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Ancient Drought Prediction and Receptiveness Practices among Communities Influence on Food Security. A Critical Literature Review

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Abstract

Purpose: Drought prediction practices entail observing behavior of certain animals, plants, trees, winds, clouds, temperature changes and other natural phenomena at the local level. The overall objective of this study was to examine ancient drought prediction and receptiveness practices among communities' influence on food security.

Methodology: The paper used a desk study review methodology where relevant empirical literature was reviewed to identify main themes and to extract knowledge gaps.

Findings: This study concluded that the interaction between the local indigenous drought experts and the formal meteorologists is central in producing climate forecasts that are meaningful for the local community. The collaboration of the various stakeholders in developing a mitigation plan on curbing food insecurity will ultimately contribute to sustainable livelihoods achieved through appropriate timing of agricultural activities, water saving and post-harvest agro-processing. Sustainable livelihoods and the resultant food security will eventually enable the community achieve sustainable development.

Unique Contribution to Theory, Policy and Practice: This study recommended that although farmers listen to meteorological forecasts from radios, among other formal communication media, they also use their AKS to predict droughts. There is need to strengthen the resilience and self-confidence of the local community to cope with drought disasters. This could be achieved through recognition and propagation of indigenous drought prediction and preparedness practices and values. The study also recommends in-depth examination of the invaluable input of the indigenous prediction practices for inclusion in regards to other studies to be done.

Keywords: *Ancient, drought prediction, receptiveness, practices, communities, influence, food security.*

INTRODUCTION

Indigenous knowledge is a body of knowledge existing within or acquired by local people over a period of time and is passed from generation to generation usually by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world (Sillitoe, 1998; Nakashima, Prott & Bridgewater, 2000; Mutasa, 2015). While citing UNEP (2008), Mercer (2012) highlights a plethora of terms associated with IK which have been widely used in literature. These include local knowledge, traditional knowledge, indigenous traditional knowledge, indigenous technical knowledge, peasants' knowledge, traditional environmental knowledge, folk knowledge, people's science, ethnoscience, local science, traditional science, village science, and rural knowledge (Mutasa, 2015).

Mercer et al. (2009) elucidate that indigenous knowledge may be considered to be a body of knowledge existing within or acquired by local people over a period of time through accumulation of experiences, society-nature relationships, community practices and institutions, and by passing it down through generations. Ocholla and Onyancha (2004) view IK as a dynamic archive of the sum total of knowledge, skills and attitudes belonging to a community over generations and expressed in the form of action, object and sign languages for sharing. From time immemorial, traditional local communities in different parts of the world have continued to rely on IK to conserve the environment and deal with natural disasters (Roncoli, 2002). O'Brien et al. (2000), similarly argue that the communities, particularly those in drought prone areas have generated a vast body of IK on disaster prediction and mitigation through EW and preparedness strategies. Further, Hulme et al. (2001) observe that drought is not a new global challenge especially in the marginalized continents. The fact that communities in these parts of the world have survived all along with a fast growing population is an indication that they have developed mechanisms and strategies to cope with droughts (IGAD, 2006).

Studies carried out in Africa pointed to the existence of an array of indigenous EWS and well developed structures through which the wisdom of the community was applied to discern impending drought (UNEP, 2003). The Intergovernmental Panel on Climate Change (2007) notes that indigenous knowledge is "an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change". In their study, Nimpuno et al. (2004) report that African people instinctively knew that they needed to understand their environment well to be able to foretell and cope with the occurrence of droughts. According to Mhita (2006), elders undertook the responsibility of predicting droughts. In this way, they would guide the people on the actions to take to mitigate drought disasters in the community. According to the DMCN (2004), indigenous EW for drought is based on keen observation and deciphering signs depicted through the behavior of certain animals, plants, trees, winds, clouds, temperature changes and other natural phenomena at the local level. Studies in South Africa found out that a 'red' moon announces the coming of drought (Nimpuno & Boshoff, 2004).

In Swaziland, some of the indigenous methods used to predict drought and famine include the abundance of butterflies (Danaus plexipus) during the farming season and the presence of armyworms (Spodoptera exempta) (Edje & Manyatsi, 2004). In a Kenyan study, UNEP (2003) observed that indigenous communities recognize that to be able to live with the natural disasters, they have to monitor the environmental conditions, including the weather, to be able to make meaningful prediction and take appropriate actions. However, IGAD (2006) discovered that there are lots of overlaps and differences in approach from community to community. Plant indicators such as the baobab tree shedding its leaves have long been used as EW indicators for both drought and rainfall onset. In Kenya's Embu County, communities in Mbeere North Sub County have designed ways of surviving persistent natural disasters through the use of traditional knowledge (Muriuki et al., 2009). For example, using IK to divine water, community members, guided by the elders dug traditional sand dams to counter drought events (Arid Lands Resource Management ProjectALRMP, 2011). The community has developed enormous volumes of undocumented drought knowledge in terms of rainfall patterns, temperature variations, soil characteristics and general weather change patterns as a result of centuries of living close to their environment. IK has played an important role in solving local problems, including those related to climate variability, impacts and associated vulnerability. Since indigenous and local people live close to natural resources, they quickly observe the changes around them and adjust their activities to adapt to the changes (MoEST, 2015).

Statement of the Problem

Drought disaster preparedness and the reduction of associated risks have gained momentum in recent years as effects of climate change continue to manifest globally (Somah, 2013). Impacts of climate change such as decreased crop yields, severe disruption of livelihoods opportunities, increased food prices, and exacerbate household vulnerability to food insecurity have pushed various communities in the world to seek ways of reducing their vulnerabilities (FAO, 2006; Kipkorir et al., 2011). The African continent has witnessed severe bouts of droughts in the last century (Mekonnen, 2006; Anandaraja et al., 2008). Yet the vast majority of rural communities in the region lack access to modern weather forecast information(Mbeva, 2000).As a result, communities, particularly those in droughts and floods prone areas have traditionally used ancient knowledge (AK) for disaster prediction and preparedness through early warning systems(Rengalakshmi, 2007; Kijazi, 2012).According to UNESCO (2010) and Somah, (2013), one of the most important principles of the convention to combating desertification and other effects of drought has been the recognition of local people's IK in the facilitation of adaptation to climate change within rural subsistence communities. However, increasing variability in climate has reduced farmers' confidence in traditional knowledge and has led them to seek out scientific weather forecasts (Oxfam GB, 2011; Kijazi et al., 2012). Local communities' AK has been neglected, vindicated, stigmatized, illegalized and suppressed among the majority of the world communities (Ocholla & Onyancha, 2004: 248).

In Kenya, modern formal education, science and technology appears to undermine the place and role of indigenous cultural values and practices regarding drought prediction, preparedness and actual mitigation (Ocholla & Onyancha, 2005). This is despite the fact that IK and contemporary science of weather forecasts complement each other (Masinde & Bagula, 2012). Thus, there is critical need to develop an integrated approach to accurately predict and prepare for drought as a way of mitigating its impacts on communities. For instance, despite the marked increase of drought incidents in Kenya, especially in the Arid and Semi-Arid Lands (ASALs), little has been done to integrate AK into formal drought prediction, preparedness and management strategies. Furthermore, not enough is known about how AK is managed with respect to various communities in the country (Njiraine et al., 2010).Integrating AK with the modern scientific approaches is an important step to addressing underdevelopment and other challenges (Makwara, 2013; Rengalakshmi, 2007). AK integration would also be a precious national resource that can facilitate the process of drought prevention in cost effective and sustainable ways (IGAD, 2006). The current study examined how indigenous knowledge and the contemporary scientific approach to drought prediction and preparedness can be integrated as a drought risk reduction strategy. More evidence on the topic is necessary in providing further understanding on provenance of food insecurity. This study will bridge the gap by assessing provenance of food insecurity.

Objective of the Study

The overall objective of this study was to examine ancient drought prediction and receptiveness practices among communities influence on food security. A critical literature review.

Significance of the Study

Drought risk reduction strategies are of critical importance to the communities as they can enhance their ability to cope with the adverse effects of the phenomenon. The Ambeere people occupy a semi-arid area that has hostile terrain and unpredictable rainfall. The study attempted to provide an important data which can be instrumental in guiding local community leaders and development agents in mainstreaming IK into drought mitigation strategies for sustainable development, leading to reliable weather forecasts and recommendations that are more plausible and useful at a local scale. The interaction between the indigenous and conventional approaches to drought prediction can create a mechanism of dialogue between the local populations and climate change professionals. This is in turn meaningful for the design of drought adaptation projects in the study area. This could eventually contribute significantly in curbing the escalating poverty and food insecurity among the rural poor in the area.

The study will inform the households on effectiveness of the already adopted strategies, inform the stakeholders of the climate trend and food security status in the area. The study as well may be of significance to policy makers such as the Ministry of Agriculture, Livestock and Fisheries, Ministry of Environment and Mineral Resources, NGOs, local organizations and development agencies among other stakeholders working in the area by providing policy recommendations that

may guide decisions that could bring change in agriculture to enhance food security. The study findings will also contribute to the existing literature on the topic.

THEORETICAL REVIEW

The study employed the Equilibrium and Non-Equilibrium theories of arid and semi-arid environment.

Equilibrium and Non-Equilibrium Theories

The concepts of equilibrium and non-equilibrium models can be used to demonstrate the extent to which semi-arid environments are equilibrium or non-equilibrium systems (Vetter 2005).Equilibrium theory asserts that systems are at equilibrium--in a steady state, with overall species composition and relative abundances stable through time--as a result of biotic interactions among its members. Such systems return to their original structure after perturbation (Reice, 2017). The model of a variable climate driving natural resource behavior, use and management of rangelands in Sub-Saharan Africa can also be explored within the non-equilibrium ecology discourse (Lankford & Beale, 2006). According to DeAngelis and Waterhouse (1987), mathematical models and empirical studies have revealed two potentially disruptive influences on ecosystems; (1) instabilities caused by non-linear feedbacks and time—lags in the interactions of biological species, and (2) stochastic forcings by a fluctuating environment. Selemani (2017) posits that equilibrium model stresses the importance of density-dependent regulation of livestock population on rangeland productivity and livestock performance. The equilibrium rangeland ecosystem suggests that rangelands respond to the environment under the influence of grazing in a sequential and predictable manner. However, overgrazing in dry land rangeland ecosystem can initiate encroachment of woody plants by changing the competitive balance among grass swards and woody plants in semi-arid environments. Non-Equilibrium theory on the other hand was coined by ecologist Wiens (1984), to describe the dynamics of arid and semi-arid ecosystems. The theory states that “all ecological systems fall somewhere on a continuum from equilibrial to non-equilibrial”.According to Lankford 30 and Beale (2006), rainfall and water variability underwrites the ecological dynamics of African savannahs. Models of non-equilibrium ecology suggest that semi-arid grasslands are driven not by a continuous accumulation of biomass but by episodic events governed by abiotic factors, predominantly ‘pulses’ of water or fire.

Empirical Review

Molu (2016), conducted a study to investigate the coping mechanisms that pastoral communities have employed in Maikona Location and their sustainability. The study employed both quantitative and qualitative methods, targeting 145 respondents including 127 Households respondents, 14 Youth and Women group members in FGDs and 4 technical/NGO representatives. Questionnaires, FGDs and key informant checklists were used as the main tools. Data were analyzed both descriptively and inferentially. The study found out that there had been real and perceived changes both in the rainfall and temperature patterns. Field inquiries indicated a great change in rainfall

patterns (94%) between 1980 and 2010 as well as a significant trend of decline from the data of the metrological department. The study recommended that the metrological department should share rainfall data constantly with the pastoralists for them to understand the dynamics of rainfall and temperature variations on livestock production and possible coping strategies customized for their situation as well as advise them on sustainability. The study further recommended the need for a long-term support like establishment of livestock market, support to education through sponsorship and adopting policies that support mobility as opposed to sedentarization of the communities. The study however presented a methodological gap as it utilized descriptive research design while our study will utilize desktop review approach.

Luasi (2015), conducted a study that evaluated genetic transformation of tropical maize inbred lines using aldose reductase (ald1) gene for enhancement of drought tolerance. Researchers are working on the development of maize that can tolerate the effects of drought. Conventional breeding has been used in the development of drought tolerant crops but often brings along undesirable agronomic characteristics from the donor parents hence, genetic engineering by identifying and inserting genes only involved in stress tolerance in plants is being explored to complement efforts of this classical approach of improving crop varieties. The Xerophyta viscosa aldose reductase (XvALDI) gene isolated from the resurrection plant Xerophyta viscosa has been postulated to be involved in the synthesis of osmoprotectants and in the maintaining of the structural integrity of macromolecules under abiotic stress. Over-expression of XvALDI gene in model plants has been shown to increase drought tolerance. In this study, the gene construct with its T-DNA harboring XvALDlgene driven by a stress inducible plant promoter, XvPSAP 1 and phosphomannose-isomerase gene as a selectable marker was used to transform CML 144 and CML 216 maize inbred lines through Agrobacterium-mediated transformation. The study presented a conceptual gap as it focused on evaluated genetic transformation of tropical maize inbred lines using aldose reductase (ald1) gene for enhancement of drought tolerance while our study will focus on examining ancient drought prediction and receptiveness practices among communities influence on food security.

Nduti (2014), conducted a study on to establish how the farmers use indigenous knowledge strategies in mitigation of drought in Gachoka Division. The data was collected from informants through questionnaires, group discussions and interviews with key persons being the village elders in every village. The findings of the research shows that 62.5% of the respondents reported that the frequency of drought in the area is less than year while 29.2 % reported that drought occur after every 1 to 2 years and 8.3% reported that the drought occur after every 5 years and above. This shows that the area is prone to drought and drought mitigating strategies are highly required. 41.7% of the respondents' plant traditional crops in their farms while 33.3% plant hybrid crops and 25% planted both hybrid and traditional crops. These results shows that indigenous crops are of high value to them and the village elders attested this because they said that though most of time rainfall in Gachoka is not sufficient to a full season when they plant indigenous crops like millet,

sorghum, cowpeas and green grams at least they harvest something small unlike the farmers who purely plant like maize, beans because when rain is not enough they barely harvest anything. The study presented a geographical gap as it focused on Gachoka Division while our study will focus on examining ancient drought prediction and receptiveness practices among communities influence on food security.

Ngugi (2015), conducted a study to determine the strategies used by livestock farmers to cope with recurrent droughts. The objectives were: to find out how livestock farmers in the study area perceive drought, to identify the effects of drought, to find out how livestock farmers counteract the problem of drought to reduce vulnerability and to determine the constraints faced by the livestock farmers in their attempt to cope with drought. Descriptive survey research design was used. Stratified random sampling was applied to select a sample of two hundred households. Findings of the study revealed that majority (98.5%) of the livestock farmers' perceived drought as a serious environmental hazard regardless of their gender and education level. Majority (71%) of the livestock farmers experienced death of their livestock during drought. Other major effects of drought included; food and water scarcity and increase in absenteeism of children from school. There was a negative relationship between farmers' education level and death of animals during drought (chi- square test df =4, $p<0.05$ (14.909). To cope with drought, the farmers sought alternative employment, received government assistance and engaged in casual labour. Some of the measures used to cope with drought differed significantly across education level. The study presented a methodological gap as it used descriptive research design while our study will use desktop literature review method.

METHODOLOGY

The study adopted a desktop literature review method (desk study). This involved an in-depth review of studies related to examining ancient drought prediction and receptiveness practices among communities influence on food security. Three sorting stages were implemented on the subject under study in order to determine the viability of the subject for research. This is the first stage that comprised the initial identification of all articles that were based on ancient drought prediction and receptiveness practices among communities influence on food security. The search was done generally by searching the articles in the article title, abstract, keywords. A second search involved fully available publications on the subject on ancient drought prediction and receptiveness practices among communities influence on food security. The third step involved the selection of fully accessible publications. Reduction of the literature to only fully accessible publications yielded specificity and allowed the researcher to focus on the articles that related to ancient drought prediction and receptiveness practices among communities influence on food security which was split into top key words. After an in- depth search into the top key words (ancient, drought prediction, receptiveness, practices, communities, influence, food security) the researcher arrived at 4 articles that were suitable for analysis. This were findings from:

Molu (2016), who conducted a study to investigate the coping mechanisms that pastoral communities have employed in Maikona Location and their sustainability. The study employed both quantitative and qualitative methods, targeting 145 respondents including 127 Households respondents, 14 Youth and Women group members in FGDs and 4 technical/NGO representatives. Questionnaires, FGDs and key informant checklists were used as the main tools. Data were analyzed both descriptively and inferentially. The study found out that there had been real and perceived changes both in the rainfall and temperature patterns. Field inquiries indicated a great change in rainfall patterns (94%) between 1980 and 2010 as well as a significant trend of decline from the data of the metrological department. The study recommended that the metrological department should share rainfall data constantly with the pastoralists for them to understand the dynamics of rainfall and temperature variations on livestock production and possible coping strategies customized for their situation as well as advise them on sustainability. The study further recommended the need for a long-term support like establishment of livestock market, support to education through sponsorship and adopting policies that support mobility as opposed to sedentarization of the communities.

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SUMMARY, CONCLUSION AND RECOMMENDATIONS

Conclusion

This study concluded that the interaction between the local indigenous drought experts and the formal meteorologists is central in producing climate forecasts that are meaningful for the local community. The collaboration of the various stakeholders in developing an mitigation plan on curbing food insecurity will ultimately contribute to sustainable livelihoods achieved through appropriate timing of agricultural activities, water saving and post-harvest agro-processing. Sustainable livelihoods and the resultant food security will eventually enable the community achieve sustainable development.

Recommendations

This study recommended that although farmers listen to meteorological forecasts from radios, among other formal communication media, they also use their AKS to predict droughts. There is need to strengthen the resilience and self-confidence of the local community to cope with drought disasters. This could be achieved through recognition and propagation of indigenous drought prediction and preparedness practices and values.The study also recommends in-depth examination of the invaluable input of the indigenous prediction practices for inclusion in regards to other studies to be done.

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