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Food Management Strategies for Coping with Food Insecurity in a Changing and Variable Climate by Smallholder Farmers in Kenya

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ABSTRACT: Food insecurity in Kenya has been experienced over the years and is getting worse. The phenomenon is partly attributed to accelerating global Climate change and variability. This study investigated smallholder farmers' perceptions on climate change; food access and consumption across seasons, and food management strategies for coping with food insecurity, with the aim of identifying promising cases that can be up-scaled to enhance food security. Five sites representative of Kenya's major agro-ecological systems were purposively selected. Three Participatory workshops and focus group discussions for 30 smallholder farmers were held in each site. The participants' collective views showed that frequent droughts, shift in the rainfall season and unpredictable rainfall pattern were climate change indicators common to all sites. Foods widely accessible and consumed were maize, beans, sorghum and cowpeas, with the former two being increasingly consumed due to their adaptability to various climatic conditions, relatively high yield and comparably cheap. In a favorable season, excess food is added value, preserved and stored for an adverse season, in which food is rationed in order to carry the family through for a longer period. There is therefore, need to equip smallholder farmers with knowledge and skills on food processing and preservation, in order to benefit from favorable seasons, by reducing post harvest food losses and spoilage.

KEYWORDS: Agro-ecosystems Climate change, Participatory workshop, food security.

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1 BACKGROUND

The Kenyan agricultural sector is the mainstay of the Kenyan economy, with 80% of the population deriving their livelihoods from agricultural related activities. The key objective of the sector is achievement of food security, by increasing availability of food with high nutritional status, at affordable prices and providing jobs and incomes that give people the means to access food, [1]. Food security is a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life without *depending* on humanitarian assistance or unethical means like stealing [2]. The Kenya government in its Food Security and Nutrition Policy [3], has embraced four dimensions of food security: Availability, stability, access, and utilization. Food availability refers to the ease with which sufficient food can be obtained. This is mainly through own agricultural production, or from markets, [3]. The second dimension, stability, relates to continuity of food supply to individuals such that they are not at risk of temporarily or permanently losing their access to the resources needed to consume adequate food (5]. The third dimension, access, comprises of availability to individuals adequate food from own production or having incomes or other resources to purchase and /or exchange with suitable foods needed to maintain consumption of an adequate nutrition level. Food access is determined by its affordability or the financial capacity to buy food 6]. Finally, food utilization refers to not only having adequate food of sufficient diversity to meet nutrient needs, but also the knowledge and means to process plant and animal materials into nutritious food, as well having adequate water and sanitation, [7]. Culture determines which foods a given community will eat or not, by making certain communities to stick to certain foods considered as important by that community.

Food diversity is crucial to food security and nutrition. Diversity refers to representation in the diet, a range of foods from each of the nutritional categories, of energy giving foods (Cereals, starchy root crops and fats); proteins from legumes and meats; and vitamins and minerals obtained from fruits and vegetables. Food utilization determines the extent to which a given community can be considered as food secure or insecure. Food insecurity in this case refers to a condition in which a population does not have access to sufficient, safe and nutritious food over a given period, to meet dietary needs and preferences, [8]. The wider the variety of foods the community produce and or can use, the more food secure the community can be and vice versa.

1.1 VULNERABILITY TO CLIMATE CHANGE AND VARIABILITY

Kenya's agriculture is mainly rain-fed and its performance varies with the agro-ecological system. In the humid, high altitude areas, productivity as well as predictability of good crop is high. In the medium altitude and moderate rainfall areas, arable rain-fed farming is moderately suitable. However, there is relatively high risk of crop failure due to increased frequency of dry spells and an uneven rainfall distribution. A large proportion of the country, accounting for more than 80 percent, is semiarid and arid, with an annual rainfall average of 400 mm. In these areas, droughts are frequent and crop fails in one out of every three seasons, [1]. A changing and variable climate therefore, aggravates or becomes a multiplier of climate risks, resulting to declining food production.

1.2 CLIMATE CHANGE INDICATORS

Climate change refers to the change in weather patterns that is attributed directly or indirectly to human activity, that alters the composition of global atmosphere, and that is in addition to natural climate variability for 30 years or longer. Notable global indicators of climate change include: Rise in atmospheric and sea temperatures; decrease in snow and sea ice; increase in precipitation in some regions and decrease in others; unpredictable rainfall patterns; change in frequency of extreme events such as cold and hot days and nights. Moreover, there are increased incidences of heat weaves, frequency of heavy precipitation, droughts, intense tropical cyclones and extreme high sea levels, [9]. Climate variability is the deviations of climate parameter statistics from the long-term climate statistics relating to the corresponding calendar period over a given period of time, such as a specific month, season or year results into (World Health Organization, [10]. As a result of climate change and variability, food and nutrition insecurity has been experienced over the years and is getting worse. Ten million people in Kenya suffer from chronic food insecurity and poor nutrition, and between two and four million people require emergency food assistance at any given time). In addition, nearly 30% of Kenya's children are classified as undernourished, and micronutrient deficiencies are widespread, [11]. However threats posed by climate change to food security and livelihoods are likely to be spatially variable given the diverse agro-ecological zones and their vulnerability. Vulnerability with regard to climate change implies that people are exposed to aspects of climate that are changing in ways

that will either generate or increase risk. For food security, the risk is of poorer nutrition or reduced access to food supplies than would be expected under "normal" climate conditions, [12].

The impact of climate change is most severe on smallholder farmers because of their limited adaptive capacities due to poverty. These cultivate mainly, using farm labor and the farm provides the main income. Pastoralists, who almost all depend on sale of livestock and livestock products to buy staple foods and other necessities, are included in this category, [13]. Impacts such as rising temperatures and increased frequency of extreme weather events put severe pressure on food availability, stability, access, and utilization. Climate change has affected natural systems especially by rising temperatures, [9]. Availability of agricultural products is affected by climate change directly through its impacts on crop yields, crop pests and diseases, soil fertility and water-holding properties. It is also affected by climate change indirectly through its impacts on economic growth, income distribution, and agricultural demand [5]; [12]. Stability of crop and livestock yields and food supplies is negatively affected by variable weather conditions. Access to food is affected negatively by climate change because as agricultural production declines, food prices rise, and purchasing power decreases. Last, climate change poses threats to food utilization through effects on human health and the spread of diseases like malaria in geographical areas which were previously not affected [12].

1.3 CLIMATE CHANGE COPING STRATEGIES

The extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to adapt to change, [9]. Over the years, development of human societies has involved a continuous process of adapting to changing environmental stresses and opportunities. While climate change is seen as a relatively recent phenomenon, individuals and societies are used to adapting to a range of environmental and socio-economic stresses, [14].

However, the rate at which climate is changing is faster than the smallholder farmers' ability to adjust their food security systems, [5]. Impacts such as higher temperature, erratic rainfall and floods are increasing the smallholders' inability to maintain or increase their agricultural productivity leading to loss of a source of livelihood and food insecurity. Due to climate variability, droughts and rainfall have become more unpredictable and traditional food management practices may no longer be sustainable [12]. Consequently, smallholder farmers in different agro-ecological zones of Kenya may have adjusted their food management strategies in different ways to ensure food security but the distinctive adjustments are less understood.

2 MATERIALS AND METHODS

2.1 PURPOSE OF THE STUDY

The purpose of the study was to investigate the smallholder farmers' perceptions of climate change, their food production accessibility patterns and consumption, and food management strategies for coping with climate change and variability. Such strategies are likely to form a sound basis which institutions supporting climate change activities can build upon in developing sustainable climate adaptation strategies for specific locations and communities of practice.

2.2 OBJECTIVES OF THE STUDY

The study aimed at investigating:

1. Smallholder farmers' perception of climate change

2. Foods accessible and consumed across seasons

3 .Food management coping strategies for food insecurity, currently used by smallholder farmers and pastoralists based on seasonal variability

2.3 METHODOLOGY

The study used participatory action research design. This involved focus group discussions of key stakeholders in food security, comprising of the farming community, Government, Non-Governmental and Faith-based community workers. Three participatory workshops and focus group discussions for 30 community smallholder farmers were held in each site, to gather collective views of the respondents. Gender representation was observed in all the workshops because the experiences of men may be different from those of women.

Five (5) sites in Kenya's major Agro-Ecological Systems, representing varying degrees of vulnerability to impacts of climate change and variability were purposively selected. These regions are regarded as climate change hotspots in Kenya and they include:

1. Arid and semi arid pastoral Livestock area of Kajiado County in Southern Kenya
2. Semi arid areas (in transition) of Mbeere Sub-county in South Eastern Kenya
3. Lake Basin High potential food crop/livestock area of Bungoma County in Western Kenya
4. Highland Medium potential crop/livestock area of Nakuru County in Central Rift Valley
5. Coastal lowland crop/livestock area of Kilifi County

The study also involved a desktop survey of the agricultural potential of the purposively selected agro ecological systems sites.

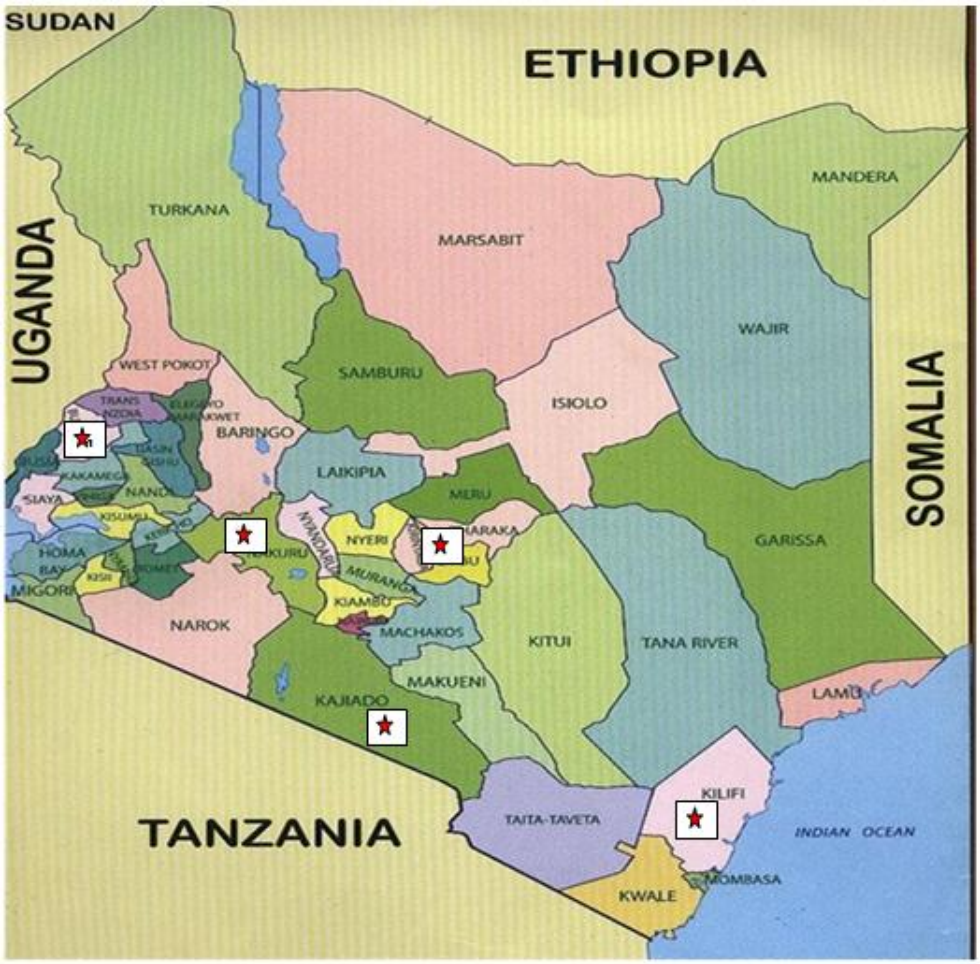

Figure 1: [★]arch Sites of Climate Adaptation Project in Kenya

2.4 STUDY POPULATION

The target population was all smallholder farmers in the five selected counties of Kenya, representative of the major agro- ecological systems, whose vulnerability to climate change varies from one system to another. These included Smallholder farmers and pastoralists.

2.5 SAMPLING PROCEDURE

Purposive sampling was used to ensure that only relevant actors in food security were selected. This involved consultations with the County Agricultural Officers, who provided a list of 30 practicing smallholder farmers in their

respective Counties. The entire population of the selected smallholder farmers who are key players in food security participated in the focus group discussions.

2.6 DATA COLLECTION AND ANALYSIS

Checklists containing various themes of Climate Change, food security and food strategies were used to guide the discussions. Responses were recorded and content analysis done in order to group each response under the relevant theme. The findings were further discussed with the participants in order to validate the responses. The information was then revised to ensure accuracy and representativeness of the data under each sub-theme of the study.

3 RESULTS AND DISCUSSION

3.1 PERCEIVED INDICATORS OF CLIMATE CHANGE BY SITES

The basis of any effective adaptation to climate change requires that the farmers and pastoralists first appreciate that the climate has changed and that it is an environmental, stressful situation that upsets food security. This realization forms the basis of devising food management strategies for coping with food insecurity that may or may not develop into adaptation, [15]. Results in Table 1 indicate that frequent droughts, shifts in the rainfall seasons and unpredictable patterns were climate change indicators common to all sites. Low temperature was only unique for Kilifi in the Coastal Lowland. Unlike other study sites, Nakuru was the only site with less flood occurrences while Mbeere shared all its climate change indicators with at least one other site. Bungoma reported increased frost occurrences and destructive lightning. The observation may be due to the county's location on the slopes and foothill of Mount Elgon and nearness to Lake Victoria, while reduced flood occurrences in Nakuru may be attributed to the relatively high sandy soils that easily allow water to percolate.

Low temperatures at the coastal lowland county of Kilifi can be ascribed to cooling effect of the ocean water as it evaporates due to rising ocean temperatures. Respondents had clear awareness about changes in the climate and the indicators relevant to their locality. This is contrary to the findings of the first comprehensive study of global opinions on climate change of 2007-2008 by Loiserowitz, [16], which showed that, industrialized countries were more aware than developing countries.

Table 1: Perceived Indicators of Climate Change by Sites

	Study Sites				
Perceived Climate Change Indicator	**Kajiado**	**Bungoma**	**Nakuru**	**Kilifi**	**Mbeere**
Livestock disease outbreaks increased	x				x
Human disease outbreaks increased	x	x	x		x
Frequent droughts	x	x	x	x	x
More dry spells within a rainy season	x	x			
Shortened rainy /growing season	x				x
Rainfall season shift	x	x	x	x	x
Rising Temperatures	x				
Low temperatures				x	
Decreasing rainfall amounts	x	x	x		
New crop pests and diseases		x			
Poor spatial rain distribution		x			
Increase in Hailstorms		x	x	x	
Increase in wind storms		x		x	x
Decrease in wind storms			x		
Destructive lightning more frequent		x			
Unpredictable rainfall pattern	x	x	x	x	x
Frost occurrences has increased		x			
Heat stress			x	x	x
Floods occurrences increased	x	x		x	x
Less flood occurrences			x		

x: Presence of indicator

Rainfall data was collected from the weather stations and companies that were keeping their records for many years such as KENGEN in Mbeere, Mumias Sugar Company in Bungoma, MRTC in Kajiado and Nightgale farm in Nakuru.

RAINFALL DATA ANALYSIS

Trends in manual rainfall for at least 30 years were calculated to compare smallholder perceptions with the actual trends in mean rainfall amounts. The results are shown on figure 2.

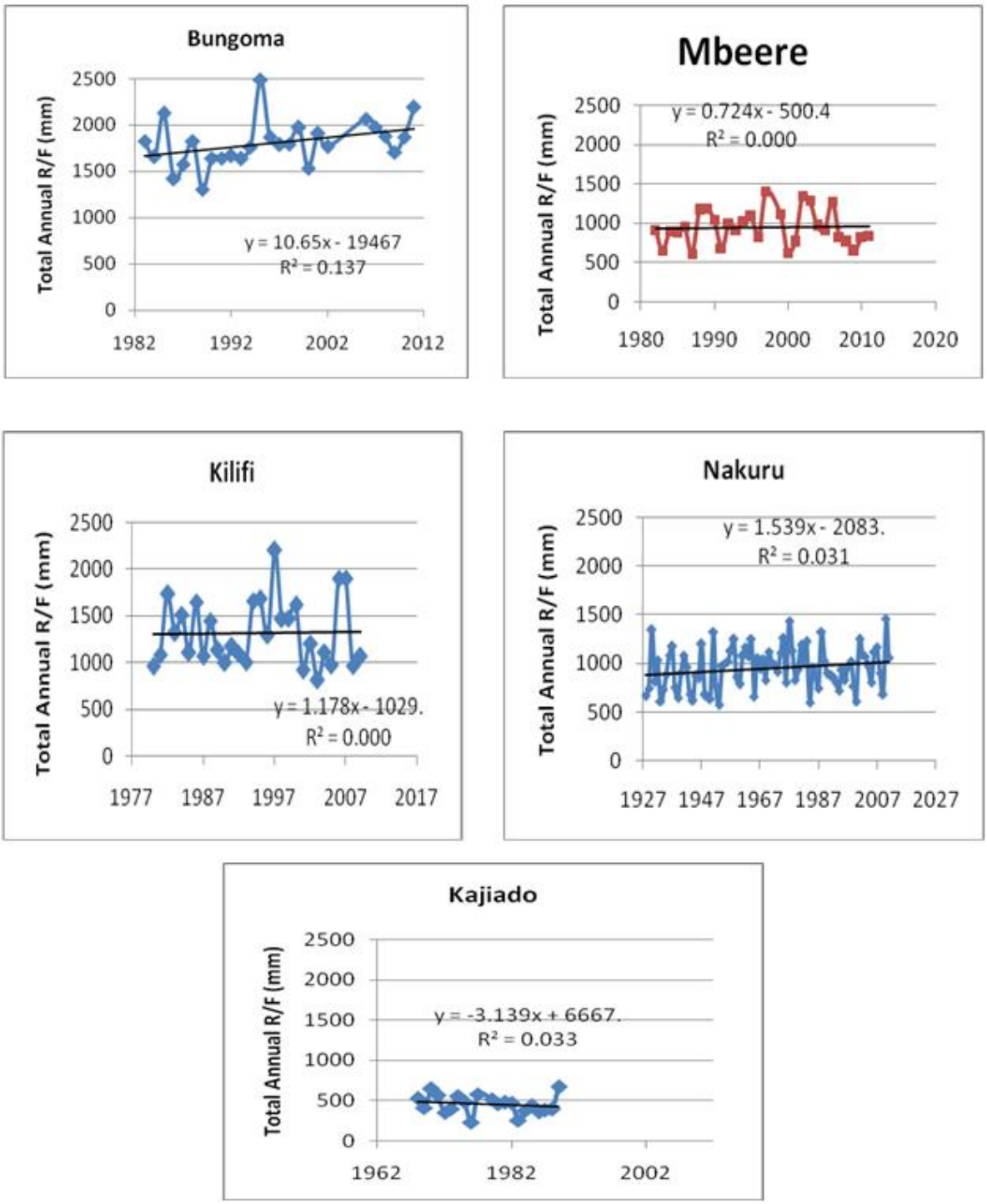

Figure 2. Total annual rainfall (mm) for Bungoma (1983-2011), Mbeere (1982-2011), Kilifi (1962-2011) Nakuru (1928-2011) and Kajiado (1962-2002)

Contrary to the smallholder farmers' perceptions, Actual trends indicate increase in rainfall amounts for Bungoma, and Nakuru, while for Kajiado and Mbeere there is slight decrease. For Kilifi, mean annual rainfall has been constant. Therefore, any adverse impact may be due to variability in mean rainfall, season shift and other climate parameters other than actual amounts. These climate parameter changes have resulted to poor or failed harvests, which in turn have caused food shortages and high prices of the available food as shown on Tables 2 (a) – (c). This is consistent with the Government of Kenya [11b] report that one of the main nutrition challenges facing Kenyans is having consistent access to food of sufficient diversity to meet nutrient needs. Bungoma , Nakuru, Kilifi, Mbeere rainfall trends reveal annual fluctuations in amount and thus the possibility of droughts, confirming the farmers perceptions

Table 2 (a): All Seasons Food Availability and Affordability of Carbohydrates (Cereals and Root Crops) in the Local Markets

	Food Affordability (x-Cheap**; xx-**Expensive**; xxx-**Very expensive**) in Study Sites' Markets**														
Foods Available in all Seasons	**Kajiado**			**Bungoma**			**Nakuru**			**Kilifi**			**Mbeere**		
Cereals															
Maize		xx		x			x				xx		x		
Sorghum	x							xx					x		
Millet								xx					x		
Wheat products			xxx		xx			xx				xxx		xx	
Rice		xx			xx			xx			xx			xx	
Root Crops															
Sweet potatoes				x				xx						xx	
Cassava		xx		x					xxx		xx		x		
Arrowroots/Cocoyam		xx			xx			xx						xx	
Irish potatoes		xx			xx		x					xxx			xx

Maize (*Zea mays*) was available in all the sites in both favorable and unfavorable seasons, and cheap in Bungoma, Nakuru and Mbeere but expensive in Kilifi and Kajiado. The wide and all seasons' availability are explained by the importance the Kenya government places on Maize as the key determinant to Kenya's food security. In case of projected shortage, the government imports or at least facilitates importation to offset any deficit. Millet (*Pennisetum typohides*) and sorghum (*Sorghum vulgare*) were available in Nakuru and Mbeere, and cheap in the latter site where the two cereals are the main staples and thrive under low rainfall conditions. Nakuru being cosmopolitan attract commodities in its market from neighboring Provinces of Rift Valley, Central, and Western, where two cereals are also grown.

Wheat products and rice were also available and perceived as either expensive or very expensive. For the former, the all season's availability is not governed by local production but imports and ease of processing. Cereals can be processed or added value to a form easy to prepare and consumed by all categories of people. For wheat, rice and maize, commercial processing, social acceptability and ease of transportation facilitate distribution and marketing.

Table 2 (a) also indicates that Irish potatoes (*Ipomea batatas*) and cassava (*Manihot esculentum*) were the most widely available root crops although the former was very expensive in Mbeere Sub-County and Kilifi County, while the latter was cheap in Bungoma and Mbeere. In these areas, production of Irish potato is not tenable due to unfavorable agro-climatic conditions. However, Irish potato was cheap in Nakuru, which is one of the main potato producers. In Kenya, potatoes are almost entirely sold in the local market and there is increasing demand for the tuber. The demand is linked to changes in consumption habits, mainly in urban centres, where chips have become a more popular part of the diet. Chips processing has become the major form of value addition for potatoes. Apart from households, restaurants, hotels and canteens are major potato consumers. Cassava was locally grown and generally affordable which may be indicative of its potential to alleviate food insecurity.

In Table 2 (b), beans (*Phaseolus vulgaris*) and cowpeas (*Vigna unguiculat*a) were available in all the sites, and perceived as cheaper in Bungoma, Nakuru and Mbeere, but expensive in Kajiado and Kilifi, hence affordable. The two legumes have a wider ecological adaptability compared to other legumes. Kilifi area had only two legumes available, which indicates a narrow variety- a threat to food security. In Nakuru, most of the legumes available (except beans) were perceived as very expensive. Green grams (*Vigna radiata*), cowpeas, ground nuts *(Arachis hypogea*) and pigeon peas (*Cajanus cajan*) are not locally produced and their availability may have been influenced by the multi-ethnic population with diverse food preferences compared to other sites where one ethnic group comprise the larger population

From Table 2 (b), Meat from cow, goat and sheep was perceived to be very expensive in all seasons, in Nakuru, Bungoma and Kilifi, . These sites practice more of crop farming than livestock. On the other hand, Kajiado is primarily a livestock keeping agro-ecological zone although meat was perceived to be expensive. The Maasai,of Kajiado being livestock herders (cattle, sheep and goats)- rely only on goat and sheep products (such as the animal's meat and milk and blood). This may have created the demand for meat products, making them expensive. Fish and poultry were the only two animal proteins, perceived to be cheap in Bungoma and Mbeere respectively. For fish it is obtained from Lake Victoria which may not be as sensitive to climate change as other larger livestock. Mbeere being a semi arid area produces a lot of goat meat, which the community prefers to poultry. Hence, low demand for poultry and consequently cheap.

Table 2(b). All Seasons Availability and Affordability of Protein Foods (Legumes, Nuts and Animal Products) in the Local Markets

	Food Affordability (x-Cheap**; xx-**Expensive**; xxx-**Very expensive) **in Study Sites' Markets**													
Proteins Available in all Seasons	**Kajiado**			**Bungoma**			**Nakuru**			**Kilifi**			**Mbeere**	
Legumes, Pulses & Nuts														
Beans		xx		x			x				xx		x	
Green Grams		xx			xx				xxx					xx
Cow Peas		xx			xx				xxx		xx		x	
Ground Nuts		xx			xx				xxx					
Pigeon peas			xx						xxx					xx
Livestock Food Products														
Milk		xx			xx			xx						xx
Meat (Beef, Mutton, Goat)		xx				xxx			xxx			xxx		xx
Fish				x					xxx		xx			xx
Eggs					xx			xx				xxx		xx
Poultry					xx			xx					x	
Ghee			xxx											

ALL SEASONS AVAILABILITY AND AFFORDABILITY OF VEGETABLES AND FRUITS IN THE LOCAL MARKETS

Kenya has many indigenous (both wild and domesticated) and exotic edible vegetables. However, Table 2 (c) below reveals that, a relatively few of those grown are available throughout the year and especially during the dry season. It may be that domestication of these is low due to agricultural systems emphasizing production of exotic varieties. Alternatively, the quantities produced may be too little to reach the local market or lack of methods to preserve them. Similar findings were reported by (Ekesa et al. (2009)[17] in a study on "*Accessibility and Consumption of Indigenous and fruits vegetables in western Kenya*"; and Fukushima et al. (2010)[18] in Kilifi. Cowpea leaves and tomatoes were the most widely available and generally affordable. For Cowpea, *(Vigna unguiculat*a), its availability and popularity can be attributed to its ability to withstand harsh conditions and its yield is always higher than that of the other indigenous vegetables. In addition, its leaves and seeds are used as food. The availability of tomatoes in all counties across seasons is accounted for by the wide adoption of greenhouse farming technology, triggered by unpredictable weather conditions, population growth and reduced acreage 19]. The crop also does well during the dry season under irrigation. Although Mbeere does not produce cabbage, there is constant supply from the neighboring Kirinyaga County, where the vegetable is produced under irrigation throughout the year.

Table 2 (c) further shows that Mango (*Mangifera indica*) was the most widely available and cheap fruit in the main producing sites of Mbeere and Kilifi. Domestication and breeding of the mango in Kenya and the resultant promotion of its production by the Ministry of agriculture has led into extension and increase in production beyond the traditional production areas and season. This coupled with improved marketing, may have contributed to all season and wide availability of the mango. Each site had at least one cheap fruit while the rest were either expensive or very expensive.

Table 2(c). All Seasons Availability and Affordability of Vegetables and Fruits in the Local Markets

	Food Affordability (x-Cheap**; xx-**Expensive**; xx-**Very expensive**) in Study Sites Markets**														
Vegetables Available in all Seasons	**Kajiado**			**Bungoma**			**Nakuru**			**Kilifi**			**Mbeere**		
Kale			xxx				x				xx				xxx
Cabbages							x					xxx			xxx
Cowpea leaves		xx		x							xx		x		
Indigenous vegetables			xxx	x					xxx		xx				
Carrots							x								
Tomatoes	x				xx		x				xx				xxx
Spinach							x				xx				
Pumpkin leaves									xxx		xx		x		
Onions	x						x				xx				xxx
Fruits															
Citrus			xxx					xx		x					x
Pawpaw		xx		x				xx							
Avocado	x				xx		x								xxx
Mango		xx			xx			xx		x			x		
Bananas		xx		x					xxx					xx	

COPING STRATEGIES FOR FOOD INSECURITY

Table 3. Food Management Coping Strategies' for Food Security

	Study Site				
Season /Strategy	**Kajiado**	**Bungoma**	**Nakuru**	**Kilifi**	**Mbeere**
Favorable Season (*Production above Normal)*					
Value addition and preservation of excess food e.g. potatoes and vegetables (Drying cereals pulses, meat); ferment milk; Ghee from milk	x	x	x	x	x
Exchange with other commodities e.g. Maize with Livestock or pottery		x	x		x
Restocking livestock herd	x				
Sell excess food for money		x	x		x
Give to relatives and friends	x				x
Eat more frequently and variety of foods	x				x
Preserve and store at home, excess food for adverse season.	x	x	x	x	x
Normal Season (*Normal production due to timely onset and cessation of rain and normal distribution for the site)*					
Eat usual number of meals and buy extra	x		x		x
Eat any available food			x		x
Cereal banks – (Keep some produce with millers and use by piece meal)		x	x		
Adverse Season (*Production below average due to rainfall below or above normal or delayed onset or both**)*					
Share available food and Livestock with neighbors & relatives (Part of the culture)	x			x	
Priority Feeding given to Children & elderly		x			x
Generosity & reciprocity	x				
Food diversification (do not stick to traditional diets)	x		x		x
Food rationing (eat fewer and less amount of meals per day)	x	x	x	x	x
Reduce variety in meals consumed	x	x	x	x	x

To cope with the increasing food insecurity arising from climate change, farmers have devised food management strategies that have enabled them to survive periodic and/or chronic food scarcity situations, as shown on Table 3:

During a favorable season, common strategies to all sites included value addition, preservation and storage of excess food, for use during an adverse season. Kajiado, the only site with pure pastoralism system, restocked the livestock herd.

In a normal season, Nakuru and Bungoma were the only sites that adopted the strategy of cereal banks where the farmers deposit a proportion of their cereal harvests with millers, and use in piece meal. These sites produce relatively high amounts of cereals and there are relatively high number of local millers who provide a market and store for cereals.

In an adverse season, food rationing (reduce portion sizes) and reduction of variety of foods in a single meal were key coping strategies. The other option was food diversification (eat any food available) while sharing of available food through generosity and reciprocity was only unique for Kajiado. This was due to the community's cultural orientation of collectivism.

4 CONCLUSION AND RECOMMENDATIONS

Smallholder farmers were aware of climate change and its indicators in Kenya. Some indicators were common while others were specific to the Agro-Ecological System. They also appreciated that climate change has resulted into decreased agricultural production leading to reduced food availability and affordability. Every site had food categories required to meet dietary needs for an active and healthy life but the general perception of food affordability was that, most of the foods were expensive. Climate change and variability therefore, affects food security in all Agro- ecological systems of Kenya, regardless of the agricultural potential, an indication that the objective of achieving food security for all Kenyans may still remain an elusive goal. In an attempt to cope with food insecurity, smallholder farmers in the different Agro-Ecological Systems basically responded with the same food management strategies with slight variations originating from culture and level of production.

The researchers recommended that:

1. The Kenya government should upgrade the knowledge and skills of Agricultural and health extension workers to include household food processing and proper methods of food storage, who in turn will train smallholder farmers on the same. This may help to curb fluctuations in food supply and the resultant food insecurity due to high food prices.
2. The Kenya government, donors and other stakeholders in Agriculture and food security should extend their financing to local community millers to enable them build appropriate storage facilities especially in the Highland Medium Potential Crop/ livestock and Lake Basin High Potential Crop/Livestock Agro-ecosystems of Nakuru and Bungoma respectively, where cereal banking is a major food management strategy. However, local insurance agencies should provide insurance schemes for community-based millers to cushion them against losses from fire, thefts and environmental hazards.

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