS version 21.0) and descriptive statistics whilst qualitative data was analyzed using thematic analysis.

Data were presented using tables, pie charts and bar graphs that were generated by making use of SPSS version 21.0. The choice of tables as data presentation tools was based from their ability to clearly classify different data.

FINDINGS

Coping mechanisms employed to mitigate the effects of climate change in the Chiredzi District

The assessment of the existing coping mechanisms showed that communities were using different strategies to mitigate the effects of climate change in the Chiredzi District. Crop production, vegetable farming and livestock sales have been dominant. As long as communities do not have an alternative of coping than using the resource that they have, these three mechanisms are more likely to continue to play significant role in mitigating the effects of climate change. Households in Chiredzi District adopted changes in planting dates, changes in harvesting dates, multiple cropping, intensive manure application, intercropping, and expansion of cultivated land area as coping mechanisms currently employed to mitigate the effects of climate change. The study results collaborated with the observation by Farauta *et al.*, [15] that indigenous adaptive measures being used by farmers to cushion the harmful effects of climate change include; changes in planting dates, changes in harvesting dates, multiple cropping, intensive manure application, intercropping, expansion of cultivated land area, movement to different site, mixed farming and use of wetland/river valley.

Floods and droughts have led Chiredzi District communities to diversify income adopting casual labour as the case for most African countries. In Malawi for instance, most households are no longer self-sufficient in crop production due to climatic events, rural Malawians depend heavily on casual employment for cash or food to fill their annual production deficit [53]. Income diversification from casual labour reduces the risk to household livelihoods from the impacts of water hazards.

Livestock sale is common practice in Chiredzi District. The onset of droughts or floods leads to the reduction in farm production and derived incomes; off farm mechanism such livestock sales allow communities to withstand the impact of floods or droughts. Studies by O'Meagher [54] confirm that the sale of livestock has been observed as the most important asset to withstand floods and droughts impact. The decision by Chiredzi District communities to work in neighboring towns like Triangle or Hippo Valley Estates on daily basis is generally, a proactive household strategy to diversify sources of income and reduce the risks posed by floods and droughts to existing livelihoods. The temporary migration is influenced by the expectation of diversify income source at the destination than within the country [39].

Sen [55] introduced the concept of derived migration to explain how floods and droughts reduce the demand for goods and services by lack of agriculture labour, threatening the livelihoods of those whose incomes depend indirectly on agriculture.

For the past decade communities in Chiredzi District have developed preventive mechanisms to protect their assets mostly in the field where they construct hut during the crop season. Intercropping, moved to high areas and elevating house play an important role during floods. Communities can cope before the event. Mitigation strategies are adopted, which aim to reduce the adverse effect of a hazard on a community or to avoid disaster from happening (by avoiding hazardous locations, evading seasonal disease vectors, choosing a safe location for a house) [56].

CONCLUSIONS

The effects of climate change on agricultural productivity are numerous, including decrease in crop yields, altered crop growing period, decrease in water availability for irrigation, among others. The focus of adaptation is to help human, agriculture and other production activities in the environment to survive the current trends in climate as the altering in climate will continue due to the existing causatives. Mitigation is aimed at reducing the causatives of climate change now, to reduce the impacts it will have in the future

RECOMMENDATIONS

In the view of the study findings and conclusion reached, the study recommends the following that:

- People in the district should stop engaging in deforestation and sand-filling of natural water bodies such as rivers as a result of stream bank cultivation, as all of which singly and/or complementarily leads to climate change. The rural communities should do afforestation in their areas.
- The communities should stop agricultural activities such as bush burning, fertilizer application, fermentation among others, as anthropological influencers they, contributes to climate change, instead they can practise zero-tillage and organic farming using organic manure.
- Government and NGOs can assist the rural communities that devoting adequate resources for the construction of support facilities for large scale water-saving for irrigation, building water harvesting schemes, water storage ponds and improve irrigation and drainage systems to combat drought and flood as they occur. Efforts need to be made to build new small-scale irrigation and drainage projects in areas that are currently not irrigated to fight drought and construction of water collective and utilization engine in hill mountainous areas. All these are meant to solve water availability for agriculture.

- Government and non-governmental organizations should invest in the research and development of agricultural technology especially in systems that are dominated by small holder investments and large private agricultural reproduction/propagation research companies. Specifically, efforts should be made to expand breeding programs to encourage research on seed and offspring varieties with traits that promote resistant to drought, high temperature, diseases and pests, and water logging for plants and animals.
- Farmers should be taught how to better manager fertilizer application and promote the increased use of organic fertilizer as a means of increasing soil fertility and reducing emissions of nitrous oxide.
- Farmers in the district should select and cultivate new well-bred animal and crop varieties with high yield potential and quality, superior, integrative stress resistance and wide adaptability and also select and cultivate stress resistant varieties with specific abilities of resistance to drought, high temperature and diseases and pest invasion.
- The communities should prevent aggravation of grassland desertification by controlling grazing intensity, recovering vegetation and increasing vegetation coverage of grassland.

Areas of further studies

In future studies, a cross-sectional and longitudinal method to examine climate change, human security and coping mechanisms in rural communities are an approach that merits further examination.

Other studies can be carried out in other districts and compare the results with the current research of Chiredzi District

The use of survey method accompanied by the use of a qualitative approach such as a personal face-to-face interview might support the findings from the survey and enhance the ability to comprehend the scopes covered.

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