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Impact of Climate Change Adaptive Strategies on Food Security in Kaloleni County, Kenya

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Abstract

Indigenous coping strategies could cause potential risks on hydrology, soil degradation, Biodiversity and crop yields, which would influence food safety in Kenya. However there's little information on assessing these strategies and their impact across the four Agro-ecological Zones in Kaloleni County. The main objective of this study was to assess the climate change adaptation and mitigation strategies used by communities in Kaloleni County with an aim of identifying the most suitable strategy per given zone. The majority of the respondents (75%) had 10 to over 20 years experience in farming; this shows that quite a good number of the respondents had good farming experience and hence information on the indigenous coping strategies used over the given years. A larger percentage of the respondents were small holder farmers as it was evident from the majority (59%) who owned between 1-5 Acres of land, followed by 11% of the respondents who owned between 5-20 Acres, while only 2% owned 20-80 Acres of land. 58% of the smallholder farmers use intercropping and fertilizer application as coping strategy to crop production, followed by 21% who had used fallowing and mulching. Impact on vegetation distribution (1980-2010) of three selected forests (fungo, kambe & Jibana) were analysed using GIS and remote sensing hence coming up with Land cover maps. Monthly rainfall data over the same range in years (1980-2010) from three rainfall stations (Malindi, Mtwapa & Msabaha) were analysed



to come up with box plots and compared to vegetation change over the same period. Monthly mean rainfall totals from the three rainfall stations indicated a decline in the mean monthly precipitation from 47mm to 8mm, observed between December and February. The long rains started from March which had a monthly total mean of 43mm, rising to its peak in May with a total of 313mm of precipitation and ending in July. Short rains started from October to December. A total of 225 small holder farmers were randomly selected, distributed proportionally across the four agro- ecological zones and interviewed using a formal questionnaire. According to the study findings, 68% of the respondents were Male, while 32% of the respondents were female. Over 60% of the respondents were aged between 41 to over 61 years, implying that they had enough experience in relation to climate change and thus provided information that was largely reliable. Field exploration was also conducted in August 2011 by visiting the various farms, water points and the three forests. From the field observation, most of the water points had dried up due to draught. Reports from FGD indicated that draught had the most frequent occurrence amongst the known extreme events. Therefore as compared to the study findings, the majority (59%) of the respondents used borehole water while 25%, tap water. Forest biodiversity destruction was also evident in the field. To support this observation, statistical data output indicated that the majority of the respondents (93%) indicated that their main source of energy was wood fuel, while the rest (7%) relied on charcoal, solar and electric energy.

Background of the Study

There is a general consensus that the African continent is particularly susceptible to the onset of climate change (Boko *et al.*, 2007). FAO (2008b) identified 16 distinct ecosystems (Agro-ecological zones (AEZs) in which various farming systems exists and which could be affected differently by climate change. In 1982, FAO classified Kenya as one of the countries in 'critical list' in terms of food sufficiency and environmental conservation. Kaloleni County is no exception given that 72% of its population is food poor. The County is endowed with a rich biodiversity of the remnant coastal forests (Burgeon and Clarke, 2000). Latest estimates show that the kayas constitute about 5% of the remaining coastal sub-tropical forests cover of Kenya. The effect on its degradation is heightened by human activities over the millennia. High livestock densities outside protected areas reduce grass cover and therefore encourage growth of woody vegetation (Western, 1994).



According to IPCC, 2007, Climate change affects food production directly through changes in agro-ecological conditions and indirectly by affecting growth and distribution of incomes and thus demand for agricultural produce. Adaptive capacity is unevenly distributed across different regions and populations, with developing countries generally having less capacity to adapt (Schneider et al., 2007). According to Barry Smit (1993), coping ability is the degree to which a system can successfully grapple with a stimulus, while adaptive capacity is the potential or capability of a system to adapt to climatic stimuli. Although the County is endowed with a complex drainage network, little irrigation takes place. Due to high temperatures, evapotranspiration on crops and loss of soil moisture is evident. High temperatures cause hard pans which makes it impossible for soil water retention. Where communities are highly dependent on agriculture, drought may affect food security and their economic performance hence acting as an impediment to achieve MDG Goal 1. In Kaloleni County, small holder farmer suffer from the effect of pest infestation and hence are compelled to shift their planting dates, crop variety and farm management strategies; in the process, low yields are experienced. Priority maize farming target 5000 hectares with an anticipated harvest of 15 bags per hectare. Yields are low because of minimal fertilizer used. With the current short rains in the district the target has gone down to 2 bags per hectare.

With the application of indigenous coping strategies, required GHG's levels would be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change; thus ensuring that food productivity is not threatened. There was an opportunity for improvement of the people's livelihood and their environment in the type of indigenous coping strategies used by small holder farmers in Kaloleni County. Sensitization of the same was done through Participatory Rural Appraisal (PRA) which involves interactive research within the community.

Statement of the Problem

Coping strategies to changes in climate have the potential to undermine economic development, decreasing poverty levels and delaying or preventing the realization of the Millennium Development Goals (MDGs). Lack of effective adaptation to the adverse effects of climate change has jeopardized the achievement of MDG goal 1 (eradicating extreme poverty and hunger) especially in the Least Developing countries in Africa. Kaloleni County situated in the Lower Coastal area of Kenya bears the brunt of harsh climatic effects. Food insecurity is the main challenge among the coastal communities, evidenced by recent cases of mortality caused by consumption of poisonous cassava tubers.



There have been several attempts by Agricultural extension providers to sensitize communities through campaigns, farmer's school and education on the best way to cope, but in the long run minimal results were achieved. The Ministry of Agriculture in a bid to review the 2006-2010 strategic plans had indicated reforms within their National Agricultural Sector Extension Policy -NASEP (MOA, 2008), whose purpose was to guide and regulate the provision of extension services in the country. The purpose of this study was to assess the most suitable indigenous coping strategies to food security in terms of innovations such as food preservation and value addition. Improving the cropping systems would also enhance food security in Kaloleni County.

Objective of the Study

Broad objective of the Study

The broad objective of the study is to evaluate climate change adaptation strategies on food security amongst Agro- pastoralists' communities at the Kenyan Coast, with a view of identifying the best bets.

Specific Objectives

1. To determine indigenous coping strategies to climate change, on food availability in Kaloleni County.
2. To investigate the indigenous coping strategies to food innovation in the study area.
3. To determine stakeholder involvement on food innovations in the study area.

Research Questions

1. What are the indigenous coping strategies on food availability in Kaloleni County?
2. What are the indigenous coping strategies on food innovation in the study area?
3. What are the stakeholder involvements on food innovation in Kaloleni County?

Scope and Limitations of the Study

The Study included 12 divisions namely; Kwale, Tsagwa, Jibana, Kaloleni, Mitulani, Kizurini, Kayafungo, Mikiriani, Chalani, Mihingo and



Chanagado. The study area was found suitable for the outlined objectives since it covers all the four Agro-ecological zones in the County. The target populations were small holder Agro-pastoralists communities that are using different Climate Change adaptation Strategies to cope with the effects of climatic shocks in Kaloleni County. The study focused on the methods that small holder farmers are using to mitigate against the effects of climate change on food security. The study utilized a household questionnaire, Focus group discussions (FGDs), in-depth interviews and observations. Both quantitative and qualitative data were obtained from primary and secondary data. Household questionnaires provided information on Climate Change, Socio economics and food security. Statistical data was analysed in Statistical Package for Social Science (SPSS) software and final outputs generated in form of frequency tables, graphs and pie charts. Climate data was analysed using Instate version +3.6 software, to come up with box plots.

Literature Review

A recent paper presented at the FAO Summit 2008 (FAO 2008) estimates how price increases in key commodities are expected to impact the import bills for food. It shows that the Least Developed Countries (LDCs) have to calculate expenditures increased by 25 percent in 2007 as compared to 2006. The estimates for the Low-Income Food Deficit Countries result in an even higher increase of more than 30 percent. 'High level Task Force on the Global Food Crisis', which was established in April 2008 by a meeting of the heads of all UN-Agencies, made the point strongly in its report to the General Assembly by quoting that *"While food commodity prices now appear to be stabilizing, prices are expected to remain high over the medium or long term"* (HLTF 2008, 8). Due to increased wealth, changes in diet towards more animal products and cereals in these countries have been noted. Meat consumption alone has doubled worldwide during the last 25 years (Ehring 2008). This is traditionally an issue documented by the former director of the World Watch Institute, Lester Brown (see World watch Institute 2003). This trend has already contributed to the decline in food stocks. The expected increase in intensity and number of extreme weather events may also bring about temporary shortfalls on the supply side. This can be one important factor for the increased volatility of food prices, especially in times of reduced storage capacities. In its recent analysis, the FAO explicitly mentions „weather-related shortfalls “as one of the factors that have contributed to the recent increase in food prices (FAO 2008a). For example, in Australia, which had been the second largest grain exporter after the US, a drought in 2006 made grain yields drop from 25 million tonnes to Less than 10 million tonnes (Bryant 2008).



The FAO sees two reasons why the urban poor are most exposed to the increase in world food prices. „First, urban populations are more likely to consume staple foods derived from tradable commodities (wheat, rice), while rural populations (particularly in Africa and Latin America) tend to consume more traditional staples, such as roots and tubers. Second, urban populations are less likely to produce a significant share of their own food or produce for sale“ (FAO 2008a, 31). In other fields also in the case of food security, certain non-climatic stressors may have a very important influence on adaptive capacity, as has been identified in the case of India (Parry et al. 2007, 71). Adams *et al.* (1998), Mendelson *et al.* (1994), Rosenzweig and Hillel (1998) and U.S Global Research Programme (2001) analysed the impact of climate change on agriculture and food security and concluded that there exist marked regional differences. For instance, the threat in the developed economies and to global food security is not as dreadful as in Sub-Saharan Africa and elsewhere which depend on rain-fed agriculture. Adams *et al.* (1999),

In Kenya, agriculture sector accounted for roughly 24 percent of its GDP in 2007 and 70 percent of the country's labour force. The sector is dominated by production of a few commodities categorized as cash crops (tea, coffee, and horticulture), food crops (maize, wheat, and rice) for local consumption, and livestock. With a population of more than 38 million people (about ten percent of which is classified as food insecure) and growing at an annual rate of about three percent, Kenya is the largest import market for food and agricultural products in east Africa. Kaloleni County in the lower coastal area of Kenya also suffers from climate change effects. Dry farming is being carried out on the farms by digging fertility pits. However a great challenge still exists due to low crop yields brought about by rainfall variability, evapotranspiration and limited fertilizer use. Extreme weather events such as drought, has led to incidence of food poisoning through consumption of wild root tubers in Kaloleni County. Studies were carried out with an aim to come up with innovations to improve on food security in the study area.

Methodology

The study was a cross-sectional survey with 225 small holder farmers randomly selected and proportionally distributed across the four (4) agro-ecological zones within Kaloleni County (Table 1). Issues on Indigenous coping strategies on Climate Change in relation to food security were captured through FGD and focus group discussions. Key issues were captured through in-depth discussion and Key informants.

Indicators of Climate Change were collected through questionnaire



surveys (both open ended and closed) reflecting on Food Security, farmers perceptions of climate change, attitudes and knowledge and its effects on food security. Food availability in the market during different seasons were identified and documented. The type of food that have decreased or increased due to climate change were also identified with an aim of developing new innovations through value addition, preservation and adaptation of improved seed varieties. Institutional involvement was also captured, with the best institution being ranked using pair-wise ranking. Purposive sampling was used to choose FGD and Key informants from the four agro-ecological zones covering the study area. Socio economics background of the respondents included: gender, age, level of education, household size land use/size and tenure were captured to help in the analysis of aspects on food security in the area. Institutional involvement was also captured through FGD and outputs given through Pair wise ranking. Secondary data were collected from key respondents in government, private and international organizations institutions and included: rainfall data and variability trends, coping strategies to cropping and Livestock systems.

Table 1: Distribution of households per Agro ecological Zone

Agro-Ecological Zone	No. of Households
Zone CL3/CL4	5,700
Zone CL4	5,700
Zone CL5	5,500
Zone CL6	5,600
Total	22,500

Tools of Analysis

Data was collected and coded, entered into a Statistical package for Social Sciences, and analysed to give outputs in form of graphs, charts and tables. Instat Version +3.6 to analyse rainfall data which was collected from three meteorological stations: Malindi, Mtwapa and Msabaha. Participatory Rural Appraisal (PRA) was used in analysis institutional data. Geographical Information Systems (GIS) was also used in preparation of maps of the Study area.

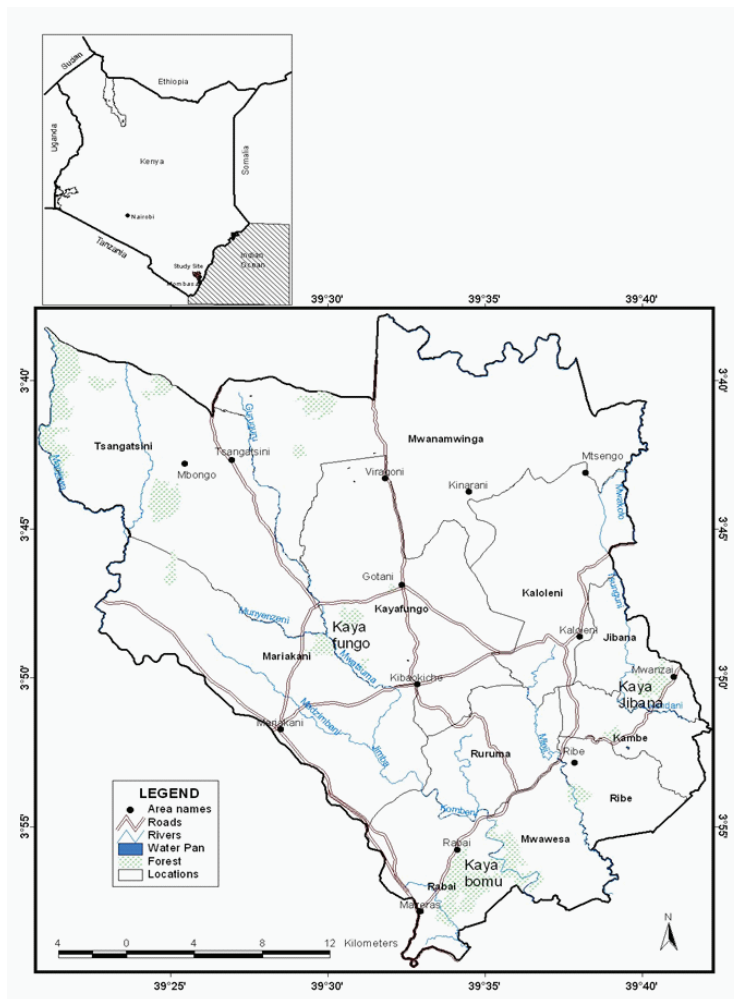


Fig 1:Map of the Study Area (Source:Geoffrey maina-Egerton University)



Results and Findings.

Background Information

Over 60% of respondents were aged between 40 to over 61 years of age with the majority of the respondents (75%) having 10 to over 20 years experience in farming; this shows that quite a good number of the respondents had good farming experience and hence information on the indigenous coping strategies used over the given years. A larger percentage of the respondents were small holder farmers as it was evident from the majority (59%) who owned between 1-5 Acres of land, followed by 11% of the respondents who owned between 5-20 Acres, while only 2% owned 20-80 Acres of land. 58% of the smallholder farmers use intercropping and fertilizer application as coping strategy to crop production, followed by 21% who had used fallowing and mulching.

Climate Variability

Descriptive statistics was used in generation of monthly rainfall totals (Figure 2). Monthly mean rainfall totals from the three rainfall stations indicated a decline in the mean monthly precipitation from 47mm to 8mm, observed between December and February. The long rains started from March which had a monthly total mean of 43mm, rising to its peak in May with a total of 313mm of precipitation and ending in July. The mean annual rainfall totals was 1281mm. From the graph on figure 2, the mean annual rainfall totals were 1281mm; a figure which exceeds data from the central Bureau of Statistics that indicated a mean annual rainfall across the four ecological zones in Kaloleni ranging from 700-1200mm. This occurrence is likely to instigate frequency of occurrence of events due to the changes in the mean (Mearns et al., 1984; Wigley, 1985). In relation to rainfall variability, (28.3%) of the respondents noted the elnino rains as the leading cause of extreme events observed in the last twenty years, followed by change in rainfall patterns (26.5%) and crop failure (26.5%).

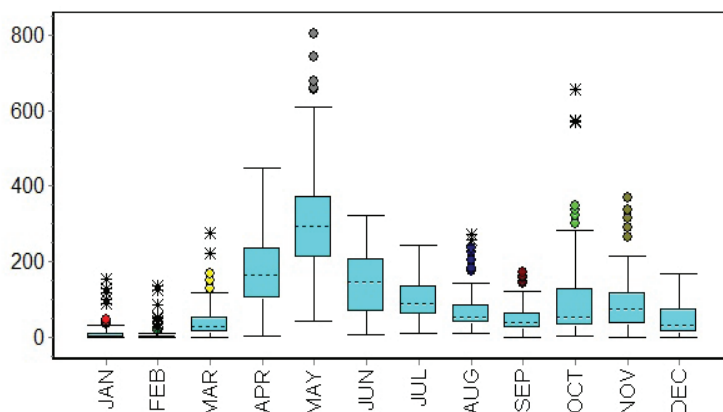


Figure 2: Mean monthly rainfall totals (mm) from Msabaha, Malindi, and Mtwapa Stations (1980-2010)

Coping Strategy to food variability

Reports from FGD indicate different types of food were in a decreasing trend, possibly due to rainfall variability (fig 2) and occurrence of extreme events such as draught, high temperatures, humidity, change in wind direction, changes in start of the rainy days and its duration. Among the coping strategies that farmers use on crop production, planting early maturing crops was rated first with 45.1%, planting improved crop variety (21.7%), Early planting (19.5%) and the rest (13.7%) implied use of waste water and early harvesting. Additional strategies observed in the field were; storied gardening (sack farming) and small livestock keeping to mitigate against the effects of climate change. To mitigate the effect of windstorms on crop production, farmers used earthing of maize stalks in order to develop large tap roots for anchor. Food availability is achieved when sufficient quantities of food are available to all individuals. Khan and Gill 2009, explain that access to food is attained when household members have enough resources to acquire food.

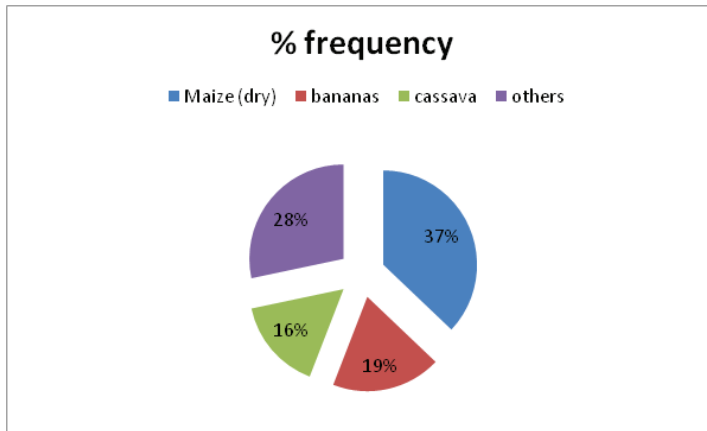


Figure 3: the type of food grown and Utilized in Kaloleni County

On the type of food available, 37.1% of the respondents utilized dry maize, 18.8% bananas, 15.8% cassava and the rest 28.3% consumed cowpea leaves, green maize, mangoes, oranges and sugarcane. (fig,3). Although dry maize was the most utilized food in Kaloleni, report from FGD revealed that while maize consumption per month in Kaloleni is 17,500 bags, yet the production stands at approximately 10,000 bags per year. A big deficit was therefore noted which reduces its availability. Factors that could have contributed to low maize production included lack of rain at critical stage of maize production (tasseling /cob formation), poor soils and high temperatures.

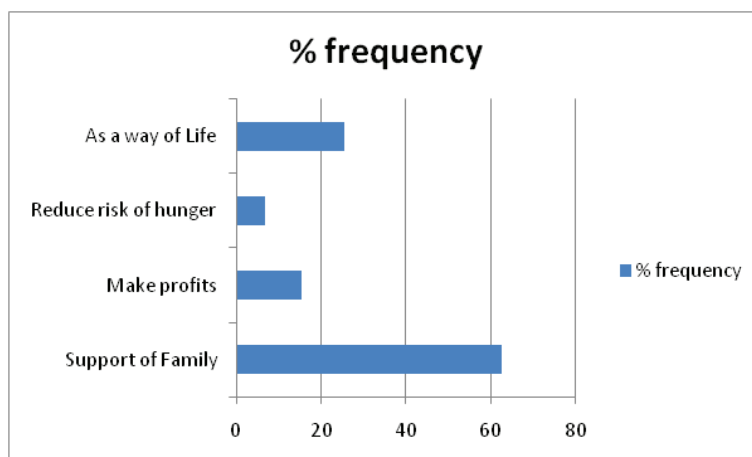


Figure 4: Reasons of respondents for growing crops.

On the attitude of the respondents in relation to crop growing, 62.5% of the respondents indicated that they grew crops to support their family; 15.4% indicated profit making, while 6.7% did it to reduce hunger and the rest 25.4% grew crops as a way of life. Although the average farm size in Kaloleni County is 7 acres per household, only one (1 acre) each is under cultivation, indicating that subsistence farming is being practiced in Kaloleni.

Table 2: Food availability in the market in different seasons

Normal Season	Adverse season	Favourable season
Green maize	Cucumbers	Traditional mangoes
Cassava	Cassava	Kales
Sweet potatoes	Appenes	Spinach
Fresh Kales	Palm nut	rice
Fresh Spinach	Mchicha	Irish potatoes
Tomatoes		Cabbages
Mkunde		



Table 2 shows food availability in the market in different seasons. The majority of the respondents, 77.4% indicated that during favourable season, traditional mangoes were cheap and hence easily accessible; 54% indicating the price of cassava as moderate during normal seasons, likewise majority (42.5%) indicated the price of sweet potatoes as moderate during normal season. From the field survey 62.4% (n=140) of the respondents indicated that food is generally expensive in the market during adverse seasons, 19.5% indicated it was less expensive, followed by 9.3% who indicated food prices as moderate or cheap. According to Kilifi District Strategic Plan (2002-2008) 65.35% are food poor and 43.02% hardcore poor meaning that they cannot meet the minimum food requirements even after spending all their income on food alone.

Coping Strategy to food innovation

In order to cope with food security during normal seasons, food was stored in cereal banks, diversified, preserved or prepared for value addition. FGD reported that vegetables are sun dried on farms and preserved. However; the level of value addition is low in Kaloleni resulting to wastage during times of peak season (MOA, 2008), evidenced by harvested mangoes, watermelons, pineapples and vegetables, that went rotting in various ecological zones. On farm technological interventions such as solar drying was applied but the major challenge was lack of exposure on farmers and extension providers. Formation of groups by the farmers was recommended in order to attract grants from NGO's for purchase of equipments. During adverse seasons, coping strategy to food security included provision of food rations in schools and reduction in variety of food consumed .FGD reported that under favourable conditions, variety of meals were taken on regular basis, and school feeding programme ran regularly (Table 2)



Table 2: New innovation adopted in food acquisition

Normal Season	Adverse Seasons	Favourable Season
Keeping grains in cereal banks	Food rations in schools	Eating well and variety meals
Food diversification	Variety in consumption reduced	Eating four times a day
Food preservation	Children, elderly and disabled were given priority.	Employment at EPZ
Value addition	Charcoal burning	School feeding programme.
	Fuel wood sales	
	Brick making/weaving baskets/mats	

Stakeholders' involvement on food Innovation.

Institutions involved in mitigating the effects of climate change were: Kenya Forest Service (KFS) whose role is to offer training on agro forestry; Athi river mining, whose role was to assist in community development issues such as building schools and hospitals. Kaya Afforestation Group (KAG) provided tree seedlings, Miko Eco CBO initiated energy saving device such as the fireless jiko; Ministry of Social Services (MSS) played the role of registration of groups within the community. Ranking of institutions indicated that KFS was leading institutions in initiating activities that mitigated climate change shocks in Kaloleni County (Table 3). According to these results, no institutions was found to directly support food insecurity in Kaloleni County. FGD reports indicated that during draughts, 'Food-for-Work' programme was initiated by a Non Governmental Organisation (NGO). Other adaptive strategies were: early marriages in exchange for dowry to purchase food; seeking of casual jobs by women to feed their family; sale of water from water kiosks and theft of immature food from farms.

**Table 3:Pair-wise Ranking of Institutions (Source: Self generated)**

	1	Kenya Forestry Service			
2	2	2	Athi River Mining		
3	1	2	3	Kaya Aforestation Group	
4	1	2	3	4	Miko Eco CBO
5	1	2	3	4	5 M.S.S
6	1	6	3	6	6

Recommendations and Conclusions

During Focus Group Discussions, use of proper tillage equipment, increased fertilizer use and preservation of vegetables through drying were recommended. Planting of orphaned crops, food diversification and value addition were cited as efficient adaptive methods to be used in curbing food shortage during extreme climatic events. To improve on yields, farmers recommended building capacity by institutions through training on how to upgrade their breeds, introduce Artificial insemination (AI) services, upgrade extension services, and educating the farmers on local chicken breeding against the exotic.

Conclusions

Since climate variability has caused economic drawback in the Agricultural sector in Kaloleni county, the Government through relevant stakeholders should step up their efforts by making a follow up by initiating new projects in the study area, aimed at improving on the adaptive strategies that small holder farmers use in coping during extreme climatic events. Establishments of farmers' school by extension providers would improve on indigenous knowledge within the cropping and livestock systems, hence improving on yields. Community involvement through Participatory Rural Approach still remains one the most efficient methods of data capture; however other approaches such as training through seminars and field days should be incorporated for knowledge retention and application by farmers.



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