

# SMALL SCALE FARMERS' CLIMATE CHANGE KNOWLEDGE AND COPING STRATEGIES: A CASE STUDY FROM NORTHERN BOTSWANA

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## Abstract

Climate change induced alterations to rainfall patterns have potential to alter predominantly livelihoods of small scale farmers in developing countries such as Botswana. The purpose of this study was to explore climate change knowledge at the local level. Globally, small scale farmers are unable to cope with adverse shocks and stress initiated by climate change. Lived experiences by small scale farmers, from heavy rainfalls due to unexpected weather alterations, are examined through the approach of place-based education in northern Botswana, mainly the Okavango and Chobe wetland places. This paper is guided by two questions, which ask (1) How do local farmers describe their local knowledge of climate change? (2) What are the coping strategies put in place by local farmers during climate stress conditions? Place-based education emphasizes pedagogy that involves local communities' real world learning experiences and reintegration to study local resources. Findings suggested that farmers describe climate change knowledge according to how it impacts them within the context of their history, culture and local experiences. In response to impacts, farmers have developed place-based coping strategies to cushion and sustain their livelihoods.

**Keywords:** Climate Change knowledge, Place-based education, Okavango Delta and Chobe, Botswana

## **1.0 Introduction**

The impacts of climate change are a reality worldwide (Fang, Liu, Hu, Shapin III, 2018; Hansen and Bi, 2017; Van oort & Zwart, 2017). Botswana, in sub-Saharan Africa (SSA) region, is not exceptional in this extreme phenomenon. Local farmers in sub-Saharan Africa still practice agro-based economy that is vulnerable to the impacts of intermittent rainfall patterns and temperatures (Kgosikoma & Batisani, 2014). They cultivate crops and rear livestock at small scale for subsistence purposes. Subsistence farming remains major source of livelihood and provides rural communities with employment and household income (Appiah & Johnson, 2017). Given their relatively poor social and economic conditions, sub-Saharan Africa countries are most likely to suffer the burden of changing weather scenarios. In Botswana, local communities in the Okavango Delta and Chobe River places are impacted by changing weather despite the fact that the two river systems are perennial. This causes a serious concern and prompt further research. Local farmers attempt to adapt by applying resilient strategies to cope with the impacts of climate change. The coping strategies for local farmers are usually guided by place-based experiences through daily social interactions. They utilise their lived experiences to continue in small scale agricultural practices that is supplemented by harvesting of veld products and fishing in the face of erratic rainfall patterns and occasional floods. Therefore, the purpose of this study was to explore climate change knowledge at the local level. Lived experiences by small scale farmers (Milfont, Wilson, & Sibley, 2017), were examined through the approach of place-based education in northern Botswana, with a focus on the Okavango Delta and Chobe River communities. Small scale farmers engage in traditional farming on relatively small pieces of land with a low turnover (Kirsten, and van Zyl, 1998) and have an array of internally developed knowledge experiences for addressing diverse issues relating to their livelihoods. They typically need continued assistance in capacity building to commercialize farming (UNDP, 2012).

## **2.0 Contextual background**

Previous research has established that temperatures in SSA have steadily become warmer than in the previous 100 years (IPCC 2007; Kotir, 2011; van de Steeg, Herrero, Kinyangi, & Thornton, 2009). This has apparently affected agricultural production for small scale farmers. Projected warming of SSA will be roughly 2.0 to 4.5°C of temperature rise by 2100, and this is expected to be stronger than the global average (Muüller, 2009). Sub-Saharan Africa could also experience as much as one meter of sea-level rise by the end of this century under a 4°C warming scenario (Serdeczny, Adams, Baarsch, Coumou, Robinson, Hare, Schaeffer, & Perrette, 2015). However, it is equally acknowledged that temperature increase will not be distributed evenly throughout the sub-continent as some areas may experience more severe changes and variation in temperatures and rainfall. Furthermore in the southern Africa region, it “is not possible to predict with any degree of certainty the exact timing, magnitude and nature of expected climate changes under the effects of global warming” (SADC, 2008, p. 50). Therefore, rural and small scale farmers in Africa, and particularly Botswana, are at risk of unexpected weather changes.

Rainfall plays a significant role in agricultural practices and production. In Africa, Agriculture supports livelihood of eighty percent of the population, representing 800 million inhabitants in 2010 (Food and Agriculture Organization, 2012 and 2016). December to February is rainy months characterised by warmer temperatures. Southern Africa has experienced intermittent droughts over the past three decades due to reduced amounts of annual rainfall. Over the years, small scale farmers have adapted to climate variability and changes. SADC (2008) suggests that climate variability in southern

Africa is influenced by interaction between the oceans and the atmosphere and the land surface, often precipitated by natural or human induced changes in the region. This change affect rainfall patterns, rise in temperatures and sea-level increased frequency of drought, floods, and tropical cyclone (SADC, 2008). Climate change and variability have far-reaching implications on local people's livelihoods, socio-economic development in SSA and in Botswana in particular. The changes present risks and opportunities to livelihoods. Due to climate change and variability, water resources and food security are threatened as a result of decline in rainfall amounts and increasing rate of evaporation (SADC, 2008). Extreme weather events such as flooding result in water-borne diseases such as cholera. Spread of malaria disease may be experienced at areas where previously it was unknown. Malaria is endemic in the northern part of Botswana (Chirebvu, Chimbari, Ngwenya, & Sartorius, 2016). Research-based reports predict that climate change impacts are expected to increase over years and decades to come, which will constitute a threat to development and diminish the chances of achieving the Sustainable Development Goals (SDGs) (Wingqvist & Dahlberg, 2008). Climate change is likely to impact on Botswana's ecosystems, especially the Okavango Delta and Chobe River area, with a probable negative impact on tourism (Hoogendoorn & Fitchett, 2018) as well as livelihood opportunities for local people residing in the basin.

The climate of Botswana is semi-arid. It is hot and dry for much of the year. Literature suggests that rainfall tends to be erratic, unpredictable and highly regional (Batisani & Yarnal, 2010; World Bank, 2010). Moreover, droughts occurred in the past and floods have been experienced in some areas in the north, central and south-central part of Botswana. This phenomenon is also due to the La Nina and El Nino events (Wingqvist & Dahlberg, 2008). Furthermore, rainfall pattern in Botswana is influenced by its position (location in the middle of southern Africa land mass), the Inter Tropical Convergence Zone (ITCZ) and the El Nino phenomenon. The movement of ITCZ southwards from Equator marks the start of the main rainy season over southern Africa (SADC, 2008). The Botswana Upper High Pressure (UHP) often results in persistent occurrence of drought in Botswana and over southern African region. In addition, El Nino phenomenon, that is the weather condition that begins with warming of waters in the western Pacific Ocean eventually affecting global climate, decrease southern Africa's rainfall, influencing Botswana's rainfall pattern and eventually livelihood sources of small scale farmers.

## **2.0 Livelihood sources in northern Botswana**

Sources of livelihoods in northern Botswana mainly include fishing, gathering of water lily (Tswii in Setswana language, *Nymphaea nouchali*) and other aquatic plants (from February to December), gathering of wild fruits by the river in summer and molapo (flood recession) farming (Maphane, Ngwenya, Motsholapheko, Kolawole, & Magole, 2017:140). Molapo farming is usually carried out from August to December (5 months) when the water level is low. Reeds and thatching grass are harvested between July and November. Molapo farming is practised in the seasonally flooded plains, which takes place as soon as the flood recedes in the Okavango Delta around August, when ploughing starts. Tourism is one of the activities that local people try to earn a living by getting jobs in campsites, lodges, hotels, and guesthouses and paid in monetary terms. Literature suggests that majority of farming activities in the Okavango Delta and Chobe River places rely on rain-fed small scale agriculture and about 25% of farming activities are based on flood plains (Kolawole, Wolski, Ngwenya, Mmopelwa, & Thakadu, 2012; VanderPost, 2009).

Therefore, the knowledge of farmers' perceptions on climate change and its impacts is crucial (Milfont, Wilson, & Sibley, 2017). This may contribute in initiating steps for adaptation and effective

coping strategies. In sub-Saharan Africa, adaptation strategies may include livelihood diversification, migration, use of artificial fertilizers and green manures, agricultural land extension, crop rotation, crop switching and selection, changes in planting dates and varieties, and soil conservation (Kotir, 2011). However, it is clear that most of the small scale farmers, for example in the Okavango Delta and Chobe regions of Southern Africa, would not afford use of modern technology to cope with changing climate in order to sustain household food production. Small scale farmers possess a wealth of ethno-meteorological knowledge acquired from elders who accumulated it through lived experiences. Ethno-meteorology based knowledge include predictions of abundance or poor rain season by, listening to the chirpings of some birds and sounds from certain insects; through certain plants; observing the gathering of clouds in certain direction; observing the pattern of early rains in a farming year; able to discern through certain signs; observing star constellation and observing the sequence of yearly weather events to determine the climate pattern in a particular farming season (Kolawole et. al, 2012). We believe that the above introduction, background and discussion of livelihood sources regarding small scale farmers enable this paper to employ the approach of place-based education.

### **3.0 Place-based education – exploring climate change knowledge at the local level**

The literature on place-based education has continued to exist in the late 20th century and placing emphasis on potential of local environments and cultural resources. Theobald (1997) stated that place-based education helps people learn the intra-dependence of their lives and their local communities and natural environments. In the process, people appreciate local social and natural resources and enhance their adaptability and coping strategies. This is important for small scale farmers in northern Botswana because “place” can enable us to understand how these small scale farmers respond to climate change impacts in their local contexts. Place-based education can transform public understanding about climate change, thus deepening knowledge about the impacts of climate change for these small communities. Gruenewald (2003) stated that place-based pedagogies are important so that the education of citizens might have direct bearing on the well-being of social and ecological places that people inhabit. Place based educators advocate for learning experiences that relates to world practices and thus improving the quality of life for local communities. For the small scale farmers in Okavango and Chobe, this could highlight what learning is taking place from their knowledge and experiences emerging from the impacts of climate change. Furthermore, Gruenewald (2003) stated that the practices and purposes of place-based education can be connected to experiential learning, contextual learning, problem-based learning, outdoor education, indigenous knowledge, environmental and ecological education, bioregional education, democratic education, multicultural education and community-based education, critical pedagogy, as well as other approaches that are concerned with context and the value of learning from and nurturing specific places and communities. Emerging from the above aspects of place based education, this paper sought to glean through small scale farmers’ lived experiences and knowledge relating to climate change in order to explore how they utilize this knowledge and their experiences to develop coping strategies.

Rural School and Community Trust (2004) recognizes place-based education as the approach of education that is rooted in local environment, which consist of the unique history, resources, culture, economy, literature, and art of a particular place. “The community provides the context for learning, student focuses on community needs and interests, and community members serve as resources and partners in every aspect of teaching and learning” (Rural School and Community Trust, 2004, p. 4). In the context of small scale farmers it would be important to explore their knowledge and experiences against their social, cultural and historical context as it relates to how climate change has impacted their

livelihood farming practices. Similarly, Powers (2004) stated that place-based education is grounded on resources, issues, and values of the local community and focuses on using the local community as an integrating context for learning at all levels. In the case of small scale farmers, it would also entail looking at how their knowledge and experiences have been applied on the utilization of resources. David Sobel is well known as an educator who assisted in developing the approach of place-based education. According to Sobel (2005) place-based education is an educational approach based on real-world learning experiences that enable learners to develop a sense of connection to and appreciation for their surrounding natural and cultural environment. Place-based education is valuable for various reasons such as providing learners with opportunities for learning in authentic ways. In the context of these farmers as these authors view place-based education, it would mean small scale farmers' connecting new learning with prior livelihood experiences and supporting linkages and making sense of what they are learning. Therefore, it is through connecting with nature in their bio-physical environments that small scale farmers can also develop a broader understanding of rural agricultural lived experiences as they respond to the impacts of climate change.

In tandem with place-based education, Gonzalez, Moll, and Amant (2005) reported that first hand research experiences with local communities allow for documentation of competencies and knowledge, which facilitates a systematic and powerful way to represent communities in terms of resources, the capital they possess, and how to harness these resources. Place-based education can help facilitate lived experiences of small scale farmers in the era of climate change which impact on their rural agricultural practices. Therefore, this paper presents findings from a qualitative inquiry that explored how local farmers are impacted by erratic climate-change related rainfall patterns. The paper is guided by two questions, which ask (1) How do local farmers describe their local knowledge of climate change? (2) What are the coping strategies put in place by local farmers during climate stress conditions? We sought to identify farmers' perceptions of climate change through their local knowledge and aim at contributing in the documentation of farmers' responses to climate change in sub-Saharan Africa.

#### **4.0 Methodology**

This qualitative inquiry followed a case study approach within a broadly interpretive orientation (O'Leary, 2004) and socially critical approach (Miles & Huberman, 1994; O'Leary, 2004). It had interpretive and socially critical orientation because the research questions involved seeking explanations of climate change knowledge at the local level. Interpretive case studies adopt a relativistic position in relation to participants' interactions and values that underlie them (Stevenson, 2004). The focus was generally on informing rather than changing or transforming farmers' knowledge. By dealing with the farmers' interpretations of their small scale farming practices, this paper addresses ways in which larger social, cultural and historical contexts might be influencing participants' perceptions of climate change. Complementing and extending the interpretive analysis, a socially critical approach, enabled us not only to understand or explain environmental and social reality surrounding these small scale farmers, but to explore opportunities for farmers as agents of change through the coping strategies they devise in responding to climate change impacts.

The case study approach was followed because it best answered the research questions and provided the depth of data collection and analysis. Data were collected through qualitative techniques which were applicable given the guiding questions. The findings that we present emerged from two case studies: (1) research that investigated integration of Environmental Education in the Okavango Delta and (2) research by a student teacher and one of the authors who investigated resilience against

environmental livelihood risks in the Chobe River area. Northern Botswana constitutes a natural heritage site because of the abundance of a variety of natural resources and potential for tourists. Specifically, the findings that are presented in this paper emerged from data collected from both male and female farming in the rural areas engaged in farming in northern Botswana. All farmers in this paper have been given fictitious names (pseudonyms) for ethical reasons.

One of the researchers arrived in the Okavango Delta on May 29, 2014 and spent two weeks with community members before administering a semi-structured interview. The prolonged engagement with the community, in northern Botswana, enabled continuous learning of local culture, place-based practices and livelihood systems that include Agriculture. As a measure of validity, this entire process strengthened rapport and increased credibility of the findings. In the Chobe River region, the student teacher was a resident of Parakarungu village in the Chobe district. Flick (2009) advised that researchers interested in observing practices in institutional contexts must conduct research within the institutional context. Therefore, primary researchers, in Okavango and Chobe, made observations and conducted semi-structured interviews with small scale farmers in their homes. The above techniques of qualitative inquiry enable in-depth explanation of lived human experiences. Contact for appointment of interviews with small scale farmers was done through telephone and word of mouth. Inductive analysis enabled emergence of themes that are presented in this paper. In order to get an in-depth understanding of lived human experiences, we engaged in a process of line by line manual analysis of data from the transcripts. We believe that the study's reliance on three primary sources (document analysis, observations and semi-structured interviews and full interviews) enabled triangulation of data.

## **5.0 Findings**

### *Responses from small scale farmers in the Okavango Delta*

The data collected through semi-structured interviews from small scale farmers in the Okavango Delta suggest that the region continuously faces extreme events of heavy rains and at times shortage of rains. This has led to the rooting of seeds underground and damage of crops through climate change. The findings also suggest that small scale farmers faces lack of warnings from government officials regarding heavy rains and or shortage of rains in the region. Findings below emerge from responses offered by small scale farmers in the Okavango Delta.

### *Unexpected floods due to heavy rains*

One of the female farmers (*Makga*) was asked to explain the kind of crops that she cultivates, in the panhandle of the Okavango Delta, for food. *Makga* responded as follows, “*we cultivate sorghum, maize, and watermelons. Only a few water melons germinated this year, but we did not get anything from them because they rot due to heavy rainfalls.*” With regard to available water sources in the village called Sekondomboro, she responded to the question as follows, “*We are relying on water from the communal stand pipe because the water from Okavango streams are also getting dry*”. The above farmer explained that they cultivate in the dry land place of the Okavango Delta, where there is open space because in the wetland streams there are lot of veterinary fences and cattle are often roaming around and may destroy their crops. *Tetu*, a male farmer, was asked to explain how he is surviving in his home village called Kauxwi. He was also asked which crops he cultivates. He responded as follows, “*We cultivate sorghum, maize, water melons and beans. Millet and maize do germinate. Water melons did not do well this season. The problem is rain. This year it was heavy rains and then the plants started to rot again.*”

*Makga* is originally from a nearby cattle post called *Xau* near *Seronga* village. She lives in *Sekondomboro* village because the father of her child is from *Sekondomboro* as well. Sometimes she is employed in part time jobs under the government program of Poverty Eradication (*Ipelegeng*). She cultivates crops in the place called *Komakaxao* near the Khoisan (*Basarwa*) village called *Tobera*. *Makga* does not have cattle to pull the plough for cultivating. She explained further as follows, “*We do not have cattle. We borrow from other people. We use those cattle the whole day, and on other days the same cattle pull the plough in other people’s fields until we all finish*” On the other hand, *Tetu* was born in *Gowa* ward, in the village called *Kauxwi*. He has a temporary job as a night-shift security guard in the nearby Junior Secondary School. He explained that in his home family members survive by cultivating crops and rearing livestock. He stated that he has 39 cattle, six goats, and eight donkeys. Regarding the issue of human-wild animal conflict, in the Okavango region, he said,

*There are some wild animals such as elephants. They just walk close to our house and passing those big trees over there going to the water valleys. There are also hyenas that sometimes trouble our donkeys and goats. Over there in the river channels, we experience hippopotamus. They sometimes walk close by our home and graze around here. After grazing, they walk back to the waters. They graze here at night. They are just like elephants. If you trouble them they attack you.*

#### *Drought due to low rainfall*

*Twii* is also one of the small scale female farmers who participated in this study. She was asked to explain what she is doing for a living and which crops she cultivates in the field. She responded as follows,

*We only cultivate in the fields to survive. But there is nothing much that germinates and could be harvested. We cultivate sorghum, beans and groundnuts. The germination of these crops does not occur the way we want. There is low rainfall. And when there is promising germination, the elephants come to destroy our crops.*

In addition to the shocks and stresses caused by climate change in the Okavango Delta, small scale farmers are devastated as well by elephants that destroy their crops and eventually they do not get satisfying reimbursement from the Government of Botswana. *Twii* explained as follows, “*We report to the Wildlife officers. The compensation is just too low to feed us.*” *Phets*, a small scale female farmer, was also asked how they are surviving in the village of *Mohembo-west*. She responded as follows,

*Here at home we survive through cultivation of the fields and planting crops. We use cattle. This year we did not harvest much. Our products from the fields are quite low. There is nothing that we can do apart from believing God. This is how our lives are.*

*Twii* is originally from *Sechenge* cattlepost and relocated to *Sekondomboro* village on her own. Just like *Tetu* above, she also raised the issue of human-wildlife conflict. She stated that she did not go to school and their livelihoods are dependent only on cultivating crops in the fields. *Phets* was born in *Mohembo-west* and survive by cultivating crops using the plough that is pulled by cattle. She explained that she did not go to school. She said, “*My parents did not give me that opportunity of going to school. I then focused on dry-land farming*”.

## **6.0 Responses from small scale farmers in the Chobe River area**

Two small scale farmers were interviewed and some observations of their practices were made. *Chidino* is a 58 year old married man with seven children in the small village of Parakarungu. His main subsistence activities, just like other small scale farmers in the Okavango Delta, are crop farming and fishing to sustain himself and his family. When there are good rains, like the rest of the community he sells his harvest to the Botswana Marketing Board in Pandamatenga village, which is a border town near Kasane. He cultivates mainly maize and very little sorghum. During the fishing season he sells fish in Kasane. A number of village farmers rely on selling their livestock to butcheries in Kasane for financial sustenance. *Chidino* is amongst those people without any livestock because he has abandoned it due to risks associated with livestock farming caused by droughts and foot and mouth disease. He had this to say,

*I had a few cattle but the last time they all died due to the drought of the past few years. I thought... why opt for re-stocking when they are going to die again or attacked by another foot and mouth outbreak! And besides with BMC no longer buying our cattle, you feel you are not gaining anything as these butcheries just cheat us and only give us a pittance for our cattle... I quit when it came to cattle ... I'm now spending my time making these hoes as you can see...*

*Chidino* now mainly makes his income as a blacksmith by using scrap metal to make items such as hoes, knives, metal buckets and bath tubs. He says he was inspired in the trade and taught by his late father who was also involved in the project for many years and due to lack of employment in the village he decided to take the practice seriously. He said, "...*What can I do except this? Again most of the jobs require people who are educated, so for some of us we don't stand a chance...*" For his trade he uses scrap metals and corrugated iron sheets which he picks from around the village to make items like hoes, knives, bath-tubs and others.

The other small scale farmer was a lady, *Kahungu*, who is a widow with five children. She supports her family's livelihood through farming. She has a small field where she plants mainly maize and sorghum, but her yields are not so good primarily because of erratic rains. Sometimes they experience flooding and at times long spells of droughts which affect her yields. Frequently, the crops are destroyed by elephants and other wild animals. She said,

*This rain nowadays is no longer reliable. It is unpredictable. At times there is flooding and all the crops drown in water or if it does not rain, it will get dry for many years. It is not like long ago when we grew up. As well how can it not go with people no longer observing these taboos...With these droughts now people cut all the trees for firewood. You try to do this, another problem arises! What with animals which will come and destroy the little that you have planted! (Sigh).*

When her husband was still alive their yields were better. But now the yields are low. At times she is unable to mobilize resources for ploughing like getting a tractor because there are only two in the village and one has to wait for a long time before she get services. *Kahungu* added as follows,

*And for some of us who have no man in the household it becomes very difficult with all these children to feed. What can one do? I have decided to devote my time to basket making so that I just sell to get some income.*



She says she could alternatively use cattle or donkeys for ploughing but she has none, most of which were killed during the foot and mouth outbreak and by the repeated droughts experienced in the area. So, she now tries to supplement her income by making baskets that she sells in Kasane to get money for food and school uniform for her children.

## **7.0 Discussion**

In retrospect, the purpose of this paper was to explore climate change knowledge and experiences and practices related to the impact of climate change at the local level. Further to that, the purpose was to highlight some coping strategies that small scale farmers have developed to sustain their livelihoods as a response to the climate change impact. The findings that are presented above, suggested lived experiences by small scale farmers, whose characteristics are typical of local communities in northern Botswana.

### ***Farmers' knowledge and awareness of climate change***

Local farmers in this study shared their internally developed knowledge experiences of impacts of heavy rains and at times shortage of rains and how it impacts their agricultural practices. Elements of experiential learning, contextual learning, problem-based learning, indigenous knowledge, environmental and ecological education, and community-based education (Gruenewald, 2003) were shared by small scale farmers. They explained as well on the rooting of seeds underground and damage of crops and general low yields as a result of erratic rains, owing to changes in climate in the area. The findings also suggest that small scale farmers face lack of warnings from government officials regarding heavy rains and/or shortage of rains in the region. Robinson and Berkes (2011) contend that new knowledge and technology, such as the one exhibited by the small scale farmers, can be accessed and developed through contacts with higher levels of organization like government institutions. The meteorological department has failed to issue early warnings to farmers on rain forecasts. Some farmers were able to draw on their knowledge from their indigenous or cultural knowledge as purported by Gruenewald (2003). This was evident in the case where the farmers were linking lack of rain or flooding thereof, to the practices that no longer take cognisance of indigenous knowledge relating to taboos which led to deforestation, a key factor in climate change.

The findings of lived experiences that are explored also relate to themes of place-based education as suggested in the Rural School and Community Trust (2004) and by Powers (2004). The Rural School and Community Trust (2004) suggested that place-based education is the approach that is rooted in local environment, which consist of unique history, environment, culture, and economy of a place. Consistently all farmers made reference to how their farming practices in their local contexts had been over the years and how these have been affected by the change in the patterns of rain. In both places of the Okavango Delta and Chobe River, different small scale farmers made reference to the local ecological, historical and social aspects of their communities as it relates to rainfall patterns and farming activities. Indeed, place-based education is grounded on resources, issues, and values of the local community and focuses on using the local community as an integrating context for learning at all levels. Moreover, the findings from small scale farmers regarding climate change relate to the ideas of place-based education as propounded by Sobel (2005). According to Sobel (2005) place-based education is an educational approach based on real-world learning experiences. This approach enables local people to develop a sense of connection to and appreciation for their surrounding natural and cultural environment as was the case with farmers in this study. Gonzalez, Moll and Amant (2005) also suggested that first hand research experiences with local communities allow for documentation of

competencies and knowledge, which facilitates a systematic and powerful way to represent communities in term of resources and the capital they possess.

### ***Farmers' coping strategies***

It was evident that small scale farmers in Okavango and Chobe areas are exposed to shocks and risks such as droughts, over flooding, cattle diseases and diminishing crop yields, all of which are associated with climate change. All these pose serious threats to the livelihoods of farmers whose sole means of survival is farming. In response to these risks there is clear evidence of some coping strategies among some of them. Some of the initiatives are undertaken at community collective level as Mbaiwa (2004) observed in his research on Community Based Natural Resource Management (CBNRM) projects in the Okavango, whereby,

*considerable amount of revenue and employment opportunities' were created to cushion farmers against these shocks and risks. According to some farmers, they took advantage and benefited from available resources and opportunities provided by CBNRM projects or government such as tractors and community public works projects (Ipelegeng) (p. 48).*

From their local knowledge some farmers opted for drought resistant crops like water melons and millet instead of the usually preferred crops. Some farmers like those in Parakarungu, drew on the importance of their local traditional knowledge (Shava, Krasny, Tidball & Zazu, 2010) where one farmer got his skills of fishing and blacksmithing from his father which is in the form of memories carried down over several generations (Berkes, 2009). The other small scale farmer also decided to produce baskets. This is a traditional skill that has run through generations in most sub-Saharan communities. Within the framework of place-based education, the basic principles of knowledge, competencies and agency develops and offer real opportunities for learning within the lived experiences of these small scale farmers (Gonzalez et. al, 2005).

### **8.0 Conclusion and Recommendations**

Indeed our findings suggested that place-based education can help develop, highlight and strengthen the knowledge of lived experiences of small scale farmers in the era of climate change, which impact on their rural agricultural practices. In southern Africa, where Botswana is situated, most farmers are small scale farmers whose livelihoods are climate dependent and hence vulnerable. Therefore, there is need to draw on these small scale farmers' existing climate change knowledge to educate and support them to be more resilient to climate change and variability. This can be partly achieved through supporting the coping strategies they have adopted such as the planting of crops that have long maturity period during years of abundant rainfall while those with short maturity period are grown during years of low rainfall. These coping strategies need to be strengthened by capacity building and development and promoting access to resources to reduce vulnerability to the impact of climate change.

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