Seasonal agricultural drought effects on small scale farmers crop production in Kakamega South Sub-county

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Abstract: **Kakamega South Sub-County located in Kakamega is a rich agricultural area though mainly reliant on rain fed agriculture. Small scale crop farmers in the area have over the years had frequent crop failure due seasonal drought. There is prediction of increasingly dry conditions in much of African countries with Kenya being no exception leading to seasonal drought mainly in agriculture due to climate change. There is need for small-scale farmers to adapt to this phenomenon. The main objective of this study was to assess the effects of agricultural drought on small scale farmers and their adaptation strategies in Kakamega South Sub-County. Random Utility Model and Capability theories were used in this study. Triangulation research design was used in the study as this catered for both qualitative and quantitative data. The study made use of both primary data and secondary data which included questionnaires, interview schedules, Focused Group Discussions (FGDs) and field observation to gather information on the effects of agricultural drought on agricultural produce. Secondary data on rainfall and temperature was collected from meteorological stations for a period of at least 35 years (1985-2020). Simple random sampling was used with a sample of 377 households using Krejcie and Morgan table (Krejcie & Morgan, 2004). Purposive sampling was used to sample information from agricultural offices and meteorological stations to obtain detailed information on the study problem. The results of this study established that Economic decline is positively correlated with decrease in crop production water availability. 96.1% of the respondents agreed that there are effects of agricultural drought on agricultural production while a paltry 3.9% were in disagreement. 74.2% of the respondents were affected by economic challenges, 15.5% faced social challenges, 8.7% by geographical challenges and lastly 1.6% by political challenges. The study recommends that rain-fed farming in Kakamega South sub-county needs to be complimented with drip irrigation, rain water harvesting and green house techniques to enhance sustainable crop production. There is also need to have accurate, reliable and customized weather information and weather advisories are timely developed and availed to the farmers.**

Keywords**: Climate Change, small-scale farmers, adaptation strategies, seasonal agricultural drought, agricultural production,**

I. INTRODUCTION

Agricultural drought links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages. The definitions of agricultural drought attempt to explain the susceptibility of crops to water deficiencies during different stages of crop development. It does not only affect the farming sector in agriculture but also the pastoral sector where it forces pastoralists to migrate from their land with their animals in order to look for pasture and water (Anthony M., 2007).

Climate change predictions indicate that Earth will be generally drier and warmer in the future (Solh and Maarten, 2014 and Olmstead, 2014). Change in future climate is projected to affect most climatic variables, such as temperature, precipitation, humidity, water discharge and availability (Arnell et al., 2011). This is due to economic and population growth, land use and pollution (Koutroulis et al., 2013). Uncertainty of water availability and quality due to climate change and pollution threatens both environmental and social aspects, including tourism, agricultural production and biodiversity (Olmstead, 2014).

Therefore, the context of climate change in relation to agricultural production for attainment of sustainable development will reduce water availability and accessibility and consequently lead to food insecurity due to low agricultural production. This necessitates the education of adaptation strategies to small scale crop farmers and government in order to be prepared before the situation become out of hand. Drought problem globally can be better understood by discussing drought situation in some countries in the world.

II. RESEARCH METHODOLOGY

2.1 Research design

This study used mixed methods research design. Mixed methods research design was used as it integrated both methods (quantitative and qualitative) and thus gave more complete understanding of the investigated problem. It ensures no important information is excluded (Denscombe, 2007; Creswell, 2009). In this method, data gathering is in sequence, depending on the research approach used (Creswell et al., 2003). An advantage of the mixed methods design is that they provide an opportunity for detailed quantitative analysis.

2.2 Study area

The study was conducted in Kakamega South sub-county as shown by Figure 1.0 below which is situated in Kakamega County in Kenya.

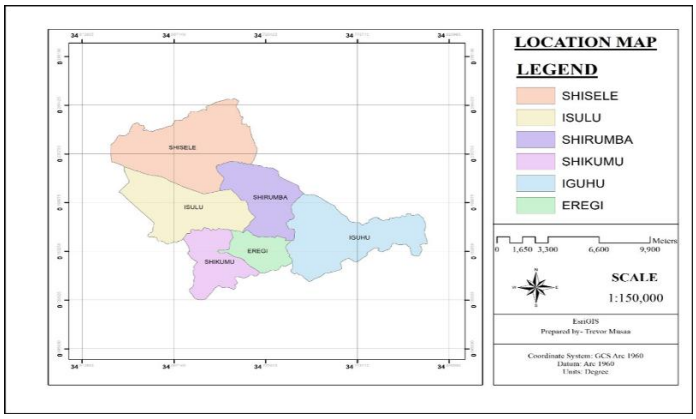

Figure 1.0: Map of Kakamega South/Ikolomani Sub-county (Source:ESriGIS 2020)

2.3 Target and sample size population

The study targeted population of 26,940 households from the four sub county wards; Idakho East, Idakho South, Idakho Central and Idakho North. The study area was selected for study on adaptation to effects of seasonal agricultural drought as the researcher saw the need of providing solution to the problem among small scale farmers in Kakamega South sub-county. The target population for this study was 26,940 households from the four wards (KNBS, 2019). Additionally, 4 agricultural officers, 12 maize sellers and 3 meteorologists was added to the target population so as to provide additional information on seasonal agricultural drought. A sample of size 10 to 30 percent was used since the sample size of 377 households is a small group of accessible population (Mugenda & Mugenda 2003).

2.4 Data sources and collection methods

Data collected was both primary and secondary data. Primary data that was collected included agricultural drought adaptation strategies, crops grown, family sizes, education levels, gender, land tenure, farming experiences and farmers views on agricultural drought issues.

Secondary data was collect from publications of the Kakamega Meteorological center on rainfall and temperature for the past 35 years. The data that already exist helped in providing information needed for the study (Mertler, 2019). For instance, this ensured that the climatic data on rainfall and temperature trends over the 35 years was genuine and thus enhancing reliability and validity of the meteorological data.

III. RESULTS AND DISCUSSIONS

A majority of data obtained 96.1% indicated that the effects of seasonal agricultural drought on small scale farmers while a paltry 3.9% of the respondents were in disagreement. An increase in agricultural drought reduces the agricultural produce of the small scale farmers. When there is agricultural drought as an a result climate change it leads to an increase in atmospheric changes such as reduced rainfall, increased temperature, prolonged drought which leads to reduced soil moisture content among others.This study is in agreement with that of Anthony M. (2007). Agricultural drought links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages. It involves the susceptibility of crops to water deficiencies during different stages of crop development. It does not only affect the farming sector in agriculture but also the pastoral sector where it forces pastoralists to migrate from their land with their animals in order to look for pasture and water.

3.1 Socio- Economic Effects of Agricultural Drought

Agricultural drought in kakamega South Sub-County has impacted on socio-economic well being of the small scale farmers through a depletion of economic resources with 72.0% of the respondents being in agreement. This was attributed to the fact that Agricultural drought resulted in low crop yields, consequently low crop yields will consequently lead to food shortage and food insecurity in the area. This is attributed to Climate change causing seasonal agricultural drought since it results in reduced water level in the farms, rivers and the water table generally. Due to the high temperatures in the dry season, it makes the rate at which soil loses water to the atmosphere high by evaporation unlike the rate at which the water is being replenished by the rainfalll. This study is in agreement with that Dariush et al., (2010) who stated that drought was a problem that consistently affected farming in Iran. Thus, farmers' resources were depleted where water replenishment was problematic, causing human suffering and decreased crop production.

3.1.1 Agricultural drought leads to low GDP/income

Agricultural drought resulted to low income,thus seasonal agricultural drought leads to low GDP or income. Most of the respondents were in agreement that Seasonal agricultural Drought is likely to affect the income and hence lower the GDP. Seasonal agricultural drought results in reduced crop production which ultimately makes the farmers to have a deficit in their crop produce.

3.1.2 Increase in food prices

The study established that agricultural drought led to increase in food prices, this is due to the reduction in crop yields leading to the ration of food in supply . This will make the prices of food to fluctuate due to high demand and low supply of food crops. Similar findings were noted during droughts in Vietnam in which food prices increase and people downgrade the quality of their food (UN/ISDR, 2011).

3.1.3 Unemployment

Unemployement among the small scale farmers due to agricultural drought is evident in the area under

study.Agricultural drought resulted to unemployment in which 62.9% of the respondents were in agreement bacause most small scale farmers are self employed , and at times can offer employment on small scale to other people in the locality such as weeding, harvesting during the farming calendar.

Thus, a decrease in crop production as a result of seasonal agricultural drought makes them to be unemployed as they can't gain any earning from their agricultural produce.This concurs with the fact that despite economic growth, many people live on <$1.25 per day thus, many household incomes are below the poverty line (World Bank, 2012).

3.1.4 Agricultural drought and natural disasters

The study established out that seasonal agricultural drought resulted in natural occurrence or natural disasters such as famine. 62.9% of the respondents indicated that most natural disaters such as famine is a consequence of seasonal agricultural drought on crop production. When there is reduction in crop production in relation to the increase human population it causes famine.

3.1.5 Agricultural drought and vegetation cover

The study established that agricultural drought led to decrease in vegetation cover with a majority 83.2% of the resondents being in agreement while a smaller percentage of 11.1 % having a contrary opinion . This is due to the fact that agricultural drought causes crop wilting due to high rate of evaporation which in the end may make the vegetative crop cover like cover crops, trees,grass and other vegetation to wilt if it loses excess water. Repeated evaporation can cause crop wilting making the vegetation to be water stressed ad finaly the roots become dry as the soil moisture content reduces.

3.1.6 Summary of the means and standard deviation of agricutural drought effects

According to the findings from this study it was indicated that agricultural drought results to depletion of economic resources resulting to decrease in crop production and conversely leading to low GDP. Unemployment has also been a major effect of agricultural drought in the study area. Agricultural drought resulted to decrease in vegetation cover and also has resulted to natural disasters such as famine.

Table 1: Table showing the effects of Agricultural Drought in terms of severity

Socio-economic statement
Agricultural drought results to depletion of economic resources
Agricultural drought results to decrease in crop production
Agricultural drought results to low GDP/income
Agricultural drought results to increase in food prices
Agricultural drought results to unemployment
Agricultural drought results to natural disasters such as famine
Agricultural drought results to decrease in vegetation cover
Agricultural drought results to reduced water availability

These findings shows that changes in future climate is projected to affect most climatic variables, such as temperature, precipitation, humidity, water discharge and availability (Arnell et al., 2011). This is due to economic and population growth, land use and pollution (Koutroulis et al., 2013). Uncertainty of water availability and quality due to climate change and pollution threatens both environmental and social aspects, including tourism, agricultural production and biodiversity (Olmstead, 2014). For instance in 2011, severe drought struck Somalia, causing a large humanitarian crisis, which affected over 10 million people; 2 million among them were malnourished children, leaving 380,000 refugees in Kenya (Vicente-Serrano et al., 2012). In Africa, one-third of the continent is described as desertified and approximately 73% of agricultural lands are degraded (UNEP, 1992). If there are two to three seasons of drought across those regions, it will cause severe environmental stress (Lean, 1995).

3.1.7 Effects of seasonal agricultural drought on small scale farmers' agricultural production

The study assessed the correlation effects of seasonal agricultural drought on small scale farmers' agricultural production in Kakamega South Sub- County. From the study, there is positive correlation of the effects of seasonal agricultural drought on small scale famers' agricultural production. Thus, since p values < 0.05 the Ho was rejected that there are no effects of seasonal agricultural drought on small scale farmers' agricultural production in Kakamega South Sub- County.

The findings indicate that low GDP/income is positively correlated with decrease in crop production ($r = 0.539$, $p < 0.05$) whereas increase in food prices is positively correlated with decrease in crop production ($r = 0.371$, $p < 0.05$) and low GDP/income ($r = 0.467$, $p < 0.05$).Unemployment is positively correlated with decrease in crop production ($r = 0.161$, $p < 0.05$), low GDP/income ($r = 0.298$, $p < 0.05$) and increase in food prices ($r = 0.272$, $p < 0.05$).

Natural disasters are positively correlated with decrease in crop production ($r = 0.193$, $p < 0.05$) ,low GDP/income ($r = 0.334$, $p < 0.05$) ,increase in food prices ($r = 0.195$, $p < 0.05$) and unemployment ($r = 0.291$, $p < 0.05$).Decrease in vegetation cover is positively correlated with decrease in crop production ($r = 0.335$, $p < 0.05$) ,low GDP/income ($r = 0.244$, $p < 0.05$),increase in food prices ($r = 0.238$, $p < 0.05$), unemployment ($r = 0.274$, $p < 0.05$) and natural disaster ($r = 0.355$, $p < 0.05$).

Reduced water availability is positively correlated with decrease in crop production ($r = 0.207$, $p < 0.05$), low GDP/income ($r = 0.285$, $p < 0.05$), increase in food prices ($r = 0.092$, $p < 0.05$), unemployment ($r = 0.127$, $p < 0.05$), natural disaster ($r = 0.251$, $p < 0.05$) and decrease in vegetation cover ($r = 0.527$, $p < 0.05$).

Economic decline is positively correlated with decrease in crop production ($r = 0.245$, $p < 0.05$) ,low GDP/income ($r = 0.312$, $p < 0.05$) increase in food prices ($r = 0.342$, $p < 0.05$), unemployment ($r = 0.346$, $p < 0.05$) , natural disaster (r =

0.324, $p < 0.05$) ,decrease in vegetation cover ($r = 0.619$, $p < 0.05$) and reduced water availability ($r = 0.499$, $p < 0.05$).

IV. SUMMARY AND CONCLUSIONS

It is evident that an increase in agricultural drought reduces the agricultural produce of the small-scale farmers. When there is agricultural drought as we have seen in the evidence of climate change and agricultural drought, there is likely to be an increase in atmospheric changes such as reduced rainfall, increased temperature, and prolonged drought reduced soil moisture content among others. Thus, farmers' resources were depleted where water replenishment was problematic, causing human suffering and decreased crop production.

Increase in food prices is positively correlated with decrease in crop production ($r = 0.371$, $p < 0.05$). Low crop production in relation to the prices of available food will increase as a result of low supply of food crop and high demand by the human beings. Increase in food prices is positively correlated with low GDP/income ($r = 0.467$, $p < 0.05$).

Small scale farmers have low income as a result of agricultural drought they will not manage to buy the food crops with high prices. Unemployment is positively correlated with decrease in crop production ($r = 0.161$, $p < 0.05$). Agricultural drought leads to low crop production which in return makes the small-scale farmers to be unemployed because the agricultural business is normally affected by agricultural drought. Unemployment is positively correlated with low GDP/income ($r = 0.298$, $p < 0.05$).

Small scale farmers are able to gather information on effects of seasonal agricultural drought which indicated that farmers are aware that Kakamega South sub-County is getting hotter and the rains decrease, less predictable and shorter in duration. These have resulted in crop failure, increased poverty, livestock health problems and seasonal droughts. This shows that small scale farmers have good level of understanding of the majority on climate change occurrence and such understanding is the main reason for small scale farmers to initiate adaptation strategies.

Rain-fed farming in Kakamega South sub-county needs to be complimented with drip irrigation, rainwater harvesting (this includes roof water and floods collection) and green house techniques to enhance sustainable crop production. Water catchments areas that act as source of most rivers in Kakamega South sub-county should be rehabilitated with indigenous trees such as bamboo. This is because scientists predicted an increased in impact of climate variability on ecosystems in sub-Saharan Africa which is expected to have serious socio-economic and environmental effects on farmers whose livelihoods depend on rain-fed farming.

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