

African Indigenous Food Security Strategies and Climate Change Adaptation in South Africa

Gaoshebe Tlhompho

*University of Kwazulu-Natal, South Africa
E-mail: gaoshebetlhompho@yahoo.com*

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ABSTRACT The paper used a participatory and case study research approach to investigate the role of African Indigenous Food Security Strategies for climate change adaptation in Ganyesa Village, South Africa. The study revealed that local people, especially women, have over the years developed local food security strategies for climate change adaptation. These included knowledge of behaviours of living organisms, wind directions, position of stars as early warning indicators of changing weather conditions, selection of appropriate seeds and animal species, mixed cropping, and water harvesting technologies and food preservation techniques such as fermentation and sun drying for food security. These knowledge systems tend to be marginalized in the search for sustainable solutions for food security and climate change. The study recommends their documentation to inform policy, incorporation into educational curriculum. This will also assist in identifying gaps to be improved through interface with other knowledge systems.

INTRODUCTION

Food security has been a critical issue in many parts of the world. Studies in various parts of the developing regions, and Africa in particular, show that climate change has serious environmental, economic, social and cultural impacts on the lives of the people and communities (Sum 2005). One of the major impacts of climate change is on food security systems because a large number of people depend on agriculture as their primary source of livelihood (Food and Agriculture Organization (FAO) 2008).

Food security is a broad term, which is defined in different ways. According to the World Food Summit (1996), food security exists when all people, at all times, have physical and economic access to sufficient, safe, nutritious food to meet their dietary needs and food preferences for an active life. The World Bank adds to the concept by indicating that the food available should also be culturally and environmentally appropriate. People have different cultures and live in different environment including climatic conditions and hence their food needs, preferences and habits are different (Simon and Gundel 2010). This conceptualization implies that food security goes beyond providing people's sustenance.

This paper has the view that most of the conceptualizations on food security are based on western values as the dominant world culture

and knowledge system. It tends to marginalize other non-western cultures, ways of knowing and value systems. For instance, the definition and conceptualization of food security should be culturally-based. In South Africa, for instance the Batswana and Zulus as cultural groups in the same country live in different environmental conditions and have different cultures. The Batswana of South Africa live in an arid area in the North-West Province. The average annual rainfall varies between 700 mm in the east to less than 300 mm in the west. The vegetation category changes accordingly from temperate grasslands in the east to arid bush and shrub veld in the west. This east-west difference in rainfall and vegetation categories governs the type of agricultural activity. The primary agricultural practices in the North West Province consist of mixed crop in the eastern regions such as in Zeerust and livestock farming in the western regions such as in Vryburg. As a result of the low rainfall, commercial forestry is absent in the North West Province (Department of Agriculture Conservation and Environment 2008). Small-scale farmers in the province are mainly subsistence in nature and rely mainly on rain fed production (National Department of Agriculture (NDA) 2004). Sorghum is the indigenous staple food due to its drought resistance nature.

The Zulu live in a coastal, tropical environment (with an average annual rainfall of 1000mm) growing a variety of food crops due to abun-

dant rainfall. Makela (2000) elaborates how the two cultural groups differ in the way they identify foods and prepare them, the condiments used, and the timing and frequency of meals based on their cultural acceptance, norms and values. This study investigates the indigenous food security strategies and climate change adaptation among the Batswana in Ganyesa village (North-West Province).

On the concept of climate change the study argues that there is no internationally agreed definition. Instead there are various perspectives on the causes and impacts of climate change. Some scholars put emphasis on natural causes while others argue that the causes are human made, while others including this study attribute the causes to a combination of both factors.

For instance, Intergovernmental Panel on Climate Change (IPCC) (2007) looks at climate change as any change in climate over time, whether due to natural variability or as a result of human activity. Human activities including the burning of coal, oil, and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. The United Nations Framework Convention on Climate Change (UNFCCC) (2007) on the other hand put emphasis on human activities as altering the atmospheric composition, and climate variability.

In the context of African indigenous ways of knowing and value systems, this study argues that in most African cultures including the Batswana, conceptualization of climate change and its impact on food security and other aspects of community livelihood have also a spiritual dimension. For instance, Notsi (2012) shows that among the Batswana certain climatic conditions floods, drought, etc. are attributed to the anger of ancestors due breaching of taboos such as hunting at certain forbidden times, harvesting certain plants or eating certain foods, etc.

Climate change is a potential threat to the South African food security agenda because of its impact on agriculture, especially among small scale farmers. The higher temperatures reduce the impact of rainfall on agricultural production, both crop and animal production in the arid areas of the country particularly in the dry north western parts including Ganyesa.

Cumhur et al. (2008) show that the higher temperatures cause decline in dairy production,

reduces animal weight gain and reproduction. The climate change threat to food security in the area is that it affects livestock through various animal diseases since most animal diseases are transmitted by vectors such as ticks, flies, etc. whose breeding is often heavily influenced by temperature changes. Lunde and Lindtjorn (2013) show that cattle, goat, horses and sheep in the area are also vulnerable to an extensive range of nematode worm infections, most of which have their development stages influenced by climatic conditions

Furthermore, Zinn et al. (2010) indicate that higher temperatures cause heat stress in plants which in some cases; the plants do not reproduce at all since excessive heat causes sterility of the pollen. As a result causing certain food crops to become scarce at a certain time of the year due to their vulnerability to climate change (Chhetri and Chaudhary 2011).

Food Security and Climate Change Adaptation within the Context of African Indigenous Knowledge Systems

Indigenous Knowledge (IK) can be conceptualized as the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. IK as holistic, dynamic and changing community-based knowledge is generated by a process of trial and error through social practice (Henderson 2000). It is on the basis of this culturally-specific and community-based nature of IK that the study has the view that the extent to which the impact of climate change are felt on food security depend in large part of culturally specific adaptation strategies a community or cultural group has developed in response to climate change. This is elaborated by Nyong and Osman (2007) and Mortimore and Adams (2001) who state that adapting to climatic changes is not entirely beyond farmers' control. African indigenous small scale farmers have over centuries through social practice using their IK had developed local strategies of adaptation to climate change. These include early warning systems and long term experience in coping with climatic variability. The early warning systems, involve the knowledge of behaviors of living organisms, that is animals, insects, plants, etc. as indicators of climate change; the monitoring of short term weather

cycles, as well as long term experiences with climatic variability and the appropriate livestock breeds, plant varieties, and resource management practices, such as mixed cropping practices. The latter involves the cultivation of different types of crops such as root crops (sweet potatoes) on the same land. The crops are harvested at different periods of the year, ensuring household and community food security (Agrawal 2003; Berkes 1999).

Kuhnlein and Chan (2000) add that from a community perspective indigenous food system includes all of the food species that are available to a particular cultural group from its local natural resources and the accepted patterns for their use within that culture. This incorporates the socio-cultural meanings of these foods, their acquisition, processing, and use within that culture. Enete and Amusa (2010) have the view that in spite of the modern technological systems introduced by western cultures and knowledge systems for food security in Africa, most people, especially in the remote rural areas still depend on their local community knowledge and technology systems including cultural values for food security and to adapt to changing climatic conditions. They strive to pass down this knowledge to younger generations for sustainability, increasing food security, and self-sufficiency within their communities

The study has the opinion that despite the fact that these community-based knowledge and value systems contribute to household and community food security while conserving the environment under changing climatic change, they have not been adequately documented through research to inform policy, to be incorporated in the education system and to be shared with young generations.

The general objective of the study was to examine the efficacy of African indigenous food security strategies and climate change adaptation in South Africa with special reference to Ganyesa village (North-West Province). As part of the human resource capacity building in the research area of IK, food security and climate, the postgraduate student in Indigenous Knowledge Systems (Masters) involved in the study originates from the community. She has a thorough knowledge of the culture and language of the study community. She was the principal investigator in the study. The involvement of other researchers was to enhance the multi-

disciplinary nature of the study. The study interrogated the following questions specific objectives:

1. What are the community perspectives on the role of socio-economic and demographic characteristics such as age group, marital status, education, religious affiliation, household size in relation to African indigenous food security strategies and climate change adaptation?
2. What types of African indigenous food security strategies for climate change adaptation are found in the study community?
3. What are the indigenous community sources of food security for climate change adaptation?
4. What are challenges of the indigenous food security strategies for climate change adaptation in the study community ?

METHODOLOGY

The unit of analysis for the study on the African Indigenous Food Security Strategies and Climate Change Adaptation in South Africa was Ganyesa village in the Kagisano Molopo Local Municipality, North West Province. Ganyesa is a semi-arid area receiving an average annual rainfall of 300mm. According to North West Province (Department of Agriculture Conservation and Environment (2008) the area is located in savannah biome and consists of Kalahari thorn veld and shrub bush veld type. The soil types are predominantly red mesotrophic sand, mesotrophic soil and shallow calcareous soil. As a result of the semi-arid conditions it is an extensive livestock producing area with limited crop farming. The area is inhabited by the Barolong Boo-Ratlou le Tau. This is one of the Batswana clans found in South Africa and North-West Province in particular.

In order to investigate the African Indigenous Food Security Strategies and Climate Change Adaptation in Ganyesa village the study followed a qualitative and case study research design. Taking into consideration the community and cultural-based nature of the study the qualitative research method was used because it is more flexible and allows interaction between the research and respondent community members using qualitative research methods such as in-depth interviews, focus group discussions, direct and participatory observation, etc. Accord-

ing to Denzin and Lincoln (2005: 3), qualitative research investigates the objects in their natural settings and attempts to make sense of, or interpret phenomena in terms of the meanings people bring to them.

According to Schwandt (2000), distinct from the use of a survey method, the epistemology of the qualitative interview aligns itself more with a constructivist paradigm than a positivist one. This is important for this study as it gave the researchers an opportunity to be actively involved rather than being just passive listeners in the research process. In this study, in-depth interviews formed a larger part of the research approach to data collection. The interviews took an informal form, with more focus on asking questions and listening to the participants. According to Seidman (1998), the use of a free-flowing and unstructured style, using convergent interviewing techniques, with emphasis on listening and observing, ensures that the interviewees' experiences are heard. Similarly, in this study the researchers were at all times attempted to allow the interviewees to tell their stories/experiences in detail on their African Indigenous Food Security Strategies and Climate Change Adaptation. During the interviews the researchers were mindful that it was necessary to gain insights into the key concepts of the research as the interviewees were narrating their own experiences and views. As a result the researchers only used the interview guide to direct the interview discussions, but never restrained any additional information that happened to arise. At all times richness of data were sought from participants as they were encouraged to talk openly about their experiences to enable insights through words and not in numbers.

The study was also participatory and used the case study approach to investigate the research problem. Kemmis and McTaggart (2005) define a participatory approach as a methodology that argues in favour of the possibility, the significance, and the usefulness of integrating research partners in the knowledge-production process. In this study the participatory approach provided the study community with the opportunity to be participants in the research process, including identification and selection of the study case, data analysis and interpretation from their own cultural perspective. The approach is meant to fill the power gap between the researcher and the researched community.

The relevance of a case study approach in this study cannot be underestimated. Babbie, (2007) looks at the case study as a research strategy that involves an empirical inquiry on a phenomenon within its real-life context. It provides a systematic and in-depth way of looking at an event or situation, collecting data, analyzing information and reporting the results. As a result, the researcher gains a sharpened understanding of why the research issues happened as they did, and what might become important to look at more extensively in the future (Bless et al. 2006).

In consultation with community leaders and indigenous knowledge holders / practitioners in the study community, a purposive sample of 40 key - informants (15 men and 25 women) were identified and selected for the study based on their knowledge and role in the community and their availability and willingness to be interviewed. This was also to ensure that both gender sections of the community are involved in the study process. The sampling process also took into account of the fact that women play important roles in food security in the community as food producers, post harvest processors including food storage and conservers food scarcity times, keepers of indigenous knowledge and preservers of biodiversity, household food providers. Babbie (2001) defines a purposive sample as a sample selected in a deliberative and non-random fashion to achieve a certain goal.

The focus group discussion method was used to ensure that all viewpoints are adequately represented. We also made sure that community members, especially women who had the best knowledge and experience of the area were included in the discussion.

A combination of data collection methods were used in order to have a comprehensive understanding of the research problem and cross-reference the different sources and methods of data collection. These included in-depth interviews, focus group discussions, participant observations and examination of secondary sources, especially past research studies and other relevant documents.

The interview guide contained both unstructured and structured questions to allow unrestricted flow of ideas from participants. However, as researchers we were aware of the potential weaknesses in interviewing as a technique of discovery in that even confidential interviews may not necessarily generate the truth but only

what a respondent is willing to share at a particular moment. As a result of this realization, during interviews this type of flaw was taken into consideration. To avoid any discomfort for the interviewee we choose not to probe too deeply into each respondent's background concerning such issues as childhood influences, current financial status, religious affiliations, etc.

Interviews alone were deemed insufficient for the study, hence were supplemented by the use of participant observation to improve the validity of the findings. Participant observation was used because it "provided us with ways to check for non-verbal expressions of feelings, to understand how participants communicated with each other and check how much time was spent on various activities. Participant observation particularly, has been used in an array of disciplines as a tool for data collection about people, processes, and cultures in qualitative research (DeWalt and DeWalt 2002).

Through the assistance and cooperation of the community leaders and IK practitioners we participated in various food security related activities in the farms including community meetings on agricultural issues, etc. We were aware of the fact that one of the limitations in using the participant observation technique is that sometimes the researcher has to rely on the use of key informants and not be interested in what happens out of the public eye. Sometimes researchers are not easily accepted in the communities where they are conducting their research. This is due to a number of things like one's appearance, ethnicity, age, gender and class may affect the researcher's acceptance in the study community. Another limitation of the participant observation study is that the researcher tends to immerse into an unfamiliar culture and studies the lives of other people as a full time community member during the period of the research. This is limiting because sometimes researchers have to change their ways of lives so as to fit within the community of study. However, this was not the case with this research study as we were familiar with the culture and the way of life within the study community.

Focus group discussions were conducted with randomly selected groups of 6-10 community members. Marshall and Rossman (1999) state that though the focus group discussion method can be seen as a form of group in-depth interview, the difference lies in the fact that it is a

group rather than one-to-one interview. Also, by getting the participants to discuss among themselves, it is a faster and easy way of collecting qualitative data in less time than would be needed for individual interviews.

One limitation, however, levelled against focus group discussions is that the focus groups are placed in an artificial environment which can influence the responses that are generated. This is due to the fact that researchers using the ethnographic technique will situate themselves in the real environment that is unreachable for focus groups. In focus groups people are collected in a meeting room thus they might behave differently from how they behave when they are not watched and it might affect the quality of research results.

The overall objective of using a variety of data collection methods was to explore people's knowledge and experience on the research problem. The use of a combination of research methods in data collection provided a better understanding of the research problem from the community perspective through interaction with them. On the issue of informed consent, the permission of participants was sought to record the interviews and conversations so as to allow us to focus on the interviewees, and their responses, not with note taking. Questions pertaining to the interviews were listed on the informed-consent sheet that each interviewee signed. In addition to respecting the privacy of the respondents we ensured their anonymity. Participants were also given the choice of withdrawing from the study whenever they felt that they have lost interest to participate. To protect the participants, their genuine names were kept confidential and the pseudo names were used when referring to their experiences.

Data collected were both qualitative and quantitative (socio-economic demographic data of the respondents). Sarantakos (1998) states that data analysis involves making sense out of the information gathered from research and to bring out meaning from data. Qualitative data in the form of digital voice recorded interviews were transcribed and translated from the local language "Setswana" into English. Interview and participant observation notes were typed and analysed using content analysis. Weber (1990: 12) explains that content analysis is a systematic method for analysing textual information in a standardised way that allows evaluators to make

inferences about that information. Classifying numerous texts and words in much fewer content categories is a central idea in content analysis.

The Quantitative data from the questionnaires were checked and coded. Vestra (2003) defines quantitative data as information based on numbers or statistics that describes activities, populations and so on. In this study quantitative data from the questionnaires were checked, coded and analysed. Validation checks were conducted through all phases of the research to ensure the highest level of data accuracy. Information which was unclear or missing were clarified or collected by returning to informants and reviewing issues and concepts.

The following sections present and discuss the research findings.

RESULTS AND DISCUSSION

The Socio-economic and Demographic Characteristics of Respondent Community Members: Community Perspectives

There has always been a concern from local community members including those in the study community that most of the studies conducted by researchers from outside these communities tend to conceptualize the socio-economic and demographic characteristics of the communities such as age group, marital status, educational levels, religious affiliation, etc. from a western perspective. They overlook the cultural meanings which the people themselves attach to these variables with regard to the various sustainable livelihood challenges facing the communities such as food security and climate change.

It is on the basis of these concerns that the study first examined the socio-economic and demographic characteristics of the local communities such as age group, marital status, educational levels, religious affiliation, etc. from the perspectives of the respondent community members themselves. These perspectives were expressed in the form of narratives in Setswana, the local language in the study community and then translated in English, with regard to the meaning and significance of the socio-economic and demographic characteristics in relation to indigenous food security systems and climate change among the Barolong Borra Tlou le Tau.

The Traditional Significance of Age Group among the Barolong Borra Tlou le Tau

The study revealed that among the Barolong Borra Tlou le Tauage group had an important significance in the cultural and socio-economic life of the people including matters of household and community food security. Rre Maabi (a community elder) explained the importance of age group distribution with regard to social/community and household division of labour for food security. According to the Barolong Borra Tlou le Tau, a boy or girl who is above five years old, was already in the age group of participating in the farming and other food security activities of the household and community. He gave an example of himself that, he used to wake up at five o'clock and take dogs to hunt with his older brothers.

This was elaborated by Rre Dioka, another community knowledge holder and practitioner, who provided his own experience on the issue by stating that when he was still a boy aged fifteen years (15) together with the boys on the same age group, they would be awaked by their fathers at four o'clock in the morning to look for cows to be milked. During the planting season, they woke up early before the parents to prepare the span of oxen and seeds for planting. When the parents woke up everything would be ready for the farming activities of the day. He further narrated that at the field he would hold the rope ahead of the oxen; his father would hold the plough and the elder brother aged twenty five (25) would drive the oxen.

On the issue of climate change in relation to farming activities as the main occupation of the people in the community, the community knowledge holder Rre Kgaole explained that certain cultural professions related to rain-making including participation in their rituals depended on ones age group. For instance, in rain making rituals one must be above twenty five years of age (25-45) to participate in these related rain-making cleansing ceremonies. It was believed that at this age group one was already married, responsible and ready to communicate with the ancestors.

The above narratives from the community members demonstrate the cultural importance of age group in the food security of the study community which tends to be neglected by western research approaches.

The study revealed that the majority of the respondents (83% males and 92% females) were in the age group of 31 years and above. In-depth interviews with them demonstrated their wide knowledge and experience issues related to household and community food security including the impact of climate change over time. These due to their age and experience emanating from being actively involved in related activities.

The Role of Gender among the Barolong Borra Tlou le Tau

In the context of this study gender is defined in terms of the socio-cultural relations between men and women in the society (Butler and Robinson 2001). Among the Barolong Borra Tlou le Tau in Ganyesa gender plays a very crucial role in matters pertaining to food security. The study revealed that women were responsible for most of the household and even community aspects related to food security.

This explained by Mme Boikanyo, a community knowledge holder, that traditionally, among the Batswana of Ganyesa men cleared the land and left women to undertake the remaining farming activities, such as weeding, harvesting, food processing and storage. However, men and women worked together in land preparation, sowing and planting. Women were also responsible for food preparation, fetching water and gathering firewood. She further explains that women also bear the responsibility for the household chores in addition to their agricultural tasks. Men are primarily involved in the production of cash crops, whereas women take care of the crops for household consumption.

For instance direct observation showed that during summer rains wild indigenous vegetables such as amaranthus were only collected by women. Women stored the vegetables in bags and processed by sun drying to be used in winter when they were not available. These indigenous vegetables if stored properly can last up to three years. The study showed that the majority of the respondents (62%) were female. In-depth interviews and focus group discussions showed that the respondent women knowledge holders and practitioners had a wide knowledge on indigenous food security strategies and climate change adaptation in the community. They demonstrated knowledge and experience of ensuring food security and coping with climatic

changes because they were directly involved in these activities for survival.

The indigenous knowledge practitioner Rre Makoi indicated that in the Batswana tradition, rainmakers were supposed to be men only. Women were not allowed to play a role because of the fact that there are certain times in a woman's life, such as during menstruation period, when according to tradition she becomes impure. During these times women were not allowed to engage in traditional medicine and healing practices. It is believed that the medicines will not be effective. However, being the main cultivators of the land for food security under changing climatic conditions, women including girls performed rainsongs and dances which constituted vital prayers for rain.

Focus group discussions revealed that women possessed a detailed awareness of the species and ecosystems which surround them for climate change adaptation. They were often the local educators, passing on traditional knowledge and technologies to younger generations, both girls and boys.

The study has the opinion that an appreciation of the role of gender and the way it impacts the intrinsic value of local knowledge systems among the Barolong Borra Tlou le Tau of Ganyesa is critical to the understanding, interpretation and use of their indigenous knowledge for food security and climate change adaptation. This is elaborated by Pidatala et al. (2003) who observed that due to this gender differentiation and specialization among African indigenous communities, the indigenous knowledge and skills held by women often differ from those held by men, affecting patterns of access, use and control, while resulting in different perceptions and priorities for the innovation and the use of IK.

The study also observed that women's role in indigenous food security and climate change adaptation was more multidimensional. They preserved the local community biodiversity due to their wide knowledge of indigenous plant and animal resources found in the local environment for food and nutritional security. Ganyesa is semi-arid area where cattle farming is an important aspect of local agriculture. Batswana women played a major part in the use of IK related to cattle as they were the ones who mostly collected fodder for cattle, milked the cows, collected and used cow dung for energy and other

purposes. They also played a vital role in post-harvest operations including food preservation and storage of grains.

During focus group discussion it was reiterated that women generally were in charge of processing animal products, which was another area of indigenous expertise. Where women were involved in milk processing and marketing, they had thorough knowledge of the fermentation process, including the effects of temperature and acidity. They were also quite knowledgeable about dairy hygiene as they washed and sundried the utensils used and the containers in which milk was stored.

During focus group discussion and direct observation it was revealed that the number of female-headed households was increasing as most men migrate due to the lack of employment and other income-generating opportunities. This explained why most women had food plots of early maturing short season crops for survival. These food plots were considered women's plots because they performed all the tasks on their plots from planting to harvesting. In some instances men assisted women to clear the plot for planting but it is not common. Example of such crops was spinach as it could be harvested in less than two months.

The above findings of this study are in agreement with FAO (2002) which observed that men are migrating from rural areas to cities in search of paid employment thereby leaving their families to be headed by women. This has resulted to women taking more responsibilities in agriculture in order to meet up with increase in family responsibilities including food security in changing climatic conditions. For example, Indigenous knowledge holder Mme Legau planted tomatoes, watermelon and pumpkins because they took only three months to be ready for harvest and needed warmer temperatures to grow.

Marital Status and Indigenous Food Security for Climate Change Adaptation

During the in-depth interviews and focus group discussions on the role of marital status in food security and climate change among the Barolong Borra Tlou le Tau in Ganyesa, Mme Kabuni, a community knowledge holder stated that traditionally, no man or woman got married among the Barolong Borra Tlou le Tau and other Tswana ethnic groups without going to the ini-

tiation school as a rite of passage where she was taught to ensure food security for her household through knowledge and skills of farming practices, weather patterns, behavior of living organisms as early warning indicators of climatic changing conditions, postharvest practices and technologies to ensure the availability of food at all times in the household.

She indicated that as married woman, wife and mother she ensured that there were enough supplies of food for the family at all times. For instance, she would cook soft porridge and fermented it to make "*Mageu*" which could be taken as a drink for breakfast. *Mageu* could last for about a week without being spoiled by weather.

Rre Molwane, a community knowledge holder, explained further on the role of marital status in rain-making. According to him, following the Batswana traditions a rain maker is usually a male and married person. He explained that if the rain maker is not married, he would not command the respect of the community and support of the ancestors. This traditional belief demonstrated the importance tradition put on the marital status of a person. The same applied to a married woman. She was treated with higher respect in society than a single woman, especially when she already have children.

Every member of society went through that process when the right age and time came in her/his life cycle. These cultural aspects related to marital status as an important community socio-economic and demographic variable are not considered in western ways of knowing and knowledge production when investigating the socio-economic and demographic characteristics of African local communities. The study revealed that the majority of the respondents (53% males; 56% females) were married.

The study was also interested in establishing the meaning attached to education among the respondent community members in relation to the research problem.

Education and Indigenous Food Security in Climate Change Adaptation

The study was interested in establishing the role of formal education in community food security and climate change adaptation from a community perspective. Mme Diabe, a community knowledge holder, had a critical view of western formal education as it exist today in South Afri-

ca because it does not prepare learners to meet the challenges of life including community such as security under changing climatic conditions. She argued that the education children receive nowadays is different from the traditional education she received in olden days. It equipped the young ones with various forms of local knowledge and practical skills to survive in harsh environment. Children learnt through parents and social practice about hunting, farming, taking care of the animals, environment, early warning systems and indicators about changing seasons and the weather conditions. They knew and observed the behaviors of living organisms such as birds, domestic animals and plants.

However, she acknowledged the significance of modern formal education as it prepared children to meet the challenges of the modern world but it needs to take into consideration the role of traditional knowledge if it is to be relevant and useful to them and society.

The researchers agree with the views of Mme Diabe that there is a gap between classroom education and the practical expectations of the society, when it comes to learner's preparedness to meet the challenges of community livelihood such as food security and climate change in harsh arid environment such as that of Ganyesa.

This view is articulated by Odora-Hoppers (2002) and Hountondji (2002) who state that the global western dominant knowledge systems produced in research and academic institutions are in contrast with the local knowledge systems which most people depend on for livelihood including food security and climate change adaptation. Western education does not prepare children for life in their immediate environments.

The study showed that the majority of the respondents (female, 60% and male, 52%) had informal education. In-depth interviews revealed that these respondents, especially the women, had a wide knowledge about the indigenous knowledge and skills related to food security and climate change adaptation in the community. They knew about community farming systems, environmental issues, early warning systems on climate change including behaviors of living organisms related to changing climatic conditions.

The study wanted to establish the household sizes of the study communities as important element for food security and climate change

adaptation. This is due to the fact that observations and own experience showed that most of the households depended on subsistence farming for food security which depended on the size of labor available in the household to perform the farming activities and consumption of the farm produce. Frigo (2004) defines a household as the basic residential unit in which economic production, consumption; inheritance, child rearing, and shelter are organized and carried out. The following section discusses the household sizes of the respondent community members. This is due to the role the household labor plays in food security under changing climatic conditions.

Household Size and Indigenous Food Security for Climate Change Adaptation

The significance of the household size in food security for climate change adaptation community was expressed by the community knowledge holder Mme Kgaole. She indicated that she grew up in a big household of about fifteen children. They were all expected to contribute to household labor for the various farming activities as well as domestic responsibilities. They were also sent to other relatives who needed help during land preparation, sowing, harvesting periods, etc. Since the households were large the heads of households ensured that enough was produced to feed the household members till the next harvesting season. Each household member of the responsible age had to contribute to the household food security. As she participated in the associated farming activities she acquired the necessary local knowledge related to food security in changing climatic conditions including the indigenous early warning systems indicators.

Mme Gaobone a grandparent explained that traditionally, much of the upbringing of children in the households was done by grandparents, and specifically the grandmothers. This is because many single mothers were working or some did not have adequate parenting skills to look after the children, especially the teenagers. Therefore, staying with the grandparents was so important for the upbringing of the child. She gave her own experience that, she grew with her grandparents. There were five girls and four boys in the household. The girls participated in all the domestic activities under her guidance. The

boys looked after the cattle guided by the grandfather.

The study has the view that the experience narrated by Mme Gaobone demonstrates the importance of household labour in food security under changing climatic conditions in the study community. Each member of the household based on gender had a role to play for the survival of the household, especially when the household was big to be fed. The study revealed that the majority of the male (60%) and female (52%) respondent's households had two to four members. During focus group discussions with community knowledge holders and practitioners it was found that ensuring food security was a household responsibility. The bigger the household size the greater was the demand for food security during climatic changes to avoid starvation.

Schultz (2009) elaborates that in most African local communities there is a rigid division of labor in farming activities by gender. This is usually influenced by the varieties of socio-economic and cultural activities performed on the farm. Men and women, as demonstrated in the study had specific activities for the survival of the household.

The study was also interested in establishing the occupational status of the respondent's community members which ensured food security in changing climatic conditions.

Occupational Status and Indigenous Food Security Strategies for Climate Change Adaptation

According to the American Heritage Dictionary (2009), an occupation is defined as any activity in which a person is engaged. In this section the study was interested in establishing the community perspective about occupational status in relation to food security and climate change adaptation. Rre Gaeilo, a community elder provides his own of an occupation that the most important activity in any community is the one which ensures the survival of its members, especially in the provision of the basic needs of life such as food security. For him, agriculture, both the growing of crops and rearing of animals are the most important occupations because all other things in the community depended on them. Every member of the society, men and women, including grown up children (boys and girls) has to be associated with agriculture in one way or another.

Mme Nono explains further that the loss of land due to high population growth led to most of the agricultural and grazing land to be used for residential purposes. Food security depends on land availability and security. It was not only a source of food supply but it has spiritual significance due to the connection with the ancestors who are buried in the soil of the land. They are the ones who give the living life and good agricultural seasons, if they are treated according to traditions of the land and community. This shows the community perspective on the spiritual link and significance between occupation, land and food security.

The study showed that the majority of the respondents (Male, 52% and Female, 58%) were involved in agriculture for food security. Only 15% of respondent male and 4% of respondent women were employed. Mme Motsei, a community knowledge holder, explained the significance of this situation in relation to labor migration out of the village. She stated that due to high unemployment rate that exist in the village, most men left the village in the search for employment opportunities hence women were left at home to be de facto heads of the households and take care of the farms. The researcher's opinion is that although not directly gathered from data, it can be brought forward that women face much heavier workload than men since they typically look after children and are involved in home chores and farm work.

The section below discusses the role of religious affiliation on food security and climate change adaptation.

Religious Affiliation and Indigenous Food Security for Climate Change Adaptation

This section is based on the observation that the local people in Ganyesa believed that ancestors provide the fertility of the land, high yield, rain etc. This demonstrated the way spirituality played a crucial role in their relationship to the ancestors and other religious beliefs associated with survival including food security. The community knowledge practitioner Rre Mobe explained that religion, especially the role of ancestors has a critical role in their lives as Botswana. Their agricultural practices and success depended on their spiritual relationship with the ancestors in ensuring good harvest and well-being of the community. The land as the source

of life and place of the ancestors was treated with respect. People believed that if the ancestors are not happy they can curse the land and bring drought hence famine to the people.

The above perspective demonstrates the way religious beliefs and practices are central to the lives of the people in Ganyesa. It influences their relationship to one another, to food security and importance of living in harmony with natural environment and the ancestors. The study showed that the majority of respondents (Female, 72%) and (Male, 60%) were affiliated to African indigenous religious practices.

Rre Morei, a community knowledge holder explained the importance of ancestors in community life including ensuring of food security, that there were rituals and offerings to ancestors to request for a good harvest, to celebrate a good harvest, to ask for rain, and to chase away curses and evil spirits. Respect for the ancestors, respect for the elderly and the earth meaning the land are amongst the deepest values of the Ganyesa socio-cultural and spiritual system expressed and rooted in indigenous agriculture of the Barolong Borra Tlou le Tau.

African Indigenous Food Security Strategies and Their Uses for Climate Change Adaptation and Community Livelihood

This section discusses the existing African indigenous food security strategies and their uses for climate change adaptation and community livelihood. This is based on the argument that the introduction of modern, especially large scale farming in South Africa, might have had great successes in certain areas of the country and the North-West Province, but a large proportion of people, especially in the rural areas such as Ganyesa are experiencing food insecurity as subsistence farmers due to vulnerability to climatic changes (A Re Ageng 2001). These subsistence farmers, mostly women, still depend on their indigenous agricultural knowledge and technology systems for food security and climate change adaptation. Observations showed that these are low cost and locally available technologies and inputs which enable them to adapt to changing climatic conditions in an arid environment of Ganyesa. The section looks at the following aspects: community sources of food supply; uses of IKS in food supply; advantages and limitations of local knowledge systems on food systems for climate change adaptation.

Indigenous Community Sources of Food Security for Climate Change Adaptation

The study was first interested in establishing the local community sources of food supply. These were well presented by Mme Kgaole, an Indigenous knowledge practitioner as a farmer who indicated that farming, gathering and hunting, especially farming have always been the main source of food supply in the community of Ganyesa. She grew up knowing that agriculture, both the keeping of animals and growing crops such as sorghum and maize as the main source of food. They kept animals such as sheep, cows, goats, chickens and dogs. Hunting was done by men and boys occasionally. During rainy season's women and girls collected wild vegetables and fruits. She indicated that the people knew about the environment as well as the changing seasons and weather conditions. However, the domesticated animals such as cows, sheep and goats were also used for cultural functions including paying bride price "lobola" and sacrifices for the ancestors for various life aspects such as in request for good harvest.

However, Mme Katlego elaborates further that taking into consideration that Ganyesa is a semi-arid area and not very conducive for crop production, animal farming has always been very crucial for food security and climate change adaptation. She indicated that cattle in the village symbolized the life of Batswana. Cattle provided food, could be sold or exchanged for food, provided income, also supplied people with manure for farming and cow dung for heating and other purposes.

The Challenges of African Indigenous Food Security Strategies for Climate Change Adaptation

The study wanted to establish the challenges of indigenous food security strategies found in the study community for climate change adaptation. This took into consideration the fact that a large proportion of the community based food security activities were done by women. Mme Diboka, a community knowledge holder as a farmer explained that women constituted about 80% of the agricultural work force in the community. In spite of being vulnerable to climate change, especially increasing drought conditions, they have overtime learnt to adapt to cli-

mate variability through the use of indigenous knowledge practices, through knowledge of behavior of living organisms as early warning indicators of changing weather conditions, selection of appropriate seeds and animal species, mixed cropping, prediction of the weather changes using wind directions, position of stars, developing water harvesting technologies and water conservation techniques to improve water retention in fragile soils.

To ensure food at all times they were using food preservation techniques such as fermentation and sun drying. Mme Mooki, an indigenous knowledge practitioner, as a farmer, elaborates further that overtime people have learnt to maintain livestock through the use of indigenous knowledge strategies to mitigate changing climatic conditions through the use of supplementary feeds for livestock; reserving pasture for use by young, sick and lactating animals in case of drought. The use of indigenous techniques to control diseases in livestock so that they can survive climatic extremes.

However, during focus group discussions and in-depth interviews we learnt that indigenous food security strategies for climate change adaptation are faced with various challenges. Indigenous knowledge practitioner Mme Ruui, as a farmer, pointed out that young people in the community have no interest in these indigenous knowledge systems due to modernisation. She explained further that the coming of modernization brought about change in the use of community based knowledge systems in areas of food security and climate change adaptation.

These changes came with new systems of education in agriculture which introduced new ways of farming. She gave the example of the introduction of hybrid seeds to produced higher yields using chemical fertilizers. Most of farmers in the village are encouraged by government extension workers to adopt the new methods of farming, how to plant hybrid seeds and use chemical fertilizers. These new methods are expensive and not easily accessible for most subsistence farmers who have no other sources of income. Most of them are women with large numbers of dependants. These new agricultural practices based on the use of chemicals destroy the environment by polluting the soil and water sources. Many people in the village, especially women and children are sick.

She explained that as a result of the influence from agricultural extension officers indigenous farming methods changed even though farmers are not certain about the new method of farming. In the village not most people use modern method of farming because the methods need special education and money to buy its facilities. The abandonment of indigenous ways of farming which were affordable and hence sustainable has made many households vulnerable to food insecurity. Moreover, Mme Mokeona went further to state that with the widespread adoption of Christianity, indigenous spiritual practices and belief systems such as taboos associated with the protection of environment and preservation of biodiversity were now seen as superstitions. This has greatly affected the spiritual base of community ways of knowing, especially the role of the ancestors in the sustainable livelihood of the people.

CONCLUSION

The study examined the role of socio-economic and demographic characteristics such as age group, marital status, etc. from a community perspective in relation to the research problem, that is African indigenous food security strategies for climate change adaptation. Contrary to western perspective, it was found that these variables had socio-cultural and spiritual significance in the community livelihood of the Barolong Borra Tlou le Tau people in Ganyesa.

African rural communities in arid environment such as Ganyesa in the North-West Province (South Africa) have always been vulnerable to food insecurity due to drought conditions associated with climate change. Most of them are women subsistence farmers. However, over the years the people in these communities have developed their own indigenous strategies of ensuring food security in changing climatic conditions. The study revealed that women in the study community made up about 80% of the agricultural work force related to food security. Their role in indigenous food security for climate change adaptation was multidimensional. They were the main agricultural producers, food processors and preservers for household food security. They also played a major role in animal production. They were the ones who mostly collected fodder for cattle, milked the cattle, processed the milk, collected and dried cow-dung

as a source of energy and other uses. They demonstrated extensive knowledge about the indigenous food security strategies and over the years have learnt to adapt to climate variability through the use of indigenous knowledge to predict the weather using wind directions, position of stars, observation of behaviors of living organisms as early warning indicators of changing climatic conditions. The elderly women have over the years developed and used indigenous adaptation strategies such as water harvesting technologies, water conservation techniques to improve water retention in fragile soils; to ensure food at all times they used food preservation techniques such as fermentation and sun drying, mixed cropping and crop diversification.

However, the study found that the modernization has brought about change in the use of community based food security strategies for climate change adaptation. Modern knowledge and technology systems are not accessible and not affordable to most subsistence farmers, especially the women due to low incomes. The use of chemical fertilizers has also polluted the water sources and soil. This decline in the importance of indigenous food security strategies and farming systems has made people in the study community vulnerable to climate change with regard to food security.

RECOMMENDATIONS

The study recommends the need to document the existing indigenous food security for climate change adaptation in the community. This is meant to protect and preserve them for future generations. They should be shared with younger generations, agricultural extension officers and policy makers for sustainability. They should also be introduced in the educational systems and agricultural development campaigns to promote knowledge and awareness of their significance among different stakeholders within and outside the local communities. Documentation will assist in identification of gaps in these knowledge systems which could be improved through interface with other knowledge systems to meet the challenges of globalization. The role of gender should be taken seriously in the documentation, promotion and interface of indigenous and other knowledge and technology. These initiatives should improve the role of women rather than marginalize and alienate them

as the main producers and users of these indigenous knowledge systems.

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