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ASSESSMENT OF THE INFLUENCE OF CLIMATE SMART AGRICULTURAL PROJECTS ON FOOD SECURITY IN WEST POKOT COUNTY, KENYA

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Abstract: **Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. The study intended to assess the influence of climate smart agricultural projects on food security in West Pokot County (WPC).Food security is at the center of accelerating economic development. The study was guided by the following objectives: - to find out the influence of CSA policies awareness on food security West Pokot County. It was steered by the basic notion of the systems theory, resilience theory in climate smart agriculture projects, theory of change in adaptation to climate change and the social- ecological theory on food security. The study employed a descriptive research design targeting 260 farmer groups from whom a sample size of 130 was drawn using simple random sampling. Questionnaire was the main primary tool for data collection. Inferential statistics and regression analysis was applied in interpreting the findings from data collected. The results showed that there was a partial positive and statistically significant correlation between food security and CSA practices awareness (r= 0.117, p= 0.003). The study findings will be important in informing policy formulation both at County and National level to address food insecurity while sufficiently mitigating the effects of climate change through implementation of relevant and adaptable climate smart agricultural projects as a form of sustainable agriculture and food security.**

Keywords: **Climate Smart, Policies Awareness, Projects Implementation.**

1. INTRODUCTION

As defined by Lipper et al. (2014), Climate Smart Agriculture is the approach for transforming and reorienting agricultural development under the new realities of climate change. International support for Climate Smart Agriculture and Food Security global efforts has been built on coordinated approaches to climate change, agricultural and food security policy areas, to ensure that capacity strengthening, technology development/transfer and financing enable national CSA actions. This requires greater coherence across multilateral policy processes, including those of the United Nations Framework Convention on Climate Change (UNFCCC), development of the post-2015 Sustainable Development Goals, and work on agricultural and food security policy by the Committee on World Food Security and Nutrition (CFS). The conclusions recently agreed by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at the UNFCCC Climate Talks (Bonn, June 2014), earlier discussion of food security and climate change at the CFS, and discussion in the UNFCCC on integrated approaches to land, may all help to align global policy. There is a consensus that over the coming decades, anthropogenic global climate change will cause dramatic transformations in the world biophysical systems that will affect human settlements, ecosystem services, water resources and food production; all of which are closely linked to human livelihoods (UNFCCC, 2005). These transformations are likely to have widespread implications for individuals, communities, regions and nations. In particular, poor, natural resource-dependent rural households will bear a disproportionate burden of the adverse impacts (Adger, 2001, 2003; Burton). The extent to which these impacts will be felt depends in large part on the extent of local and national adaptations and adaptive capacities (Shah, Fischer & Velthuizen, 2008; Meams & Norton, 2010).Although there is a considerable scientific uncertainty about the future trajectory of climate change, its impacts are already discernible and will increasingly affect the basic elements of life for people around the world (IPCC, 2007). Such impacts include those on numerous agricultural regimes and human health including infectious disease vectors (Adger et al., 2007). Negative impacts in average crop and pasture yield will likely be clearly visible by 2030. For example, in parts of Brazil, rice and wheat yields could decline by 14%, according to their forecast.

Climate smart agriculture (CSA) is a farming system that is famously called triple "win" by both the World Bank (WB) and Food and Agriculture Organization (FAO). FAO 2010 has defined CSA as agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes Greenhouse gases (GHGs) (mitigation) and enhances achievement of national food security and development goals. There is growing acknowledgement that agriculture and food systems need to change regardless of any climate change impacts.

Africa is at the tip of the spear of climate change impacts mainly due to the interactions of multiple stressors, including extreme poverty, over-dependence on rain-fed agriculture, HIV/AIDS prevalence, insufficient public spending on rural infrastructure, knowledge gaps and poor data availability and quality (UNEP, 2005; IPCC, 2007). These stressors contribute to a weak overall adaptive capacity, and thus may compound poverty for vulnerable groups.

In recognition of the disproportionate burden that climate change places on small island developing states (SIDS), FAO supported six African island nations in their efforts to make their agriculture more resilient to climate shocks and boost economic development. The $1.5 million project -- funded through the Africa Solidarity Trust Fund focuses on a variety of activities to mitigate and adapt production to changing climate conditions, and make farming practices overall more efficient. Farmers in Cape Verde, Comoros, Guinea-Bissau, Mauritius, Sao Tome and Principe, and Seychelles benefited from training and knowledge exchanges on climate-smart food production, as well as ways to create viable market opportunities for nutritious food. According to the united nation environmental programme (UNEP), by 2050, between 350 million and 600 million people are projected to experience increased water stress due to climate change. Climate variability and change is projected to severely compromise agricultural production, including access to food across Africa. Towards the end of the 21st century, projected sea level rise will likely affect low-lying coastal areas with large populations. Climate variability and change can negatively impact human health. In many African countries, other factors already threaten human health. For example, malaria threatens health in southern Africa and the Eastern Highlands.

Achieving sustainable *food security* in developing countries with rapidly growing population and a *changing climate* is a major challenge. More food is needed in the future but climate change means less food production potential and poor people will be hit the hardest. Climate-related crop failures, fishery collapses and livestock deaths already cause economic losses and undermine food security, and these are likely to become more severe as global warming continues. As a result, in developing countries, a number of programs that seek to overcome the threats to agriculture and food security in a changing climate through exploring new ways of helping vulnerable rural communities adjust to global changes in climate have been developed. Identifying and addressing the most important interactions, synergies and trade-offs between climate change and agriculture has thus remained a key area for exploration towards achieving food security globally. Implementation of unique, innovative and transformative programs that addresses agriculture in the context of climate variability, climate change and uncertainty about future climate conditions will further steer countries in Africa towards the right direction in attaining food security. According to the Consultative Group on International Agricultural Research (CGIAR), adaptation in the way we produce food, farm our lands and treat our environment will be key to mitigating the effects and ensuring food security. In addition, it is still very important that meaningful adaptation to agricultural practices and attempts to limit emissions are made to ensure the risk posed by climate change on agriculture is manageable.

Responses need to come quickly through application of the best and most promising approaches, tools and technologies. This initiative can only be realized with improved interactions among scientists, researchers, policy makers, civil society, and those who depend on agriculture for their livelihoods. Both local and global action is needed to accelerate the sharing of lessons on institutions, practices and technologies for adaptation and mitigation, with serious commitment to working in partnership, enhancing capacity and addressing societal differences. The increasing global demand for food, as well as for feed and biomass-based raw materials, e.g. fuel and fibre crops, has increased the pressure on the agricultural sector in the past decade, especially in Africa. Addressing the three pillars of food security, i.e. food availability, through enhanced agricultural productivity; access to food, through income generation arising from processing and trading; and use of food, through increasing nutritional quality has been the agenda advanced by the Food and Agriculture Organization of the United Nations. Nutrition-sensitive agriculture has been viewed as the pillar of improved nutrition and better health. Despite the fact that as a system it's just emerging and therefore has not been integrated as such in the agricultural and nutrition concepts and strategies of most countries, the examples derived from a wide range of very different countries and cross-cutting topics do reveal a variety of possibilities and opportunities for incorporating nutrition objectives into agriculture and food systems.

However, climate change impacts combined with high population growth rates, unsustainable agricultural practices, and high levels of land-use change, among others require significant changes in farming practices to increase productivity and at the same time use natural resources more efficiently and sustainably. Examples of these practices include, shifts to new crops and varieties, water and soil conservation measures and planting trees on farms. While none of these practices are new, the way in which they are framed is evolving. Ideally, agricultural production systems managed in a climate-smart way emit fewer greenhouse gases, sequester carbon, and at the same time become more productive and resilient in the face of a changing climate.

Although adaptation and mitigation have been developed as two distinct responses to climate change, the two are often applied in concert. In fact, agricultural strategies that help farmers adapt to climate change may simultaneously reduce greenhouse gas emissions or sequester carbon. Strategies that achieve both aims, while sustainably increasing agricultural productivity, are the essence of the concept of climate-smart agriculture. These world organizations think that carbon financing through implementation of this system will help solve food insecurity in poor and developing countries. As per the fourth assessment report (AR4) (IPCC, 2007) climate change is considered one of the most serious threats to sustainable development in Africa. Studies have shown that about 90 percent of disasters afflicting the world are related to severe weather and extreme climate change events. Impacts of the projected climate change are expected in many sectors such as economic activities, agriculture, natural resources and physical infrastructure.

Climate driven changes affect resources critical for economic development of Kenya. An example is the 1999/2000 La Nina droughts, which left approximately 4.7 million Kenyans facing starvation. In addition, increased average temperatures have led to the spread of vector borne diseases like malaria to areas where the disease is not known to be endemic. Figures compiled by the department of international development(DfID) suggest that between 50,000 and 100,000 people, more than half of them children under five, died in the 2011 Horn of Africa crisis that affected Somalia, Ethiopia and Kenya (where over 3.7 million were affected) with the drought denying the economy a whopping 1.2 trillion over the 2008-2011 period. In Kenya, drought affected two channels including increased mortality of livestock in drought affected areas (that is home to 10 percent of the country's population) and exercabating increases in food prices. A recent study by World Bank has estimated that the direct costs of climate change in Kenya will potentially amount to between one and two billion US Dollars annually by the year 2030.

As noted by Röhss et al., (2016) Global efforts to combat climate change have been unsuccessful and the dry lands of West Pokot are experiencing an unpredictable climate with more frequent and more severe droughts and erratic rainfall. The unpredictable and harsher nature of the climate leads to a rural to urban migration and a general depopulation of the dry lands in Kenya, including West Pokot County. It has also caused loss of livelihood arising from loss of livestock; particularly in ASAL areas due to depletion of natural vegetation and pasture. The country therefore requires transformation of its agricultural systems to make them more productive, resilient and competitive in generating incomes under a changing climate. CSA provides an excellent opportunity for this transformation since it is an approach that sustainably increases agricultural production and builds resilience of agricultural systems to climate change. On 18 January 2005, following the adoption of Hyogo framework for action (HFA) by 168 countries in the world, it was immediately revealed Kenya was among countries in Africa facing serious environmental troubles especially in its ASALs that make up 75 percent of the land mass due to existence of multiple stresses (poverty and ecosystem degradation) and thus remained more vulnerable due to low adaptive capacity. For instance, a research by Röhss et al.,

(2016) on ecological, social and economic resilience in west pokot county revealed key areas of critical improvement such as development of local user organizations, national system for disaster relief and sustainable mitigation for areas exposed to climate change. On 18 March 2015, UN member states (Kenya included) adopted the Sendai framework for disaster risk reduction 2015-2030, the successor framework to the HFA 2005-2015. Kenya has undertaken various interventions to address its capacity needs by strengthening vulnerability analysis and food security monitoring, supporting the modernization of the meteorological department, strengthening institutions in charge of disaster risk reduction (DRR) among others. For instance, WPC is characterized with frequent droughts that overburden the agriculture sector and thus impact on the economy negatively. Over time the situation has been complicated by an increase in natural disasters and the need for more water resources for livestock, agriculture and human existence. The study sought to evaluate the influence of CSA policies awareness on food security in West Pokot County.

2. INFLUENCE OF CSA POLICIES AWARENESS ON FOOD SECURITY

Policy implementation and ultimate awareness by stakeholder's experience myriad of challenges. This includes: inadequate resources in terms of funds and political interference (Clar et al., 2013). Funds are needed for surveillance and monitoring, availing information by printing booklets among other activities and uses. With respect to environment management policies, sometimes politicians have turned a blind eye to violators and even promoted certain damaging activities to the environment out of self-interest (Sophie, 2007). With regard to wetland resources, policy implementation is hindered by lack of wetland knowledge (Sophie 2007). Other analysts highlight lack of policy awareness as an important constraint (Clar et al. 2013). There are also cases where the right structures for implementation are not used. For example, climate change and climate smart policies have been implemented only through central ministries and NGOs using project based parallel structures, yet local government structures are seen as key in creating an enabling environment for supporting rural people to adapt to climate change (Friis et al., 2013). This is because adaptation is inherently local and policies and adaptation measures adopted by institutions and decision makers should be coordinated at both national and local levels.

There is increased acknowledgement of the need to ensure climate smart agriculture (CSA**)** policies awareness to bolster adaptation of communities to climate change and thus diversify mechanisms of food production. For some groups, especially the farming communities, adaptation seems to be the best option to counter the effects of climate change as they are highly vulnerable and thus need to adapt their livelihood systems to changing climatic conditions (Ngigi, 2009). While farmers are able to manage risks in their everyday lives, including those related to climate, they also need to adapt in order to reduce the negative impacts of climate change (Okonya 2013). However, for adaptation activities and efforts to be well directed, they must be guided and supported by policies and strategies (Burton et al., 2006). Identifying policy options available to address the adverse effects of climate change is seen as one of the first steps in responding to climate change (Smith & Lenhart 1996) and developing Climate Smart Agriculture frameworks. This is in agreement with Hassan and Nhemachena (2008) who emphasize that the coping strategies of farmers need to be supported by appropriate public policy and investment and collective actions to help increase the adoption of adaptation measures. In addition, they point out that the most relevant policies are those that target climate sensitive sectors such as agriculture, forests, ecosystems and water resources. Consequently, many governments around the world have recognized the need to facilitate climate change adaptation with a broad range of public policies (Clar et al., 2013). At the international level, Burton et al. (2006) puts across three complementary approaches to future adaptation efforts that include initiating new steps under the United Nations Framework Convention on Climate Change (UNFCCC) to facilitate comprehensive national adaptation strategies and to provide reliable assistance for high priority CSA implementation projects. Second, international responses seek to integrate adaptation across the full range of development and committing stable funding for an international response. Third, the Organization for Economic Co-operation and Development (OECD) and European Union (EU) countries are also concerned about climate change adaptation (Bauer et al., 2011).

CSA policies are an important aspect of the wider context in which adaptive decisions are made since the policy context may have constraining effects to the implementation of adaptation responses (Madzwamuse, 2010). The policy context has two main elements: existing policies and new policies (Urwin &Jordan 2008). With the existing policies, there are policies or strategies that impact positively on the scope of pursuing adaptation at lower levels even when they do not mention climate change. On the other hand, new policies, both climatic and non-climatic need to be designed in ways that facilitate adaptive decisions (Urwin & Jordan 2008). With regard to adaptation, public policies are concerned with raising awareness on CSA as well as building adequate capacities and helping to put capacities into action (Adger et al., 2005). In addition, public policies do play a role in resolving conflicts of interest, reducing external effects that are triggered or reinforced by climate change and ensuring that public infrastructure withstands future climate impacts (Bauer et al. 2011). In order to realize significant adaptation impacts, economic space and capacity for diversification is needed, as well as policies that can enable evolution of local level innovations and responses (Thomas & Twyan 2005). Thus, the policy environment should not only be conducive for adaptation but should also serve to facilitate appropriate innovations for creative adaptation.

Agricultural extension officers serve as one likely source of information on CSA practices. The extent and quality of this information depends on whether extension agents are themselves trained in or are aware of CSA practices. However, a long literature identifies likely gender differentiated access to and impacts of agricultural extension (Meinzen-Dick et al., 2011). Extension agents are not the only source of information about new agricultural practices; other sources include: NGOs, community meetings, farmer organizations, religious groups, family members, neighbors, radio, private sector agriculture-service providers, cell phones, and traditional knowledge (Feder et al., 2011). Hypotheses have been developed that individuals may have different levels of and access to channels of information based on age, sex, and social norms, in addition to valuing some channels of CSA information over others (Chaudhury et al., 2012). While household members do share some information, one cannot assume that information is fully shared within the household (Johnson et al., 2013).

3. METHOD

The study adopted a descriptive survey design. The study targeted 260 farmers benefitting from climate smart agricultural projects groups in West Pokot County with a sample size of 130 respondents only. The data Collection Instruments was questionnaire. The questionnaire was administered to five respondents from each category within the study area as means of testing validity and reliability. Upon completion of data cleaning, Statistical Package for Social Sciences (SPSS) version 21.0 was used in analysis. Results obtained was presented in tables, comparative charts, pie charts as well as inferential statistics such as Pierson moment coefficient correlation tables. A regression model was generated.

4. DISCUSSION

The respondents were supposed to tick appropriately whether they were aware of what climate smart agriculture entails and the results were presented in table 4.1 below.

Table 4.1: Awareness on Climate Smart Agriculture (CSA)

Awareness of CSA	Frequency	Percentage
Yes	91	75.2
No	30	24.8
Total	121	100

When the respondents were requested to indicate whether they were aware what climate smart agriculture entailed, the highest proportion responded in the affirmative (75.2 percent) while only a small proportion negated (24.8 percent). Those who responded in the affirmative were then requested to indicate the first source of climate smart agriculture information. The results are tabulated in the table 4.2 below.

Table 4.2: First Source of CSA Information

First source of CSA information	Frequency	Percentage
Radio	30	24.8
Agricultural extension agents	21	17.4
NGO	8	6.6
Learning institutions	16	13.2
Farmers groups	46	38.0
Total	121	100

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The analyzed data showed that majority of the respondents first heard about climate smart agriculture from farmers groups (38.0 percent). Only 6.6 percent reported having known about climate smart agriculture from NGOs. 24.8 percent of the respondents reported to have heard about CSA from the radio, while 17.4 percent and 13.2 percent noted to have got information from agricultural extension agents and learning institutions respectively. The respondents' level of awareness on selected climate smart agricultural practices was also assessed. To determine this, the respondents were given a table containing several parameters measured in Likert scale in relation to the level of awareness regarding each of the parameters. The response was guided by the statement from the questionnaire with the options against each parameter provided as: strongly aware, aware, not aware, unaware as shown in table 4.3 below.

Table 4.3: Level of Awareness on Select CSA Practices

Climate Smart Agricultural Practices.	%Strongly aware	%Aware	%Not aware	% un aware	% Strongly unaware	Total
Irrigation	42.1	40.2	3.5	12.5	1.7	100
Agro forestry	35.1	34.3	11.5	11.1	8.0	100
Crop residue mulching	34.1	37.4	8.7	14.3	5.5	100
Improved feed management	46.5	33.1	12.5	5.4	2.5	100
Switch to drought tolerant livestock	38.2	32.5	13.5	13.3	2.5	100
Pasture management	37.1	29.1	15.6	11.7	6.5	100
Cover cropping	22.3	27.0	18.5	22.2	10.0	100
Water harvesting and management	48.1	38.5	1.5	8.4	3.5	100

The awareness on select climate smart agricultural practices was determined and recorded on Likert scale. Majority of the respondents 42.1 percent were strongly aware of irrigation, 40.2 percent were aware. Only a small proportion of the respondents, (3.5 percent and 1.7 percent) stated to be not aware and strongly unaware about irrigation respectively. However, another 12.5 percent of the respondents reported as being un-aware about irrigation. When requested to indicate their level of awareness concerning agro forestry, most of the respondents (35.1 percent and 34.3 percent) reported as being strongly aware and aware respectively. Only 8.0 percent reported as being strongly unaware while 11.1 percent were un- aware. Similarly, another 11.5 percent of the respondents were not aware of agro forestry practices. When requested to indicate their level of awareness on crop residue mulching, 37.4 percent reported as being aware, 34.1 percent were strongly aware while only about 8.7 percent reported not aware of crop residue mulching. However, 14.3 percent and 5.5 percent reported as being unaware and strongly unaware respectively.46.5 percent and 33.1 percent of the respondents were strongly aware and aware respectively on improved feed management CSA practices while 5.4 percent and 2.5 percent were unaware and strongly unaware respectively. However, 12.5 percent of the respondents were not aware of the improved feed management CSA practices. Similarly, the respondents were required to indicate their level of awareness on the CSA practice of switching to drought tolerant livestock. 38.2 percent of the respondents were strongly aware, 32.5 percent were aware while a very small proportion, (2.5 percent) were strongly unaware of the CSA practice of switching to drought tolerant livestock. On the contrary, 13.5 percent and 13.3 percent of the respondents reported as being not aware of the practice and being unaware respectively. The respondents were further requested to indicate their level of awareness on pasture management. Only 6.5 percent were strongly unaware on the practice while 37.1 percent and 29.1 percent stated to be strongly aware and aware respectively. However, 15.6 percent were not aware about the pasture management CSA practices with 11.7 percent reporting un aware. 22.3 percent of the respondents reported as being strongly aware of cover cropping while a small proportion of 10.0 percent were strongly unaware. 27.0 percent were aware and on the contrary was22.2 percent of the respondents. However, 18.5 percent were not aware about cover cropping. When requested to indicate their level of awareness concerning the practice of water harvesting and

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management, 48.1 percent of the respondents were strongly aware with another 38.5 percent reporting as aware. However, a very small proportion (3.5 percent) was strongly unaware while 8.4 percent of the respondents were unaware. Only 1.5 percent of the respondents were not aware of water harvesting and management practices.

Correlation:

A Pearson correlation was carried out to determine the relationship between food security and CSA practices awareness, CSA stakeholders as well as CSA challenges.

Table 4.4: Correlation

		Food security
	Pearson Correlation	.117
CSA practices awareness	Sig. (2-tailed)	.003
	N	121

There was a partial positive and statistically significant correlation between food security and CSA practices awareness ($r= 0.117$, $p= 0.003$).

Regression analysis:

Table 4.5: Summary model

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	76.243[a]	.161	.633

a. Estimation terminated at iteration number of parameter estimates changed by less than .001.

Nagelkerke R Square (R^2) is the coefficient of determination from table 4.5shows how food security varied with CSA policy awareness. The Nagelkerke R Square was 0.633 implying that there was a combined variation of 63.3 percent of the factors influencing food security. Therefore, there were other factors influencing food security.

Table 4.6: Regression coefficients

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	**Upper**
Step 1[a]	CSA practices awareness	.839	.652	1.656	1	.045	.432	.121	1.550

a. Variable(s) entered in step 1: CSA practices awareness.

Regression coefficients

Results from table 4.6 on regression coefficients shows the Predictors: CSA policy awareness,

Dependent variable: Food security.

The following regression analysis equation was derived.

$Y= 5.878 + 0.839X_1 + \mathcal{E}$

Whereby Y is food security, X_1 is CSA practices awareness,

The regression model shows that CSA policy awareness ($P = 0.045$), had significant influence on food security.

5. CONCLUSIONS AND RECOMMENDATIONS

Data emanating from the study revealed that CSA practices awareness had a significant influence on the implementation of CSA projects in West Pokot County. The correlation coefficient implied that CSA practices awareness had significant influence on CSA projects implementation in West Pokot County at $p= 0.003$ or $P<0.05$. This means that the null hypothesis (H_{o1}): CSA practices awareness had no significant influence on CSA projects implementation in West Pokot

County was rejected. The alternative hypothesis (H_{A1}) was true: CSA practices awareness had a significant influence on CSA projects implementation in West Pokot County. The results showed that there was a partial positive and statistically significant correlation between CSA projects implementation and CSA policies awareness (r= 0.117, p= 0.003). The null hypothesis H_{O1}: CSA policies awareness had no significant influence on the implementation of CSA projects was rejected.

Based on the study, it was recommended that it's noble to recommend that climate smart agriculture projects ought to be implemented with adequate training of farmers groups and other stakeholder groups so as to create a pool of members well versed with the principles and knowledgeable in climate smart agriculture to match the recommended project output and outcomes so as to boost food security in West Pokot County. Much more effort needs to go into creating the right structures for enhancing awareness on CSA projects.

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