Building Resilience to Climate Change with Ecosystem Based Adaptation (EBA) Driven Agriculture: Farmers Perception in Eastern Ghana

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Abstract

Climate change increasingly brings about unpredictable weather resulting in droughts in some places and flooding in other places. When these events happen, farmers suffer especially resource poor farmers with low income, small land holdings and ill-equiped to accommodate the climate related problems. In this project, researchers, employed training in Ecosystem Based Adaptation technologies, establishing experimental plots where participating farmers learned practically and participating farmers completed questionnaire in two communities in the Eastern Region of Ghana. Results show that farmers adopted several EBA driven agricultural practices, including altering planting dates, intercropping with trees, food crops and mixed cropping. Other technologies adopted included; ridges, and mounds. Research further revealed that, most participating farmers (61%) increased their yield from about 26 to 40 percent. Also, 19 % of them showed that the increase in yields through this EBA driven practices is above 40% of their produces as compared to the baseline where these methods were not used extensively. Participating farmers would like to see new policy directive work to ensure that there are: Investments into rural development, including; soil improvements, improving marketing facilities and linkages, and building of good road networks which should all serve as important preconditions for development and sustainability of EBA approaches.

Keywords: Climate change, Ecosystem, Technologies, Farmers, crop yields, policy

Introduction

The IPCC (2008) report noted that global warming is impacting on the hydrological cycle and hydrological systems as evidenced by changing precipitation patterns, intensity and extremes; widespread melting of snow and ice; increasing atmospheric vapour; increasing evaporation; and changes in soil moisture and runoff. Growing water scarcity, increasing population, degradation of shared freshwater ecosystems, and competing demands for shrinking natural resources distributed over an area involving many riparian states have the potential for creating bi- and multi-lateral conflicts (Manase, 2010). Ecosystem-based management is an environmental management approach that recognized the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation (Christensen et al. 1996, McLeod et al. 2005). According to Yaffee, (1999); terrestrial ecosystem-based management (often referred to as ecosystem management) came into its own during the conflicts over endangered species protection (particularly the northern spotted owl), land conservation, and water, grazing and timber rights in the western United States in the 1980s and 1990s.

The management of soil to improve organic content in the soil results in improved fertility that results in immediate improvement in moisture holding capacity and crop yield increases The impacts of climate change for farmers includes erratic and unpredictable rainfall in amount and distribution. This makes improvements in water-holding capacity a big adaptation advantage. One of the best ways to improve the organic content of soils in poor rural, low resource areas is to transfer animal manure into those soils and to retain residues and dig them back into the soil. The reliable access to water for both domestic and productive uses is essential to reduce undernutrition in Ghana and other places in Africa, where the vast majority of smallholder farmers still depend on rain-fed agriculture despite high seasonal and inter-annual rainfall variability. Yields for both crops and livestock have stagnated or grown only slowly for decades; as a result, net food imports of basic staple foods have increased rapidly in order to feed the growing population. Climate change and continued population growth are expected to exacerbate food and nutrition security challenges in the region moving forward, adversely affecting progress toward reducing undernutrition.

Investing in effective water management may also be profitable. In most places in rural Ghana the potential may be largest for small-scale irrigation which can be fit more flexibly into many different settings while irrigation supported by a large dam is important in the very dry areas. Springler (2015) estimate that, a total capital investment of US$12.7 billion per year through the year 2050 could profitably develop up to 24 million hectares (ha) of irrigated agricultural land in sub-Saharan Africa (SSA) without depleting water resources, up from about eight million ha in 2010.

Springler reiterated that “the time for investment is now as the region’s population deserves access to water for productive uses in order to increase food and nutrition security, increase resilience in the face of growing climate variability, and conserve remaining forested areas”

To address food security and achieve the Malabo Declaration commitment to end hunger by 2025, there is need for efficient and effective water management systems through

EBA technologies is essential for raising agricultural productivity levels and helping achieve the. Promoting resilience of livelihoods and production systems to climate variability by increasing investments for resilience building EBA is inline with achieving the commitments of the Malabo Declaration. Environmental Based Adaptation technologies has many other roles beyond ensuring stable and increased food production under more variable climate. Through increased agricultural productivity and crop diversification the EBA can be a source of diverse food to support livelihoods in rural communities. Additionally through the sales of excess foodstuff to the local and external markets and the employment it generates in the process especially in minor or lean seasons, EBA technologies can become source of income to impoverished rural livelihoods. Finally, the implementation of EBA technologies can serve as the window of opportunity for rural women's empowerment through the training the receive to better manage their land resources and exercise control over resources and reduced time spent on practices that do not work for them

This study reports on a project implemented in two locations in the Eastern Region of Ghana to address the following goals:

- Mitigate critical environmental problems in the two locations in Eastern of Ghana
- Train farmers in the two communities to tackle hunger and environmental degradation by managing efficiently land and water; growing crops, trees and managing the ecosystem sustainably
- Provide hands-on training on sustainable agriculture, and low-cost green solutions to help rural families and communities conserve the environment
- Seek opinion on how farmers want government to assist by way of policy interventions

The risk addressed were Critical environmental problems –degradation, heavily leached, degraded and soils deficient in nutrients, erratic rainfall patterns, poverty and hunger, deforestation, low incomes, lack of knowledge or Ignorance?

Methodology

The methods employed entailed a community based education and training programme during which farmers were exposed to various EBA driven and sustainable agricultural practices. The project also established community demonstration farms and tree nurseries to serve as experimental fields where farmers worked with trained volunteers to implement best practices. Farmers then transferred sustainable farming practices back to their own farms. Volunteers work with farmers through the season in two villages in the Eastern Region of Ghana. The field training and work with volunteers started in 2013, farm visits also started in 2013 as well as meetings with farmers and farmer group meetings. The paper based questionnaire survey was carried out in 2015 to understand critical issues affecting EBA driven agriculture in the two rural communities namely:

- How did the training on EBA driven agriculture helped farmers improved their crop yields and food security?
- What EBA driven practices were implemented by farmers?
- What important issues do farmers want to see addressed by policy decisions?

The study was a cross sectional in that, the relevant data was collected only at a point in time when each respondent was asked to complete the questionnaire.

Population and Sample Sizes of the study

Population for the study comprised farmers both women and men within the two communities. The study population was estimated to be 1000 farmers .The sample size was 211. Only respondents who claimed to have participated in one or all of the training section were included in the study.

Questionnaire Development

The questionnaire employed Likert scale with five levels ranging from strongly agree (5 points), agree (4 points), uncertain (3 points) disagree (2 points) and strongly disagree (1point) and in some cases yes or no answer was used.

Validation of Instruments

The instruments for the study was assessed for content and construct validity. Each item of the instrument was carefully analyzed and checked to ensure that it conveyed the necessary message.

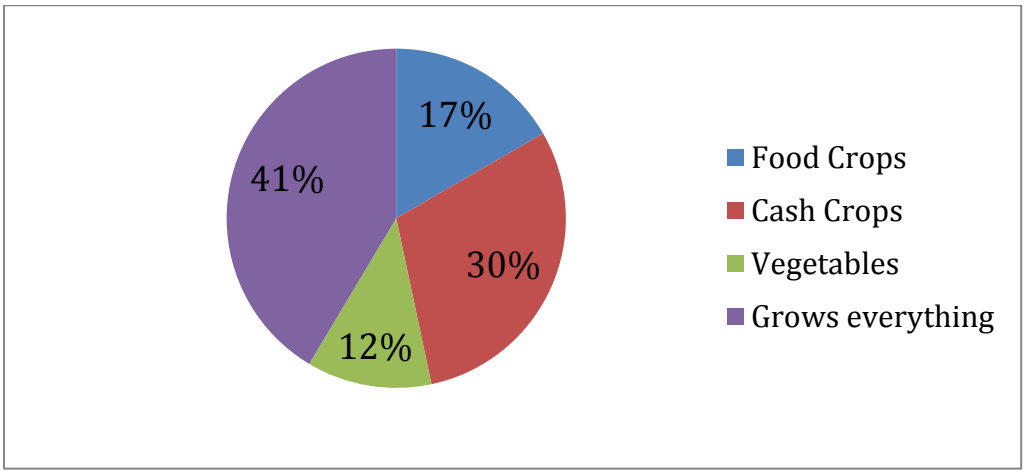
Results

Ecosystem Based Adaptation for Food Security Project Survey

On the demographic characteristics of famers under study, Fig. 1 indicates respondents' farming activities, category of farmers under study and the farm size they cultivate. From the distribution of patronized farming activities shown in the pie chart below it is assessed that majority of farmers under study cultivate all types of crops. The study indicates that 41% of the respondents grow everything in their farmlands. Also, it is observed from the pie chart that cash crops are seen to be the second patronized farming activity of respondents (30%). Food crops was shown to be patronized by the farmers, 17% of the study respondents made this assertion. However, a few of 12% of the study indicated that they patronized vegetables only. We can infer that since most of farmers may need all types of farm produce to cater for their families, they grow food crops, cash

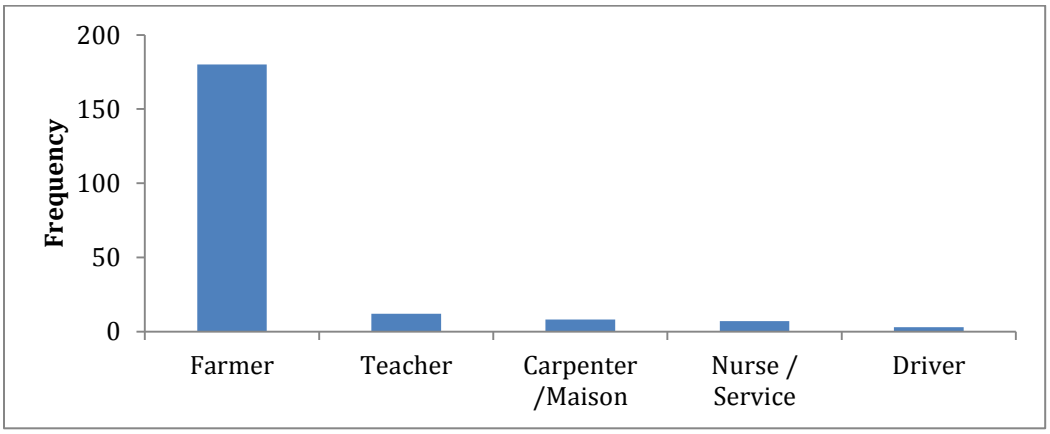
crops and vegetables altogether on a piece of farmland. This indicates that proper care (security) is needed about the farm products grown in this area.

Fig. 1. Distribution of various patronised farming activities



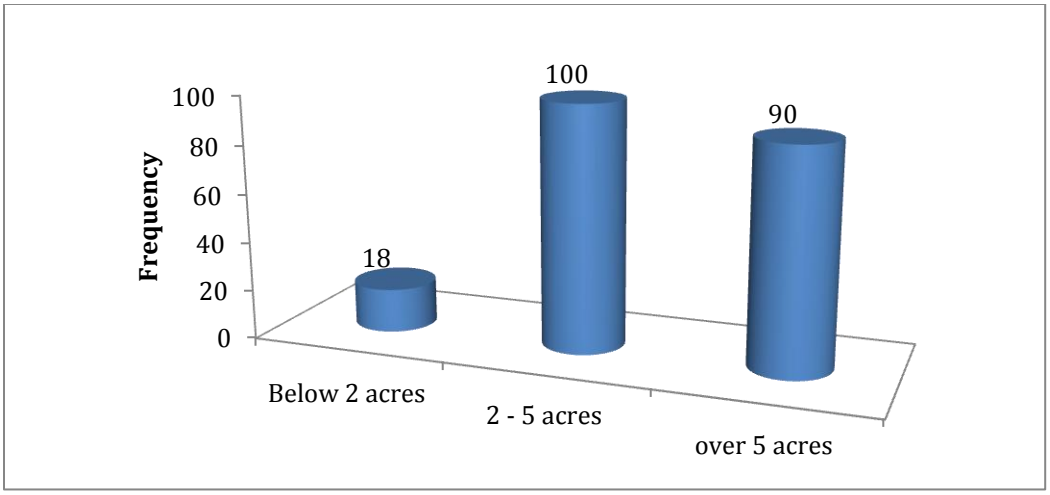
It was also observed that respondents' primary occupation wasn't farming. Although the study revealed that most of the study respondents primary occupation was farming, we can assess that other respondents who primary occupation were as Teacher, Carpenter/Mason, Nurse/Service personnel's and drivers all patronize farming. However, since majority of the study respondents are farmers, it indicates that the sample of the study provided the in-depth knowledge of the EBA activities providing food security.

Fig 2. Category of farmers studied



Farm sizes of respondents as shown the bar graph below also informs that majority of the farmers under study are medium to large scale. It is asserted that the 100 farmers had farm size of 2-5 acres whiles 90 respondents also had over 5 acres of farming lands. It is shown that a few (18) cultivated on farm lands below 2 acres.

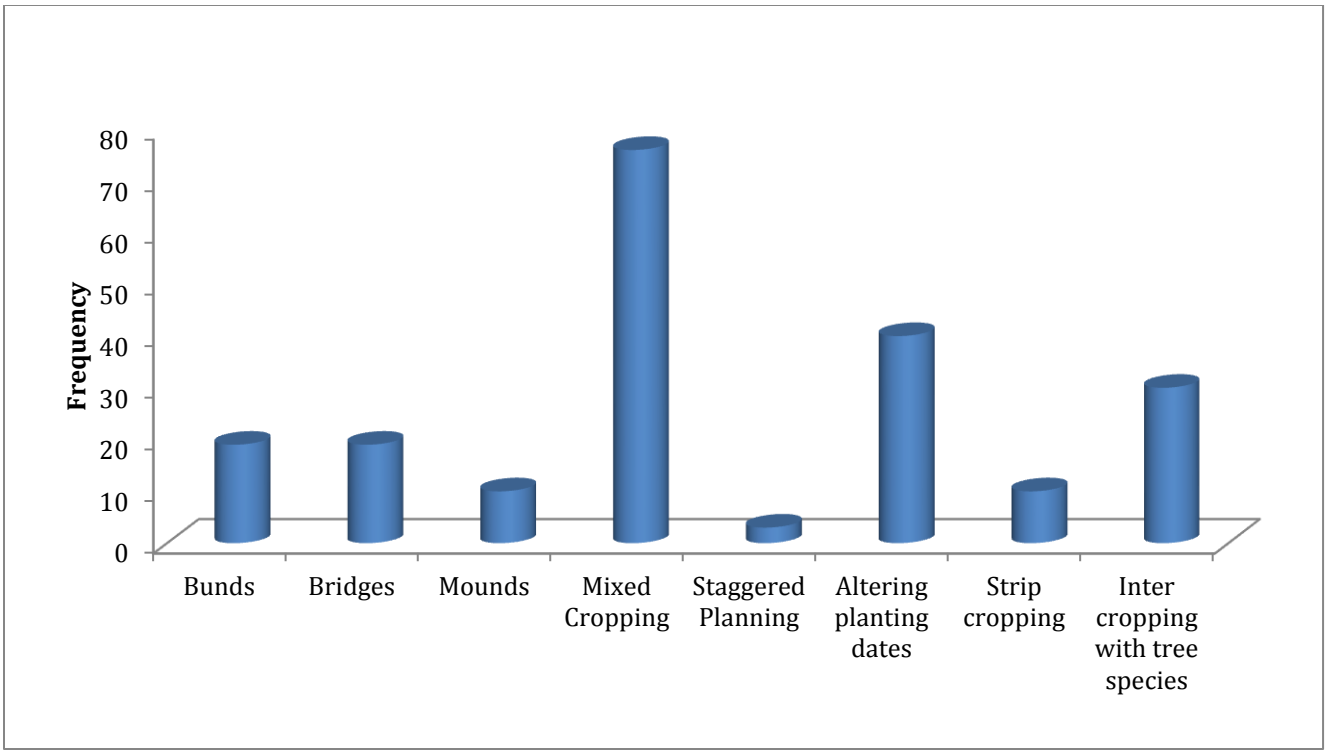
Fig 3. Sizes of farm holdings



Respondents were asked if the participated in this intervention, the activities they practiced most and whether the EBA activities improves food security. as shown in the table below it is indicated that 89.6% of the respondents are aware and participate in the activities. Meanwhile, 1.4% of the respondents indicated they were on aware of the activity whiles 9.0% indicated non response to this statement. Majority of the respondents has indicated their awareness of the EBA activities and adoption of the activities involved.

Farmers' used the mixed cropping strategy the most. Also, it subsequently shown that farmers also adopt the altering planting date method to prevent food insecurity. Meanwhile the method of intercropping with trees is also third major used EBA activity. It can be assessed from the above that since, it was shown in the pie char above that farmers grows everything, the EBA activities such as the mixed cropping, altering planting and the inter cropping provides a secure way of bringing food, cash and vegetables on a farmland. However, it shown that the ridges, mounds, staggered and strip cropping are all EBA activities that are adopt**ed**

Fig. 5. EBA driven agricultural practices,



On adapting to the various activities by farmers, the study shows that EBA intervention has improved the yield of respondents to some extent. 98% of the respondents indicated that EBA intervention have come to improve the yield of farm products. A few of 2% of the study respondents shown that the EBA intervention has yielded no improvement in the yield they cultivated. Determining the level of security before and after the implementation of EBA intervention, respondents were asked to indicate their security status. From Table 1 below, it is shown that farmers 0.9% of famers were secure whiles 98.1% were insecure before the adoption of EBA driven agriculture. However, respondents indicated that after the adoption, 95.7% of them were secure in food needs. We can infer that these interventions have added about 94.8% of security to the farmers products and therefore has reduced the food lost for majority of farmers who practiced EBA driven practices.

Table 1. EBA driven agricultural practices and food security

	Food security issues	
Response	Before	After
Secure	2(0.9%)	202(95.7%)
Insecure	207(98.1%)	3(1.4%)
Don't Know	2(0.9%)	6(2.8%)

Respondents were able to quantify how much increment is earned based on adapting to this intervention. It is shown in the table below that reducing food lost and food waste by

this intervention, most farmers (61.1%) are able to increase their yield from about 26 to 40 percent of their products. Also, 19.0% of them showed that the increase of productivity through this intervention is above 40% of their produces as compared to before the usage of these methods. The rest of the study respondents also indicated that there was an increase from 1 to 25 percent of the product as compared to the previous where there was no intervention.

Table 2. Data on farmers yield increases

Response	Frequency	Percent
1 - 10 %	6	2.8
11 - 25 %	32	15.2
26 - 40 %	129	61.1
above 40%	40	19.0
Non Response	4	1.9
Total	**211**	**100.0**

EBA driven agriculture has improved the yield of farmers produce, we identify how the approach used to restore and produce such increase. It is shown in the table 3 below that EBA driven agricultural practices improved soil fertility by minimizing soil and nutrient erosion and also provided better ways to water rejuvenation and moisture retention.

Table 3. EBA driven agriculture and soil fertility

Response	YES	NO
Enhance Soil Fertility	210(99.5%)	1(1%)
minimize soil and nutrient erosion m	211(100%)	__
water rejuvenation and moisture retention	211(100%)	__

Also seeking for farmers view on what other should be done about the EBA intervention, respondents indicated that stakeholders and Government should educate farmers well on the activities of the EBA intervention so that farmers will increase in their productivity. The respondents also made aware that there should be public awareness of the EBA interventions to make sure that the approach gets taken up into the policy.

On the question of wbat must be done by way of policy directives, farmers had this to say (Table 4)

Table 4. Policy directive to help EBA driven agriculture

Approach	Frequency	Percent
Educate Farmers	126	59.7
Public Awareness	15	7.1
Guaranteed markets	70	33.2
Total	**211**	**100.0**

Majority, 49.3% farmers request that there will be more food processing industries setup so as to help in the processing and preserving of food products. Farmers acknowledge that introducing more EBA practices will also help farmers produce more. There is a need that more education and awareness of the EBA activities will be reached to farmers in order to harvest more produce from their farmland.

Table 5. Policy changes farmers want to see

Changes	Frequency	Percent
Setup more Food processing Industry	104	49.3
Introduce More EBA activities to farmers	37	17.5
Create Guaranteed Markets	70	33.2
Total	**211**	**100.0**

They also suggested that some incentives such as providing capital to go more it into mechanic farming in other to produce more is necessary. They emphasized that they require farming tools that can better speed up the activities that are outlined by the EBA.

Table 6. Incentives to motivate farmers adopt EBA driven practices

Incentives Required	Frequency	Percent
Provide capital to farmers	40	19.0
Provide Farming Tools and Inputs	101	47.9
Provide Assured Markets	70	33.2
Total	**211**	**100.0**

Conclusion

***Conclusions and recommendations*.** In the future, food systems are likely to change for a number of reasons, including increased global affluence and the challenges of feeding a global population that may reach nine billion persons by the 2050s (Royal Society 2009). Our review highlights anthropogenic climate change as a further important factor and summarizes some of the impacts that it may have on nutrition and food safety in developed countries. One of the more certain impacts is increasing food prices once global temperatures rise more than 3°C, which may lead to increasingly unhealthy food choices and exacerbate existing health inequalities.

An altered climate will mean that food will be produced under different environmental conditions and, coupled with adaptations to and mitigations against climate change, food production will be very different in the future. These changes will result in emerging pathogens, new crop and livestock species, altered use of pesticides and veterinary medicines and will likely affect the main transfer mechanisms though which contaminants move from the environment to food. All these may have implications for food safety and the nutritional content of food.

Effects of climate change on food safety may be highly localized, with the foods most at risk being those produced in areas undergoing rapid environmental change, agricultural adaptation, or mitigation. Individuals from vulnerable groups where dietary intakes are already suboptimal (e.g., persons with low incomes, migrant workers) and nutrient density requirements are elevated (e.g., pregnancy, childhood, old age) also may be at increased risk. As mitigation against climate change, individuals may start to consume food produced with lower-GHG emissions. Such changes imply lower red meat and dairy consumption, which would have positive effects in terms of lower rates of cardiovascular disease but may result in higher prevalence of iron and zinc deficiencies. Consumption of more locally produced and seasonal food may lead to insufficient fresh fruit and vegetable intakes at various times of the year in temperate countries. Developed countries have monitoring structures and policies that may limit potential effects of climate change on food safety. We suggest that the structures in place to respond to nutritional challenges

are less robust, especially due to the potential conflicts between public health and industry.

Much of the climate change and food research discussed in this paper is based on a range of standard IPCC scenarios on how climate may change and has not considered outlier scenarios, changes in extreme events, or more rapid or complex changes in climate (Butler 2010). These conditions could have more drastic consequences for food than those discussed in this paper. However, one of the first assessments of such impacts suggests that a collapse in the Atlantic thermohaline circulation would not have large impacts upon agriculture in Europe (Kuhlbrodt et al. 2009).

Given the significant uncertainty about potential effects of climate change on food security, we recommend further research to quantify possible impacts on nutrition and food safety, including effects resulting from increasing food prices and changes in consumer behavior. In addition, it is important to maintain and strengthen existing structures and policies to regulate food production, monitor the quality and safety of food, and respond to nutritional or safety issues that arise. Climate change also may require enhanced use of emerging risk identification systems to detect new food safety problems at the earliest opportunity. Environmental and health sectors must work together to take advantage of areas of common ground (e.g., promoting reduced red meat consumption to lower GHG emissions and reduce the incidence of ischemic heart disease) and resolve potential conflicts (e.g., greater consumption of seasonal food to lower GHG emissions conflicting with health goals for year round consumption of fruit and vegetables). Such cooperation is essential to provide consistent health and environmental messages to the public and develop suitable interventions.

References