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Contributions of Climatic Smart Agricultural Practises on Adaptation to Climate Change among Small holder farmers in Nyaribari Chache Sub-County, Kisii County

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ABSTRACT: Smallholder farmers are usually susceptible to the effects of climatic variations. Most of these farmers, their agricultural activities are greatly rainfall dependent and compounded by their acute poverty, poor infrastructural and technological advancement. This study sought to assess the contribution of Climate Smart Agricultural strategies on adaptation to climate change among small holder farmers in Nyaribari Chache Sub-County, Kisii County. A household survey was conducted for collection of primary data. Ten administrative sub-locations were randomly sampled for the study. Twenty households were randomly sampled from each sub-location to make a sample size of 200 households. Questionnaires, interviews and focused group discussions were administered to collect data on contributions of Climate Smart Agricultural strategies to adapt to climate change among small holder farmers in Nyaribari Chache Sub-County, Kisii County. Both descriptive and inferential analysis were used to analyze data collected. Study findings indicated that crop diversification, use of different crop cultivars, crop rotation and mixed cropping were the primary adaptation approaches employed in the study area. CSAP Adopted by Smallholder Farmers was statistically significant ($p<0.005$). Determinants of smallholder farmers' choice of CSAP on adaptation to climatic variations had a significant impact on embracing of CSAP ($p<0.005$). Access to credit facilities, inadequate extension facilities, low education levels, scanty weather and climate statistics were main hurdles impacting on implementation of CSAP. Therefore, in order to check the susceptibility of smallholder farmers to effects of weather or climate erraticism and variations, stakeholders should heighten exposure of farmers to extension services and prompt distribution of climate variations data for informed decision making.

KEYWORDS: Mixed cropping, Crop rotation, Extension, Credit, Kisii

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1.0 INTRODUCTION

Sub-Saharan African countries such as Kenya are susceptible to harsh effects of climate change which adversely affect their economies and thus livelihood of their populations. Smallholder farming is highly at risk to the effects of climate change since it greatly relies on rainfall for agricultural activities. These small scale farmers, most of them are under high levels of paucity, and subjected to poor transport and technological knowhow (Adimassu and Kessler, 2016). African agricultural practices including Kenya exhibit varied soil moisture content and great weather and climatic variations which in turn impends a nation's food security, economic progress and population's livelihood (GoK, 2017). The agricultural sector contributes approximately 30% directly and 35% indirectly through agro- industries to the Kenya's GDP. Additionally, agriculture contributes 66% of aggregate exports and also generates approximately 60% of the population's employment (UNEP, 2015). Adaptation to climate variations serves as a remedy towards harsh effects of climatic changes based on the global standard in the United Nations Framework Convention on Climate Change (UNFCC) (IPCC, 2018).

It is usually of great significance when acclimatizing to climatic variations since it reduces the adverse impacts of climate erraticism and thus alter the population's living standards and improve on the capability of utilizing opportunities (IPCC, 2019). This constitutes to adjusting the socio-economic actions, in order to reduce the vulnerability of households, communities, nations and various sectors to the changes in climate (IPCC, 2018). Small holder farming ought to adjust so as to exhibit flexibility towards

various patterns of ecological change in their respective localities. To survive with the fluctuating climatic conditions, farmers have to adopt new farming technologies and practices such as embracing of Climatic-Smart Agricultural Practices (CSAP) (Füssel, 2007). CSAP entails farming activities which concurrently cause rise in agricultural production and thus, improves the adaptive potential of farming and lowers greenhouse gases but contribute to the attainment of national millennium development goals (FAO, 2013).
Introduction of improved crop cultivars, divergence and subsistence diversification are the most common adaptation mechanisms utilized by smallholder farmers in Sub-Saharan Africa (Gbetibouo, 2009). In Kenya, the smallholder farmers employ agricultural practises such as planting of various propagules, change of crop cultivation schedules by either early planting or later in the season, crop diversification, substitution to livestock farming with crop production, venture in non-farming practises, reduction in population of livestock reared, adoption of various controlling practises of livestock rearing, intensive irrigation, application of manures, fertilizers and pesticides, improved water and soil conservation measures and mulching as CSAP (Mutunga *et al.*, 2017).
However, in order to embrace CASP, the decision of small-scale farmers towards their adoption is subjective to economic potentiality and various contextual aspects including population and institutional features (Gbetibouo, 2009). The household contributing factors for embracing of new agricultural ideas and practices includes gender, age, family size, level of education, income and farmers' experiences (Mutunga *et al*., 2018). In case of old age, vast agricultural experience, high level of education and big sized families was observed to highly affect adoption of the different measures to improve on the flexibility against climatic variations (Kimani and Bhardwaj 2015). Nyaribari Chache Sub-county is greatly inhabited and predisposed to climatic erraticism and variations (KCG, 2013). This compounded with land dilapidation renders the smallholder farming methods susceptible. This study assessed the factors affecting smallholder farmers' choice of CSAP. This generates a basis for intervention methods from different stakeholders to improve on the adaptation of CSAP.

2.0 MATERIALS AND METHODS

2.1 Description of the Study Area

Nyaribari Chache Sub County is among the 9 Sub Counties of Kisii County. Nyaribari Chache sub county comprises of 6 administrative locations constituting of 17 sub-locations and covers an area of 317.4Km^2 (Source: Kisii County development Plan, 2021). The region has temperature ranges of 10ºC to 30ºC. Nyaribari Chache Sub County (initially the Kisii Central district) had a population of 608,000. Nevertheless, having a population growth rate of 3.8% the population has ballooned over 750,000 (with 18.5% living in urban settlement (KNBS, 2019). This sub county is among the greatly populated Sub Counties in Kenya. As a result of its dense population, a substantial portion of the land is utilized for farming. However, land has been apportioned between households; farmland size is small with an average being 14,000 m² (MoA, 2017). Consequently, approximately, a quarter of an acre has been allocated for agricultural practises. Most farmers engage in subsistence agricultural activities with insignificant portion market disposal. The land for cash crop production is about 3,900ha while for food crop farming is roughly 12,600ha (MoA, 2016). Livestock rearing is dominated by dairy and local poultry farming. Agriculture provides employment for an estimated 85% of the residents either directly or indirectly and the projected rural poverty is 32% with certain areas having 60% (Kisii county development plan (MoA, 2016).

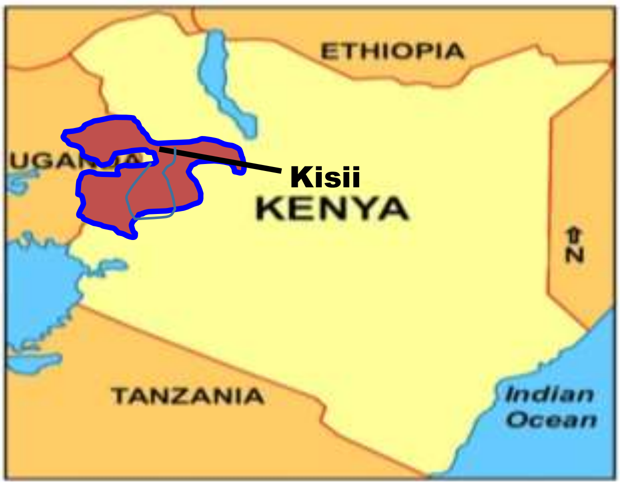

Figure 1: Kisii County, Kenya, where the study was conducted.
Source: Kisii County profile plan (22/01/2021)

Figure 2: Kisii Sub-County Locations; Kisii County where the study was conducted.

2.2 Sample Size and Sampling Procedures

All the seventeen administrative sub-locations in Nyaribari Chache Sub County were marked distinctly on similar, small sized pieces of paper, folded and then put in a bucket. Random picking of only ten pieces of paper, one after the other to represent the six locations was done. From each of the ten randomly selected sub-locations, 20 households were then selected equidistantly along transect laid along the sub-location to give a total sample size of two hundred (200) households which were used for this study.

2.3 Data Collection

A survey with questionnaire administration on the 200 households was conducted in order to collect data on CSAP employed by farmers and also carry out interviews and focused group discussions so as farmers can identify various CSAP they had adopted to enhance their resilience. The adoption of these practices were specially carried out to boost agricultural production and also enhance resilience to climatic unpredictability and variation.

2.4 Data Analysis

Data on CSAP was analysed using descriptive statistics. Mean differences and correlation was computed using paired-sample t-test.

3.0 RESULTS

3.1 CSAP Adopted by Smallholder Farmers

This study looked into six CSAP Adopted by Smallholder Farmers; Crop diversification, Change of planting schedule, Mixed cropping/ crop rotation, Change of crop cultivars, Use of organic manures, Soil and water conservation measures as shown in Table 1.

Table 1: CSAP Adopted by Smallholder Farmers

CASP	Respondents/Farmers			
	Adapters		Non-adapters	
	Number	Percentage (%)	Number	Percentage (%)
Crop diversification	50	25	26	13
Change of planting schedule	41	20.5	28	14
Mixed cropping/ crop rotation	36	18	33	16.5
Change of crop cultivars	28	14	34	17
Use of organic manures	25	12.5	38	19
Soil and water conservation measures	20	10	41	20.5
TOTAL	**200**	**100**	**200**	**100**

Figure 3 shows the percentage of CSAP as obtained from the sampled households. Among the adapters, crop diversification had the highest percentage of 25% followed by change of planting schedule at 20.5% while soil and water conservation measures had the least percentage 10%. For the non-adopters, soil and water conservation had the highest percentage of 20.5% followed by use of organic manures while crop diversification recorded the lowest percentage of 13% as illustrated in in Figure 3. CSAP Adopted by Smallholder Farmers was statistically significant ($p<0.005$); Appendix A (ii).

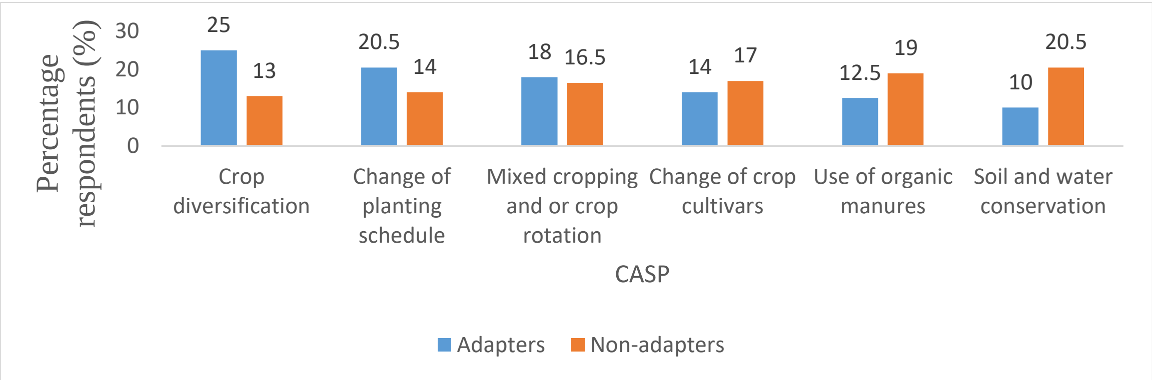

Figure 3: CSAP Adopted by Smallholder Farmers

3.2 Determinants of Smallholder Farmers' Choice of CSAP on Adaptation to Climatic variations

Access to credit facilities recorded the highest percentage of 15% followed by access to extension facilities at 14% while farm revenue had 13.5%. Household size and farm size, each had 12.5%, education level had 11.5% access to weather or climate updates had 11% while farmer attitude had the least percentage of 10% as illustrated in Table 2. Determinants of smallholder farmers' choice of CSAP on adaptation to climatic variations had a significant impact on embracing of CSAP ($p<0.005$); Appendix B (ii).

Table 2: Determinants of Smallholder Farmers' Choice of CSAP on Adaptation to Climatic variations

CASP	Frequency	Percentage (%)
Household size	25	12.5
Education level	23	11.5
Farm revenue	27	13.5
Access to credit facilities	30	15
Access to weather/climate updates	22	11
Access to extension facilities	28	14
Farmer attitude on weather/ climate variation	20	10
Farm size	25	12.5
TOTAL	**200**	**100**

Figure 4 shows the percentage determinants of Smallholder Farmers' Choice of CSAP on Adaptation to Climatic variations. Access to credit facilities had the highest percentage of 15% followed by access of extension facilities at 14% while farmer attitude on weather or climatic variations had least percentage at 10%.

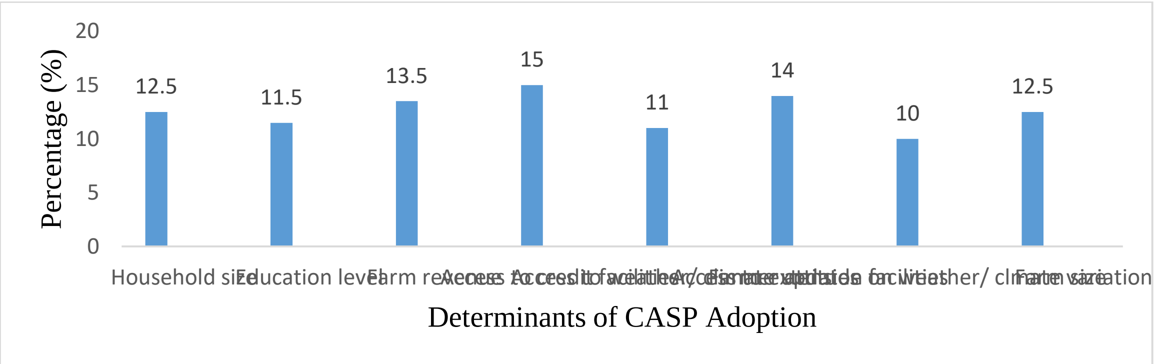

Figure 4: Determinants of Smallholder Farmers' Choice of CSAP on Adaptation to Climatic variations

4.0 DISCUSSIONS

4.1 CSAP Adopted by Smallholder Farmers

It was observed that majority of the farmers were found embrace diversification of crops they grew. Farmers cultivated drought resistant crops such as sorghum and millet. Crop diversification by smallholder farmers is considered as the most ecologically viable, less expensive and rational way of lowering eventualities in the agriculture sector between small scale farmers (Makate, 2016). These results were in tandem with those obtained by Kichamu *et al.*, (2018) in Matungulu Sub-County, Eastern Kenya and Wamalwa *et al.*, (2016) in Kitutu Chache North and Kitutu Chache South Sub-counties, Kisii county, Kenya, who observed that crop diversification as a primary adopted practise to survive with the variations in climatic conditions.

A large population used manure by 19.5% of the respondents can be due the price of fertilizers being comparatively unaffordable. This study found out that 14.0% of farmers altered the time of their farming schedule in order to capture the changing seasons of cultivating crops in reference to variations in temperature and rainfall patterns. Variations in the rainfall amounts and its reliability led to the alteration of the crop production schedule. Majority of the farmers were observed to cultivate crops after the onset of rainfall since they were now certain that there was enough soil moisture content sufficient for crop growth.

From the Key informant interviews and focused group discussions, it was revealed that most farmers cultivated crops between December to February which was the first planting season before the start of long rainfall spell. However, with the delayed onset of rains, they changed crop cultivation to between the months of March to May. Additionally, for the short rainfall spells, July-August, they changed it to September characterized with onset of a short rainfall spell. These results were in line with those obtained by Kahsay *et al.*, (2019) who observed that 83.60 % and 86% farmers in Hawzen and Irob respectively in Northern Ethiopia adopted shift of a crop planting schedule as an adaptation measure to counter various impacts of climate variation.

The study noted that 16.5% of the respondents embraced either crop rotation and/or mixed cropping so as to enhance crop production. Concerning mixed cropping, the farmers exhibited a capability to inhibit comprehensive crop letdown since the crops are impacted by climatic conditions in varied ways. Data from focused group discussions, farmers indicated that mixed cropping provides them an opportunity to cultivate a number of crops at a time which cushions them in case one crop fails.

This practise is appropriate for adaptation since it can be applied on different land sizes especially small pieces of land which are common in the study area (KCG, 2013). The food crops that were found to be cultivated under mixed cropping system included maize and beans while crop rotation was commonly carried out with either maize, beans and millet. Mixed cropping is beneficial since it results into high amount of crop produce from the same land. Additionally, the practise does not lead into additional soil degradation since the crops have different nutrient requirements and can be mutually significant to one another (Katharine *et al.*, 2013).

Farmers who embraced soil and water conservation measures aimed at retaining water for a longer time to support growth of crops and control soil erosion. Any amount of water collected can be utilized for irrigation during dry seasons in order to improve on crop produce or for planting off-season, to generate household revenue. This measure was embraced by comparatively a low number of farmers since it demands more capital costs and skills which inhibit extensive adoption by smallholder farmers (Fox *et al*., 2005).

4.2 Determinants of Smallholder Farmers' Preference on CSAP on Adaptation to Climatic variations

Large households may afford sufficient labour force to aid the adoption of CSAP. Study findings found out that household size influenced the adoption of CSAP. Large household size offers chance of embracing these CASP as it is linked with labor-intensive farming activities (Marenya and Barrett, 2007). These results are in line with those obtained by Ochieng *et al*., (2017) and Akumbole *et al.*, (2018) who observed that large household size affected adoption of planting of trees and improved maize technology.

High level of education influenced adoption of CSAP and thus enhanced flexibility against climate inconsistency and variation Mutunga *et al*., (2018). This is because educated farmers are likely going to embrace new technologies based on their awareness of the potential benefits from the proposed climate change adaptation measures (Nhemachena and Hassan, 2007). A higher level of education of a farmer is likely to be associated with knowledge and information on climate variability and change, improved technologies, and higher productivity, therefore appropriate adaptation strategy might be selected.

Poorly educated farmers are may have high probabilities of crop diversification in order to increase productivity since they regard cultivation of various crops as a means of diversifying uncertainties. In order to embrace other practices, there is need to educate more farmers through field days, agricultural training centers and seminars. These results are in tandem with those obtained by Addisu *et al*., 2016) and Mutunga *et al*., (2018) who observed that level of farmers' education affected the adoption of most agricultural practises. Farm revenue also had an influence on the adoption of CSAP since households with a high revenue can be linked with the ability of adopting modern farming practices (Maguza-Tembo *et al*., 2017). Soil and water conservation measures and appropriate utilization of organic manure demand capital investments. Farmers with more revenue will always be in a position of adopting most of CSAP compared with poor farmers. These study results are in tandem with findings obtained by Belay *et al*., (2017) and Debalke *et al.*, 2013) who observed that farm revenue influenced adoption of CSAP.

Access to credit facilities enable farmers acquire essentials such as farm inputs and skills significant in adaptation to ecological variations besides diversification of their revenue generating enterprises from farming. Access to finances assist the farmers in adoption of up-to-date farm management skills in response to climatic variations. The farmers are also enabled in the acquisition of important agro-inputs necessary in crop production such as fertilizers and certified seeds for planting. These results are in agreement with those obtained by Ochieng *et al*., (2017) and Mutunga *et al*., (2018) who noted that farmers' access to credit facilities enhances their adoption of CSAP such as soil and water conservation measures for improved crop production.

Farmers with access to extension services will try to adopt new farming practices in a way to adjust to variation in weather and climatic conditions. These findings were in agreement with those obtained by Syngenta, (2014) who observed that availability of extension services such as sharing of important agricultural information such as better-quality farm inputs, farming skills to farmers influence adoption of CSAP. Similarly, access to weather or climate conditions updates is a vital aspect which impacts on the adaptation choices. These results are in line with those obtained by Shilenje and Ogwang (2015) who observed that weather forecast information can enable them plan on whether to plant short maturity crops or long maturity crops.

Acquisition of information about weather and climate on additional to the available information about climate change to farmers, increases the rate of adaptation. Farmers' attitude on climate variations as a result of the diminishing tendency and unreliable rainfall, extreme temperature conditions can influence farmers' perception on adoption of CSAP. These study results are supported by those obtained by Ochieng *et al.* (2017) who observed that farmers who indicated that reduction in rainfall and extreme temperature conditions affected their agricultural activities had high chances of embracing soil and water management measures.

CONCLUSION

- There was a significant average disparity between adapters and non-adapters on CSAP and therefore, smallholder farmers in Nyaribari Chache Sub County have not embraced fully CSAP.

- CSAP such as crop diversification, change of planting schedule, mixed cropping/ crop rotation, change of crop cultivars, use of organic manures, soil and water conservation measures once adopted by farmers, have a potential of increasing agricultural produce. However, the adoption level for these CSAP was comparatively low among farmers in the study area, which implies that the farmers are less aware of the importance of embracing these practises.
- Determinant of adoption of CSAP such as household size, education level, farm revenue, access to credit facilities, access to weather/climate updates, access to extension facilities, farmer attitude on weather/ climate variation and farm size were found as primary hindrances to the adoption of CSAP.

This study will serve a basis for the county management staff in the ministry of agriculture to formulate strategies geared assisting smallholder farmers in the region embrace and adjust to seasonal weather and climate variations.

RECOMMENDATIONS

- The government and other relevant stakeholders should intensify agricultural educational awareness and emphasize on need to seek extension services by smallholder farmers in the study area.
- Agricultural sector to establish linkages with different stakeholders in order enhance CSAP awareness through various communication channels and the importance of CSAP adoption.

REFERENCES

1. Addisu, S., Fissha, G., Gediff, B. and Asmelash, Y. (2016). Perception and adaptation models of climate change by the rural people of lake Tana Sub-Basin, Ethiopia. *Environ Syst Res*.
2. Adimassu, Z and Kessler, A. (2016) Factors affecting farmers' coping and adaptation strategies to perceived trends of declining rainfall and crop productivity in the central Rift valley of Ethiopia. *Environ Syst Res. 5*:1–13.
3. Akumbole, J. A., Zakaria, H. and Adam, H. (2018). Determinants of adoption of improved maize technology among smallholder maize farmers in the Bawku West District of the Upper East Region of Ghana. *Agric Ext J; 2*(3):165–75.
4. Belay, A., Recha, J.W., Woldeamanuel, T. and Morton, J. F. (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. *Agric Food Secur. 7*; 6(1)-21.
5. Debalke, N. M. (2013). Determinants of farmers' preference for adaptation strategies to climate change: Evidence from north shoa zone of Amhara region Ethiopia. *Munich Pers RePEc Arch.*
6. FAO (2013). Climate-Smart Agriculture Source Book. *Food and Agriculture Organization of the United Nations.* Sourcebook on Climate-Smart Agriculture, Forestry and Fisheries.
7. Fox, P., Rockström, J. and Barron, J. (2005). Risk analysis and economic viability of water harvesting for supplemental irrigation in semi-arid Burkina Faso and Kenya. *Agric Syst.*
8. Füssel, H.M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. *Glob Environ Chang.*
9. Gbetibouo, G.A. (2009). Understanding farmers' perceptions and adaptations to climate chang and variability: The case of the Limpopo basin, South Africa. *IFPRI Discussion Paper 00849*.
10. GoK (Government of Kenya) (2017). Kenya Climate Smart Agriculture Strategy.
11. IPCC (2018). An IPCC Special Report on the impacts of global warming of 1.5°C. *Intergov Panel Clim Chang.*
12. IPCC (2019). Special Report on Climate Change and Land. Ipcc;
13. Katharine, V., Cull, T., Chanika, D., Hamazakaza, P., Joubert, A. and Macome, E. (2013). Farmers'responses to climate variability and change in southern Africa - is it coping or adaptation? Clim Dev. 2013; 5(3):194–205.
14. Kahsay, H. T., Guta, D. D., Birhanu, B.S., Gidey, T.G. and Routray, J. K. (2019). Farmers' perceptions of climate change trends and adaptation strategies in semiarid highlands of Eastern Tigray, Northern Ethiopia. *Adv Meteorol*.
15. Kimani, N.C. and Bhardwaj, S.K. (2015). Assessment of people's perceptions and adaptations to climate change and variability in mid-hills of Himachal Pradesh, India. *Int J. Curr Microbiol Appl Sci. 2015; 4*(8):47–60.
16. Kichamu, E. A., Ziro, J.S., Palaniappan, G. and Ross, H. (2018). Climate change perceptions and adaptations of smallholder farmers in Eastern Kenya. Environ Dev Sustain. 2018; 20 (6):2663–80.
17. Kisii County Government-(KCG). (2013). The First County Integrated Development Plan; 2013- 2017.
18. KNBS (Kenya National Bureau of Statistics), (2019). *Kenya population and Housing Census.*
19. UNEP (2015). Green Economy Sector study on agriculture in Kenya. Maguza-Tembo, F., Edriss, A. K and Mangisoni, J. (2017). Determinants of climate smart agriculture technology adoption in the drought prone districts of Malawi using a multivariate probit analysis. *Asian J Agric Extension, Econ Sociol.*
20. Makate, C., Wang, R., Makate, M. and Mango, N. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: Adaptive management for environmental change. Springerplus; 2016.

21. Marenya, P.P. and Barrett, C.B. (2007). Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Food Policy; 32:* 515–36.
22. Mutunga, E., Ndungu, C. and Muendo, P. (2017). Smallholder farmers' perceptions and adaptations to climate change and variability in kitui County, Kenya. *J. Earth Sci Clim Change; 8*(3):1–7
23. Mutunga, E., Ndungu, C, Muendo, P. (2018). Factors influencing smallholder farmers' adaptation to climate variability in Kitui County, Kenya. Int J Environ Sci Nat Resour; 8(5):155–61.
24. Nhemachena, C. and Hassan, R. (2007). Micro-Level Analysis of Farmers Adaption to climate change in Southern Africa booksgooglecom.
25. Ochieng, J., Kirimi, L. and Makau, J. (2017). Adapting to climate variability and change in rural Kenya: farmer perceptions, strategies and climate trends. *Nat Resour Forum; 41*:195–208
26. Shilenje, Z. W., Ogwang, B. A. (2015). The Role of Kenya Meteorological Service in Weather Early Warning in Kenya. *Int J Atmos Sci.*
27. Syngenta (2014). Agricultural Extension, Improving the livelihood of smallholder farmers.
28. Wamalwa, I. W., Mburu, B.K. and Mang'uriu, D.G. (2016). Perception of climate change effects and its influence on uptake of climate smart practices among small scale farmers of Kisii County, Kenya. *Int J. Inf Res Rev. 3*(5):2409-2417.

APPENDIX 1: DATA ANALYSIS OUTPUT

A) CSAP Adopted by Smallholder Farmers

i)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	A	16.6667	6	2.85774	1.16667
	AD	16.6667	6	5.56477	2.27181

ii)

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	A & AD	6	-.970	.001

B) Determinants of Smallholder Farmers' Choice of CSAP on Adaptation to Climatic variations

i)

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
F	8	12.5000	1.64751	.58248

ii)

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F	21.460	7	.000	12.50000	11.1226	13.8774