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RESEARCH ARTICLE

CLIMATE-SMART AGRICULTURE FROM THE INTENSIVE VEGETABLE FARMERS PERSPECTIVAL

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ABSTRACT

Climate-Smart Agriculture (CSA) has been identified as the best way forward to contribute to mitigating climate change for enhanced agriculture productivity. The study was conducted in Asokwa Municipal in the Ashanti region of Ghana as a case study with the following objectives; to identify existing CSA practices adopted by vegetable farmers; to evaluate existing institutions and their role in facilitating the adoption of CSA practices and to establish the likely factors that may promote or inhibit adoption of CSA practices. Purposive sampling was used to select twenty-seven participants due to restrictions on COVID-19 and limited resources. The significance of this method is that participants are selected by virtue of their capacity to provide rich-textured information relevant to the phenomenon under study. Results from the field showed that the commonly adopted CSA practices were improved crop varieties, irrigation and manure management scoring 100% each followed by crop rotation (66.7%). The least adopted practices, from the highest to the lowest were agroforestry (12.5%), mulching and rain harvesting (8.3%) each and compost application with 4.2%. The key factors inhibiting the adoption of CSA consist of insufficient information, water scarcities and financial constraints. The conclusion drawn was that the Agricultural sector must become climate-smart to successfully tackle current food security and climate change challenges. Beyond doubt, it will require management and governance practices based on ecosystem approaches that involves multi-stakeholder and multi-sectoral coordination and cooperation.

KEYWORDS

Climate Smart Agriculture, climate change, food security, adoption, practices.

1. INTRODUCTION

Population growth, rapid urbanization, and dietary changes are placing tremendous pressure on food systems, particularly in developing countries. Based on current income, population and consumption trends, the Food and Agriculture Organization of the United Nations (FAO) estimates that, by 2050, some 50 percent more food will be needed to satisfy the extra demand compared to 2013 (Alexandratos and Bruinsma, 2012). The challenges posed by rapid growth in food demand are intensified by the effects of climate change on agricultural systems, including crops, forestry, livestock and fisheries.

Climate change and extreme weather events, such as severe droughts and crop failure - triggers of food insecurity crises pose further challenges to sustainable development across the continent (Aggarwal et al., 2018; Barrett et al., 2017; Ubilava, 2018). Additionally, heavy reliance on rain-fed agriculture and preponderance of extensive agriculture, makes SSA a region highly vulnerable to climate change and extreme weather shocks (Arslan et al., 2015; Asfaw et al., 2016; Binswanger-Mkhize and Savastano, 2017). For example, the recent El Niño droughts in Southern Africa devastated maize yields in the 2015/16 farming seasons and was particularly grievous as it resulted in massive food security crises in the region (Ubilava, 2018; World Bank, 2016; World Food Programme, 2017). Climate-Smart Agriculture is particularly useful due to the synergy between agriculture and climate change mitigation and adaptation (FAO, 2016; Jayne et al., 2018; Steward et al., 2018). The CSA presents an important strategy to tackle the effects of climate change on agriculture in the continent because it helps to ensure that agriculture proceeds in ways that protect and conserve natural resources (Chandra, Dargusch, et al., 2017; FAO, 2016; Lipper et al., 2014). Moreover, CSA is critical for communities who simultaneously depend on agriculture and limited natural resources for their livelihoods (Sommer et al., 2018; Teklewold et al., 2017; van Noordwijk, 2017).

However, despite a number of analyses highlighting the import of CSA for natural resources management and environmental conservation in Africa, precise estimates of the adoption of CSA remain elusive in the sub-continent (Aggarwal et al., 2018; Ampaire et al., 2017; Karlsson et al., 2018). Some authors (e.g., FAO, 2010; Khatri-Chhetri et al., 2017; Lipper et al., 2014) argue that smallholder farmers in the developing world, especially SSA, face binding resource constraints that may constrain them from fully adopting CSA despite the potential benefits of doing so. An important reason is that many CSA practices (such as physical infrastructure like stone bunds and contour trenches) are resource

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intensive and are thus hard for average smallholder farmers to afford (FAO, 2016; Khatri-Chhetri et al., 2017; Kpadonou et al., 2017).

Climate-Smart Agriculture is a concept developed by FAO, as an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change (FAO, 2013). Climate change and variability are emerging as the major threats to development across the continent impacting adversely on agriculture and livelihoods. Similarly, Africa's population continues to grow with an estimated annual growth of 2.4% and the population is predicted to double from its current 0.9 billion people by 2050. According to the FAO (Ibid.), more than a quarter of Sub-Saharan Africa's people are currently undernourished. Crop production needs to increase by 260% by 2050 to feed the continent's projected population growth.

Thus, Africa's agriculture must undergo a significant transformation to meet the simultaneous challenges of climate change, food insecurity, poverty and environmental degradation. Climate-Smart Agriculture should be part of the solution in addressing this problem (FARA, 2015). In order to feed the growing population sustainably in the context of climate change, agricultural productivity needs to grow. Africa has a great potential to increase its crop production. It has around 60 % of the world's uncultivated arable land, suitable for crop production, and the highest margins for improving the productivity in already cultivated land. It is mandatory, however, that this increase in production and productivity happens in a climate-smart way (Hanne, Carmen and Francesco, 2015; Partey, et al, 2018).

Climate-Smart Agriculture includes proven practical techniques, such as mulching, intercropping, conservation agriculture, integrated crop-livestock management, crop rotation, agroforestry as well as improved water management system and innovative practices, for instance better weather forecasting, more resilient food crops and risk insurance (Boto, Biasca and Brasesco, 2012). Conservation agriculture has three components-- the zero tillage or at least minimum soil disturbance, retention of crop residues for soil cover which is also sometimes called mulching and rotation or intercropping of cereals with leguminous crops (FAO 2001).

The CSA shares many of the practices of Conservation Agriculture (CA). However, the challenge lies in the extent to which poor smallholder farmers can successfully adopt CSA practices with current surprises and shocks which climate change presents. Being climate smart therefore calls for adopting practices such as knowledge smartness, nitrogen smartness, energy smartness, water smartness, weather smartness and carbon smartness (Aggarwal, Zougmore and Kinyangi, 2013). This hinges on developing new or enhancing existing institutions to support poor smallholder farmers to successfully adopt these practices.

Ensuring that institutions and incentives are in place to achieve climate-smart transitions is thus essential to meeting these challenges. For instance, in Nepal, rice farmers and their supporting institutions have successfully evolved and co-produced location-specific climate sensitive technologies such as agronomic practices and improved rice varieties. These have facilitated the adoption of technologies in a more efficient manner and has also improved knowledge network among scientist, farmers and institutions, (Chhetri, Chaudhary, Tiwari, and Yadaw, 2017). In Ashanti Region, there are analogous institutions like Rocha Ghana. The question is whether they are functioning well and are adequately equipped to cause change in the lives of the farmers in disseminating information, technology as well as livelihoods improvements.

Efforts to increase food production have only encouraged more synthetic fertilizer and related agrochemicals use, as well as an encroaching desertification from agricultural extensification, which are potential sources of Green House Gases (GHGs). Hence, the need for the adoption of improved practices in agriculture which embraces increased food production and reducing its environmental footprint concurrently (Beddington et al. 2012a). Sustainable agriculture and now Climate Smart Agriculture have been identified as the way forward in achieving this goal.

2. Literature Review

Climate change is incipient as a major threat on agriculture, food security and livelihood of millions of people in various places of the world (IPCC, 2014). Several studies indicate that agriculture production could be significantly impacted due to increase in temperature (Lobell et al., 2012), changes in rainfall patterns (Prasanna, 2014) and variations in frequency and intensity of extreme climatic events such as floods and droughts (Brida and Owiyo, 2013; Singh et al., 2013). The estimated impacts of both historical and future climate change on cereal crop yields in different regions indicate that the yield loss can be up to -35% for rice, -20% for wheat, -50% for sorghum, -13% for barley, and -60% for maize depending on the location, future climate situations and projected year (Porter et al., 2014). Changes in crop cultivation suitability and associated agriculture biodiversity, decrease in input use efficiency, and prevalence of pests and diseases are some of the major causes of climate change impacts on agriculture (Zabel et al., 2014; Norton, 2014). Agriculture production systems require adaptation to these changes in order to ensure the food and livelihood security of farming communities. There are several potential adaptation options to reduce moderate to severe climatic risks in agriculture. Adaptation options that sustainably increase productivity, enhance resilience to climatic stresses, and reduce greenhouse gas emissions are known as Climate-Smart Agricultural (CSA) technologies, practices and services (FAO, 2010).

Largely, CSA emphasises on developing resilient food production systems that lead to food and income security under progressive climate change and variability (Lipper et al., 2014). Many agricultural practices and technologies such as minimum tillage, different methods of crop establishment, nutrient and irrigation management and residue incorporation can improve crop yields, water and nutrient use efficiency and reduce Greenhouse Gas (GHG) emissions from agricultural activities (Jat et al., 2014; Sapkota et al., 2015). Similarly, rainwater harvesting, use of improved seeds, ICT based agro-advisories and crop/livestock insurances can also help farmers to reduce the impact of climate change and variability (Mittal, 2012; Altieri and Nicholls, 2013). In general, the CSA options integrate traditional and innovative practices, technologies and services that are relevant for particular location to adopt climate change and variability (CIAT, 2014). In this study, we consider a technology or practice as climate smart if it can help to achieve at least one pillar of CSA (either increases productivity or increases resilience or reduces GHG emission). For all adaptation options, farmers need to make ex-ante decisions under climatic risk, while making short and long-run investments depending on the extent of current climate variability and expected climate change in the future (Callaway, 2004).

The adoption of CSA practices will involve new techniques and approaches in transforming agricultural systems to concurrently increase food security, build resilience and mitigate climate change to which smallholders lack the capacity to develop them. For example, these new approaches include the adoption of Sustainable Land Management practices accompanied by dissemination of useful information within a climate lens context. However, the successful adoption and development of all these factors however will hinge on the level of institutional involvement, (FAO, 2013; Meinzen-Dick, Bernier and Haglund, 2013). The importance of institutions are demonstrated in their ability to develop innovations to adapt to changing climates (Amaru and Chhetri, 2013), and at the local level, they play instrumental roles in the area of information gathering and dissemination, resource mobilization and allocation, skill development and capacity building, providing leaderships and networking with other decision makers and institutions as well as interventions that improves sustainable livelihood outcomes (Agrawal, 2008). Understanding the importance of institutions and more importantly local level institution is crucial to achieving climate change adaptation.

For instance, in Niger, local communities have been playing a leading role in the country's development with the support of a Community Action Plan (CAP) of which many of the initiatives implemented have contributed to mitigating climate change and enhancing the resilience of the country's agriculture system to the effects of climate change. For instance, more sustainable land management have been implemented on nearly 9000 ha with a goal of increasing agricultural productivity, vegetative cover and carbon sequestration and as well as reducing water erosion on 88% of sites. The project also supported social protection measures such as cash transfers, seasonal labour-intensive public work programmes and safety nets for the most vulnerable. This project is however financed by World Bank, Global Environmental Facility, GEF and International Fund for Agricultural Development (IFAD) and with the support of local institutions and community members for the sustainability of the project (Neate, 2013).

Climate-Smart Agriculture (CSA) could be very much context specific. That is to say, CSA is not a prescribed practice or a specific technology that can be universally applied. It is an approach that requires site-specific assessments of the social, economic and environmental conditions to identify appropriate agricultural production technologies and practices. It is however, not a new phenomenon, it is only a new concept used to address climate change and agriculture but then embodies existing strategies and sustainable land practices that can help achieve the 'triple wins' for food security, adaptation and mitigation, (FAO, 2010; Naess 2011). It also includes sustainable practices in fishery and aquaculture but for the purpose of this study, it is limited to sustainable practices in vegetable production. It however, includes practices not limited to conservation agriculture, crop rotation, agroforestry and conservation watershed management (Grainger-Jones, 2011; McCarthy and Brubarker, 2014; Neufeldt et al., 2013). Climate- Smart Agriculture interventions in climate smart villages are also classified to include; weather smart, water, carbon, nitrogen, energy and knowledge smartness (Aggarwal et al., 2013).

The impacts of changes in climate are often felt more by smallholder farmers as they are already coping on degraded lands and lack the knowledge and capacities to adapt their production systems to climate change and variability (FAO, 2013; Yaro, 2010). At the same time, increase in production system among smallholders is projected to entail significant increase in emissions of GHGs (IPCC, 2014a). This has necessitated the urgency to reduce concentrations of GHGs from the atmosphere and agriculture's vulnerability to changing climates. Enhancing food security while reducing ecological footprints of production systems will require sustainable approaches to agriculture (Beddington et al., 2012a). Hence, the adoption of CSA as a "unifying concept on climate change and agriculture" (Naess 2011). Climate-Smart Agriculture is defined as any agriculture practice that sustainably increase food production, build resilience to climate change (adaptation), reduces/removes greenhouse gases (mitigation) and enhance the achievement of national food security and development goals (FAO, 2010). The definition integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing the food security, ecosystems management and climate change challenges.

In another definition by, (DfID, 2012)., CSA includes programmes that;

i. Support the livelihoods of smallholder farmers and build prosperity.
ii. Produce food that farmers and consumer's need.
iii. Improves people's nutrition, especially that of women and children.
iv. Help farmers adapt to existing and future climate risks.
v. Sustains the health of the land and increases its productivity.
vi. Avoid loss of forest and biodiversity and
vii. Store carbon in the soil and reduce emissions of greenhouse gas from agriculture.

The above definitions point to CSA as means of promoting sustainable agriculture that is devoid of GHG. (Maryknoll, 2012). Climate is the set of weather conditions prevailing in an area over a long time, typically three consecutive decades (IPCC, 2014b). Several factors contribute to the definition of climate, including long term averages of temperature and precipitation, but also the type, frequency, duration, and intensity of weather events such as heat waves, cold spells, storms, floods and drought. However, climate change refers to a change in the state of the climate that can be identified (Using, example statistical tests) by variations in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC, 2014a).

Though climate change is caused by both anthropogenic and natural causes, anthropogenic activities have been strongly blamed for the increase in greenhouse gas concentration in the atmosphere which by far exceeds normal levels, causing global warming and subsequently climate change, (IPCC, 2014b; Hansen and Sato, 2013; Wang, 2013). Anthropogenic causes of climate change are attributed to industrial processes which includes burning of fossil fuels for energy and transportation, agriculture systems and deforestation, (Pidwirny, 2006; Hansen and Sato, 2013; IPCC, 2014a). Globally, climate change is expected to cause the increase in the frequency and intensity of climatic events such as floods, droughts, cyclones, hurricanes and typhoons and such events will impact on socio-economic sectors including agriculture, water, energy and health, with increases in relatively small averages of temperature (Bates, Kundzewicz, Wu, and Palutikof, 2008; IPCC, 2014a; UNFCCC, 2007).

Developing countries are expected to be more vulnerable to climate change due to their much dependence on rain-fed agriculture (IPCC, 2014a). There are no doubts that climate change and variability is manifesting in Ghana. The primary feature of Ghana's climate is the alternate wet and dry season influenced by the Inter-tropical Climate Zone and the Monsoon winds. The country has over the years experienced increasing temperatures, rising sea levels, erratic rainfalls leading to floods and droughts, (EPA, 2011; Stanturf et al., 2011) affecting the livelihoods of many smallholder farmers.

Therefore, the study seeks to focus on the following questions:

1. What existing CSA practices that are being adopted by vegetable farmers?
2. What institutional provisions are available to promote the transition from conventional agriculture to CSA?
3. What existing factors promote or inhibit the adoption of CSA practices?

The primary objective of this study is to document local CSA practices adopted by vegetable farmers in Asokwa Municipal and how institutions can enable its successful adoption to promote improved livelihoods and ecosystem. Specifically, this research aims at achieving the following objectives:

1. To identify existing Climate Smart Agriculture practices adopted by vegetable farmers in Asokwa Municipal.
2. To evaluate existing institutions and their role in facilitating the adoption of CSA practices.
3. To establish the likely factors that may promote or inhibit adoption of CSA practices.

3. METHODOLOGY

3.1 Study sites

The study was carried out in four communities: Gyinyase, Karikari farms, Ramseyer and Kaase all in Asokwa Municipal in the Ashanti Region of Ghana. The Municipality is one of forty-three (43) Districts / Municipals / Metropolitans in the Ashanti Region. The Municipality shares boundaries with Oforikrom to the East, Subin to the North West, Nhyiaeso to the West and Bosomtwe District to the South. The Municipality covers an estimated land area of 23.04km square which is about 0.094 percent of the Ashanti Region's land area (24,389 Km square) (Asokwa Municipal Assembly, 2019). The Municipal falls within the wet sub-equatorial type. The average humidity is around 84.16 percent at sunrise and 60 per cent at sunset. The average minimum temperature is approximately 21.5 degrees Celsius and the maximum average temperature is about 30.7 degrees Celsius.

The moderate temperature and humidity and the double maxima rainfall regime with an average annual rainfall of 1402.4 mm have a direct effect on population growth and the environment as it has precipitated the influx of people from every part of the country and beyond its frontiers to the Municipal. Change in humidity, temperature and rainfall have a direct bearing on adoption of CSA. The physical and natural environment is therefore an essential element or factor contributing to the socio-economic development of the Municipal. This is chiefly because the climatic conditions are not so hostile (GSS, 2014). The agriculture in the Municipality mostly focuses on the cultivation of vegetables such as carrot, cabbage, lettuce, spring onion, raddish and beet root as well as rearing of livestock such as chicken, goat, sheet, cattle, pigs, fish farming on a very small scale. Gyinyase, Atonsu and Ramseyer are the major vegetable production site in the municipality and probably one of the highest in the region (Asokwa Municipal Assembly, 2019).

3.2 Data sources and research design

To successfully implement this study, data from both secondary and primary sources were collected. Secondary data was accessed from articles, reviews of scientific books, dissertations, conference papers, internet search and other related sources. The secondary data generated helped to review literature and also provide a deep insight into primary data; both the empirical and theoretical base for data collection and analysis. Farmers within the study sites are known by the researcher since he is an Agricultural officer. Nevertheless, three Agricultural officers in the study areas purposefully provided a list of names of farmers by virtue of their capacity to provide rich-textured information relevant to the phenomenon under study. The primary data was obtained from semi-structured interviews / questionnaires (case study). The study initially adopted focus group discussion but due to restrictions on COVID-19 in the country, individual interview was conducted. Semi-structure interview involves pre-set questions that allowed further probing and explanation of answers were undertaking with farmers and Municipal Agricultural Officers. It is semi structured because it contains both open ended and close ended questions.

Open ended questions gave respondents the opportunity to provide their own answers to be filled in the provided space while close ended questions restricted them to choose from the alternative answers provided. The main ethical concerns regarding this research are confidentiality and safeguarding participant interests. In this research, voluntary participation and confidentiality were observed as a result, the researcher respected participant's unwillingness to disclose an information. A number of actions were used to safeguard the farmers and to guarantee anonymity. Inform consent form was used but explained verbally to the participants. This study took place between December 2020 and February 2021. Each interview lasted at a minimum of 20 minutes. In order to identify the local CSA practices adopted by vegetable farmers and their perception about the method of farming, descriptive designs were used. The goal of descriptive research is to describe a phenomenon and its characteristics. This type of research is more concerned with what rather than how or why something has happened (Burns and Bush, 2003). The significant aspect of the respondents was that, they practice organic vegetable production.

3.3 Sampling technique, sample size and data analysis

This study used purposive sampling for the selection of participants. As argued by Teddlie and Yu (2007), purposive sampling is described as non-probability sampling where a respondent is deliberately selected due to some qualities they possess. Tongco (2007), also posit that purposive sampling can be used if time and resources are constraining factors in adopting a random sampling. The sample size for the study was twenty-seven, 24 farmers and 3 Municipal Agricultural Officers as key informants due to limited resources. The farmers were selected from the four vegetable growing communities as mentioned in the study area above. The rationale behind the use of purposive sampling was to get the maximum variations of respondents. Thus, this was done to ensure that farmers with different socio-economic profiles (e.g., age, gender, education, plant cultivated, etc.) are represented. Qualitative data collected through different methods such as observations, case studies and in-depth interviews were subject to qualitative contextual analysis however, the researcher will only discuss trends. All data collected were conducted in Twi (since is it the predominant language) then translated into English.

3.4 Justification of the study

Climate-Smart Agriculture has been stipulated to be a "unifying concept on climate change and agriculture" (Naess, 2011). Not only does it increase productivity, but it strategically positions farmers to build resilience and concurrently mitigates GHGs with goals to improve food security and national development, notably among developing countries. CSA calls for proactive and smart institutions to manage current and future climate risks likely to be experienced by farmers or assist them in taking advantage of the opportunities that climate change may bring. For instance, successful adoption of CSA by farmers in Asokwa Municipal will require institutions to induce innovations which will boost food security, provide information and also facilitate them to access storage facilities and inputs. However, this still remains a challenge in the study area. Despite the extent of the problem, very little research has been carried out within that scope. Thus, this study seeks to produce valuable information that could be used in developing an effective policy to promote CSA in the Municipal and beyond.

4. Results

4.1 Bio-data of the participants

I will now describe the demographic characteristics of the respondents. By this I mean educational background, gender and age distribution. These characteristics are believed to influence agricultural production and may also inspire decision to adopt Climate-Smart Agriculture practices.

Table 1: Educational background of participants

Educational background	Gyinyase	Karikari farms	Ramseyer	Kaase	Total	Percentage
No formal education	0	0	0	0	0	0
Primary	2	1	1	0	4	16.7
JHS/MSLC	2	2	1	0	5	20.8
SHS/O` & A` Level	6	3	2	2	13	54.2
Tertiary	2	0	0	0	2	8.3
					24	100

From the Table 1, it could be inferred that all the participants had at least some form of education. The participants educational background starts from Primary, Junior High School (JHS) / Middle School Leaving Certificate (MSLC), Senior High School (SHS) / Ordinary Level (O` Level) and Advanced Level (A` Level) through to tertiary.

Table 2: Gender distribution

Gender distribution	Gyinyase	Karikari farms	Ramseyer	Kaase	Total	Percentage
Male	8	5	2	2	17	70.8
Female	4	1	2	0	7	29.2
					24	100

Table 2 shows that male farmers outdo females in vegetable cultivation. The few females in the study area were due to the fact that vegetable production was laborious and most of the work were done by men.

Table 3: Age distribution of the participants

Age distribution	Gyinyase	Karikari farms	Ramseyer	Kaase	Total	Percentage
Below 20	0	0	0	0	0	0
20 – 25	1	0	1	0	2	8.33
26 – 30	3	0	1	2	6	25
31 – 35	2	3	2	0	7	29.17
36 – 40	2	1	0	0	3	12.5
41 - 45	3	1	0	0	4	16.67
46 – 50	1	1	0	0	2	8.33
51 – 55	0	0	0	0	0	0
56 - 60	0	0	0	0	0	0
Above 60	0	0	0	0	0	0
					24	100

It could be said from table 3 that vegetable farmers within Asokwa Municipal were between the ages of 20 and 50. This presupposes that if a person is above 50 years of age it will be relatively difficult to go into intensive vegetable cultivation. A farmer from 41–45-year age group said that young men were farming, it was the case that only old people farmed in the past but that has changed now

4.2 Existing CSA practices adopted by the participants

The study revealed that the participants were aware of most of the CSA practices but they have adopted the concept differently. Some of the existing CSA practices adopted by the farmers are represented in Table 4.

Table 4: The rate of adoption of CSA by participants.

CSA practices	Percentage of awareness	Number of Adopted participants	Percentage of adopted
Crop rotation	79.2	16	66.7
Improved crop varieties	100	24	100
Mulching	45.8	2	8.3
Compost application	20.8	1	4.2
Agroforestry	33.3	3	12.5
Irrigation	100	24	100
Manure management	100	24	100
Rain harvesting	50	2	8.3

Frequencies are reported and from the Table 4 so far, all the CSA practices have been adopted although not at the same rate. It is also important to note that the participants in question are organic vegetable farmers, therefore the practices that has been widely adopted by them are critical in their situation. Widely adopted practices included improved crop varieties, irrigation, manure management, crop rotation and rain harvesting. The adoption of these practices has been associated with the promotion of food security, soil organic matter enhancement, carbon sequestration and livelihood development which supports both adaptation and mitigation objectives.

Two of the farmers said that the biggest problem in the past was the control and use of inorganic agro-chemical - people harvest the crops before a safe period and this endangers the health of the consumer. It could be said of the study that, there was an indication of some sort of CSA promotion which has induced the participants adoption. Participants were more aware of sustainable agriculture and organic agriculture than the term CSA. The commonly adopted practices were consistent with studies done by (Branca et al., 2011; Scherr, Shames, and Friedman, 2012; Garrity, Akinnifesi, and Ajayi, 2010). That confirm that the adoption has been associated with the promotion of food and nutrition security and soil organic matter enrichment. This is to presume that, for successful adoption of CSA, there is the need to develop strategies that will provide multiple benefits to the practitioners.

4.3 Institutional provisions available to promote CSA

In all the study sites the only institution that were still available to promote CSA was Ministry of Food and Agriculture (MoFA). It was also found that, Rocha Ghana which was best known for Climate Steward programme, has a native tree species plantation at Gyinyase (one of the study sites). The trees planted maximises land use in that it could be pruned for firewood or cut for timber and sequester carbon. Although the project was ongoing but Rocha Ghana has left for a couple of years now. As a result, Officers from Ministry of Food and Agriculture were interviewed to gain additional information about their activities on promoting CSA. MoFA has instituted several strategies through trainings, field demonstration, home and farm visits, educational tours and other means to get the farmers abreast with CSA practices.

There was also provision of subsidised improved seeds to farmers through flagship programme in the agricultural sector called Planting for Food and Jobs (PFJ). This programme was made possible by the Government of Ghana to promote enterprise-based agriculture and inclusive value chains. The PFJ was also made to promote demand-driven agricultural development, focusing on improving productivity through the application of knowledge, information and technology to enhance the quantity, quality and timely delivery of agricultural produce for value addition. Several approaches have been rolled out by MoFA which are geared towards CSA adoption, but the researcher believes that there were still more strategies to be applied.

The Ministry (MoFA) could collaborate with Ghana Meteorological Agency for daily, monthly or long-term weather forecast. This would help farmers to plan ahead strategically. Soils should be tested from time to time to know the nutrient status before any additional organic matter added. Again, the right Integrated Pest and Production Management (IPPM) practices should be introduced to the farmers as pertained to their situation. Irrigation equipment could be made available to the farmers at a subsidized price like improved seeds. This would help them to take advantage on erratic rainfall that has brought about by Climate change. All these needs to be done in partnership with MoFA and other existing institutions like research, Environmental Protection Agency etc. The findings from the study suggest that, to achieve any effective adaptation action, there should be a total collaboration with all the existing institutions or stakeholders.

4.4 Factors that inhibit adoption of CSA practices

The results from the field (through the interview) suggest that several factors including insufficient information on weather, water scarcities and financial constraints inhibit effective adoption of CSA practices. This in return accounted for low adoption of agroforestry, mulching, rain harvesting and compost application. These constraints call for collaborative institutional support. The participants mentioned that, agroforestry takes too much time, labour intensive and relatively expensive. Most participants expressed disinterest in the use of mulch because of the tedious nature in carrying out the task and the cost of getting the materials. On the issue of rain harvesting, participants cited that rainfall has been erratic and the cost involved in getting materials was relatively high.

The two farmers who have adopted the rain harvesting practice said that people do not believe them when they try to teach about water harvesting. Finally, on the issue of compost application, the factors that accounted for low adoption rate was due to the fact that composting takes relatively too long a time to mature. It could be said that, facilitating effective CSA adoption goes far beyond providing just an information and disseminating technologies. However, identifying inclusivity (of all stakeholders) as a priority in both decision-making through to the assessments of costs and benefits of any intervention will enhance CSA adoption. Although the findings represent the author's subjective view but the issues raised could be generalised to a broader region in Ghana.

5. Discussion

Agricultural sector must become climate-smart to successfully tackle climate change and current food security challenges. Climate-Smart Agriculture is not a new agricultural system, nor a set of practices. It is just a new approach, a way to guide the needed changes of agricultural systems, given the necessity to jointly address food security and climate change. The CSA has become a pathway towards development and food security and it is built on three pillars: increasing productivity, enhancing resilience of livelihoods and ecosystems and reducing and removing greenhouse gas emissions from the atmosphere. Early action is needed to identify, pilot and scale-up best practices, strengthen institutional capacities, and build experiences that can help stakeholders make informed choices to make the transformation to Climate-Smart Agriculture.

Tools and knowledge on Climate-Smart Agriculture must be further developed and shared. There must be investment in education, capacity development and communication. Inter-sectoral approaches and consistent policies across the agricultural, food security and climate change are necessary at all levels. The agricultural sector can be an important part of the solution to climate change by capturing synergies that exist among activities to develop more productive food systems and improve natural resource management. Sustainable utilization of natural resources will require management and governance practices based on ecosystem approaches that involve multi-stakeholder and multi-sectoral coordination and cooperation. This is a crucial element for the transformation to climate-smart agriculture.

6. Conclusion

The results indicate that farmers were aware of some sort of CSA practices. Further analysis of MoFA's institutional roles indicated that their role in structuring impacts and risks were not effectively carried out. There is the need for the provision of credible meteorological information such as seasonal climate predictions and updates to help farmers plan their activities. Most farmers doubted the credibility of weather-related information given to them from the media because there are several instances where weather events did not occur as predicted. Therefore, there is the need for Ghana Meteorological Agency to strengthen the credibility of climate information reaching farmers, so they can confidently rely on such information and adapt to reduce the risk of crop failures. In an effort to promote Climate Smart Agriculture practices all the participants have become more socially included and perceive that the adoption of CSA would improve and maintain a healthy and sound environment.

The study revealed that for farming to be sustainable, there is the need for improvement in soil fertility. The unpredictability of rainfall and other climatic elements is confirmed by the perception of participants in the study area. Majority of the participants have noticed a decreased in rainfall patterns and increased periods of drought. To them precipitation has been unpredictable and they perceive that there has been delay in the onset of the wet season. Thus, the participants perceive a sharp change in rainfall and temperature than any other elements of the weather. There is the need to identify coping strategies and the factors that influence that adaptation of the identified strategies. The empirical results show that there are more young farmers and they should be targeted and involve in training programmes and workshops related to climate change.

This will not only guarantee the future of food security status but also reduce youth unemployment in the country. Irrigation and rain harvesting as an adaptation strategy are common among the farmers in the Asokwa Municipal. This presupposes that farming in the Municipal is not rainfall dependent. Government in collaboration with civil societies or the private sector need to channel more resources into the investment of soil and water conservation strategies. Considering the complexities in terms of changing farmer's behaviour and strategies in adopting CSAs, there will be the need for frequent extension services to farmers to enable them successfully adopt best practices.

Extension services will also serve as a platform for sensitising farmers on the importance of adopting CSA practices and ensure both men and women can successfully operate in an environment without political, economic or sociocultural hindrances. Numerous practices and technologies that can contribute to reaching the objectives of Climate-Smart Agriculture already exist. However, increased investments are needed to build the institutional capacity to support their adoption. Investments will also be needed to address gaps in knowledge and technology to support uptake at any local level. Finally, the technologies, practices and services adopted by farmers directly or indirectly contribute to improve productivity, enhance resilience and reduce GHG emission. Practices that help to improve at least one component can be considered as CSA.

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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study was reported; that no vital features of the study have been omitted.

Ethical approval and consent to participate: This study follows all ethical practices during writing. Consent to participate was obtained from each respondent.

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