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HOUSEHOLDS' LIVELIHOOD ADAPTATION STRATEGIES AFTER THE CLOSURE OF LARGE-SCALE JATROPHA INVESTMENT: A CASE OF MION DISTRICT IN THE NORTHERN REGION OF GHANA

John Amoah-Nuamah[1], Clarke Ebow Yalley[2]*, Martin Maxmillian Acquah[3] and Wahab Musah-Abdul[4]

Department of Geography Education, University of Education, Winneba-Ghana [1]
Department of Social Studies Education, University of Education, Winneba-Ghana[2]
Department of Arts and Social Science, Our Lady of Apostle College of Education, Cape Coast-Ghana[3]
Department of Planning, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana[4]

Abstract

African possesses the largest land acquisition ratio as compared to other continents. Based on this, a Biofuel Africa Ltd a Norwegian biofuel company acquired over 23, 000 hectares of arable land for the cultivation of Jatropha in Mion District which created job opportunities, improved health care facilities and ensured access to quality education. All these resulted in the improvement of the livelihood conditions of the rural populace. However, due to due to lack of a ready accessible market, unfavorable weather conditions, pest and disease damages, low yield, and high cost of maintenance of farming logistics led to the seizure of operations by the Biofuel Africa Ltd. What then becomes the livelihood condition of the locals who depended on operations of the Biofuel Africa Ltd operations for survival. It is against this backdrop that this study sought to investigate the households' livelihood adaptation strategies after the closure of large-scale Jatropha investment in the Mion District in the Northern Region of Ghana. The case study framework, simple random sampling technique, close-ended questionnaire as well as a semi-structured interview guide were used for this study. The study's findings revealed that the adaptation strategies intensive farming, mixed cropping, shared land with relatives or friends, acquisition of land from other communities, petty trading, migration, encroachment, off-season farming and multiple strategies had a marginal positive effect on their livelihood outcomes. It is therefore recommended that land lease should be done within a midterm period with subsequent renewal. This will create an enabling environment to allow the rural population to return to their land if the company decide to stop operating.

Keywords: Biofuel, Jatropha Plantation, livelihoods, Livelihood Adaptation Strategies, land Grabbing

Introduction

Global demand for energy is set to increase significantly in the coming decades, especially in the midst of rapid economic development, industrialization and rapid population growth in the developing world (Brahmbhatt, Haddaoui, & Page, 2017). Biofuel from plant sources has swiftly emerged as a central issue for natural resource managers, agricultural developers, and energy policy makers(Sulle & Nelson, 2009). The growing interest in the expansion of the biofuel industry is driven by rising fuel prices, increasing concerns about global climate change, exhaustive nature convention fuel, and desire to ensure rural development (Danso, 2015). In Ghana, the Ministry of Energy and Natural Resources drafted an energy plan in 2006 to solve its energy problems. It was aimed at producing 10% of biodiesel by the end of 2015 (Ben Hagan, 2015). However, in 2010 the Energy Ministry came out with new bioenergy policy to substitute the national consumption of fossil fuel with 10% and 20% bioenergy by 2020 and 2030 respectively (Energy Commission, 2010). This and other reasons such as favourable political and physical environment created the enabling environment for the cultivation and production of biofuel (Hamenoo, 2014). This has led to the influx of several Jatropha companies in Ghana. According to Hamenoo (2014),

there are about 17 biofuel companies in Ghana with 15 owned by foreign nationals. German et al., (2011) asserted that out of the total land acquired by Jatropha companies about 1,075,000 hectares of the land were situated in the forest-savannah transition zone which covers the Ashanti Region, Northern Region and Brong Ahafo Region of Ghana. It is imperative to state that the production and use of biofuel as an alternative source of fuel has been spearheaded by developed countries (Sulle & Nelson, 2009a). The utmost intention was to improve the livelihood opportunities of rural development, providing alternative energy sources and mitigating the alarming rate of greenhouse gases emissions. Specifically, Biofuel Africa Ltd a Norwegian biofuel company in 2008 acquired over 23, 000 hectares of arable land for the cultivation of Jatropha in Kpachaa, Jimle and Kpalkore communities in Mion District (Danso, 2015). According to Danso (2015), Biofuel Africa Project alone provided about 300 jobs, engaged in the construction of schools and clinics to improve livelihood conditions, accessibility to education and health of the local people living within the study communities.

Despite the gains and intended alternative to improve the livelihood opportunities to rural population, the Biofuel Africa Ltd a Norwegian biofuel company abandoned the plantations. The halt of operation by the company was due to lack of a ready accessible market, unfavorable weather conditions, pest and disease damages, low yield, high cost of maintenance of farming logistics and inadequate funds for project continuity. The seizure of Biofuel Africa Ltd plantation project resulted in the decline of regular payment of subsides causing a reduction in the wealth positioning of the indigenous people, decline in the operations of the schools and clinics. Coupled with these negative effects, the local people displaced by the Biofuel Africa Ltd plantation could not return to their lands because the lease period contract has not expired. Consequently, this phenomenon displaced the livelihoods opportunities of people who depended on these lands for survival will be worse off economically, financially and property acquisition. This outcome is manifested through the locals lost their wage employment as well as the lands that provided and sustained their livelihoods through either cultivation of crops or the rearing of farm animals. This phenomenon is likely to have resultant effects on the poverty level, deprivation of health and educational opportunities, widen the socio-inequality gap among the rural people within the Mion District. It therefore becomes imperative to conduct a study to ascertain how households are adaptation strategies amidst the closure of the Jatropha project.

Qualitative studies have been conducted on farmers adaptation of Jatropha plantations as their livelihood adaptation strategy (Basiinger et a., 2012; Mogaka et al., 2014), abandonment of Jatropha cultivation (Ahmed et al., 2017; Slingerland & Schut, 2014), reasons that lead to the discontinuity of Jatropha cultivation (Goswami & Choudhury, 2015) and effects of Jatropha plantations on the livelihoods of the rural population while the projects were in operation (Acheampong & Campion, 2014; Acheampong & Betey, 2013a; Danso, 2015; Favretto, Stringer, & Dougill, 2014; German et al., 2011; Timko, Amsalu, Acheampong, & Teferi, 2014; Van Eijck et al., 2014). Within the Ghanaian context, Schoneveld (2011) used a content analysis explore the how affected people in large scale land deals in the Brong-Ahafo Region whiles Boamah (2010) also explored Jatropha biofuel project and its effect on food security in the affected communities in Northern Ghana. Gauging from studies reviewed, it seems to suggest that limited studies exist to ascertain the households' livelihood adaptation strategies of rural population after the closure of large scale Jatropha investment. It is against this backdrop that this study aims to address the methodological, literature and respondents gap by adopting the mixed method approach to investigate the households' livelihood adaptation strategies after the closure of large scale Jatropha investment in the Mion District in the Northern Region of Ghana.

Research Questions

The following research questions guided the study:

i. What are the adaptation strategies employed by household after the closure of large-scale Jatropha investment?
ii. What is the impact of the adaptation mechanisms adopted by household on their livelihood outcomes?

Literature Review

Coping and Adaptation Theory

The theory of adaptation is a multidisciplinary theory which has its roots from the natural sciences, specifically evolutionary biological science (Smit & Wandel, 2006b). Despite the fact that the meaning of adaptation stems from the natural sciences is debated, it extensively alludes to the improvement of genetics attributes which makes living organisms or systems to cope with natural changes, so as to live and procreate (Kitano, 2002). The idea of adapting in the scope of natural sciences includes scales from individual organisms to the entire population of a particular species of organisms or the total ecosystem (Krimbas, 2004).

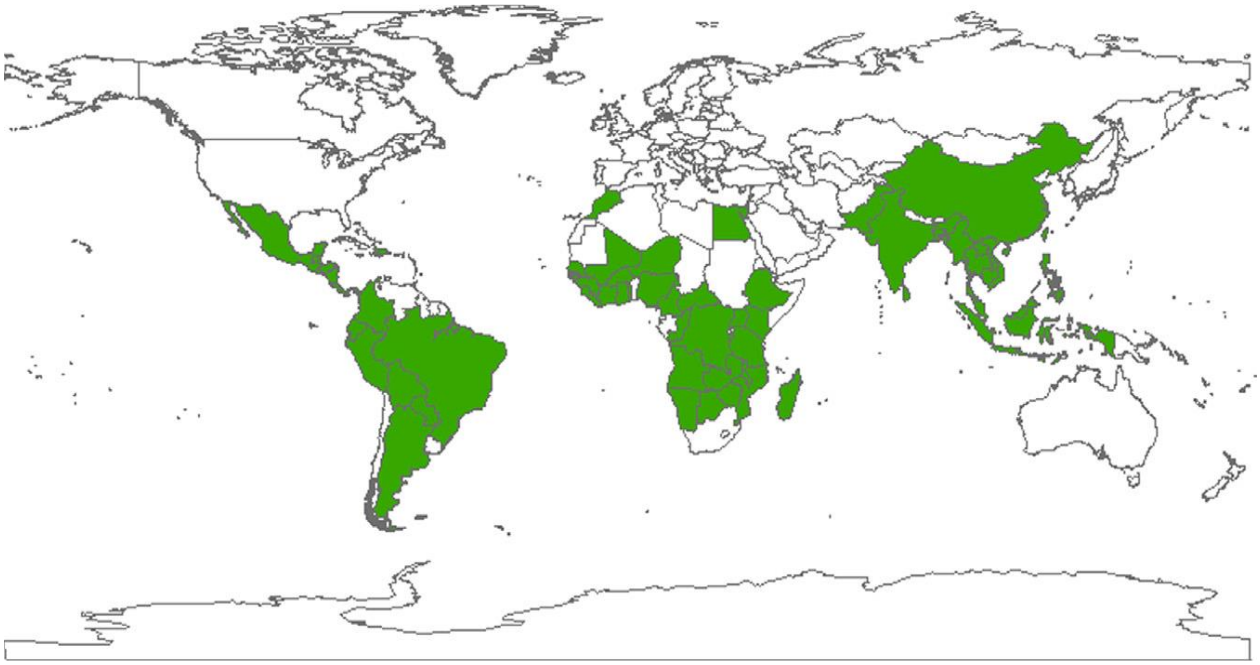
The use of the concept of adaptation to social sciences has been followed to the anthropologist and social scientist Julian Steward, who utilized "social adaptation" to depict the modification of "culture cores" to the common habitat via subsistence exercises or activities. The idea of adaptation has been utilized both unequivocally (explicitly) and certainly (implicitly) in the sociologies, incorporating into natural disaster, political environment, and issues of food security (Smit & Wandel, 2006b). The connections amongst biological systems and political economy regularly regarded as issues of adaptive management of dangers identified with political and social power relations, asset utilize, and worldwide economies (Adger et al., 2005).

To adapt simply means to cause something to adjust or suit by changing or altering it (Adgeret al., 2005). The meaning of adaptation with regard to human dimensions refers to "a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity" (Smit & Wandel, 2006b). Similarly, Brooks (2003) defined the adaptation as ''adjustments in a system's behavior and characteristics that enhance its ability to cope with external stress'. Gregorich *et al.*(1994), adaptation alludes to any adjustment, regardless of whether inactive, receptive or expectant that can react to foresee or genuine result related to environmental change. With respect to measurement, According to Füssel (2007), adaptation refers to processes, activities or results in a particular system, including families, group, and nation that makes the system more ready to cope with, oversee or conform to change to certain conditions, hazards and dangers. Thus, adapting is the process of changing some elements within a particular system to make it capable of withstanding any external forces (Brooks, 2003).

Coping strategies are short or immediate term strategies put in place in response to unexpected failure in a system (Zoomers, 1999). This means that coping is the short term or immediate strategies put place to curtail unfavorable effects of a particular phenomenon, while adaptation is a long-term planned strategy which focuses on finding an alternative to solve existing phenomenon. For instance, when a particular group of people may have to cope with a seasonal flooding, but may have to adapt to climate change. Coping means the flexibility and feedback to adjustment or changes in environmental, social, institutional, economic and political and institutional situation with a given period of time (Smit & Wandel, 2006a).

Global Concentration of Large Scale Jatropha Investment

Global statistics indicate that the global share of large scale land acquisition among the continents are 66.2 percent for Africa, Asia (21 percent), America (8.2 percent), Europe (2.3 percent) and Oceania (2.3 percent) (Anseeuw et al., 2012). They further added that 48 percent of the total land in Africa has been leased. Most of the land acquired by the investors are being used for agricultural purposes in developing countries (Arezki, Deininger and Selod 2015). Typical among these are the establishment of Jatropha plantation. The growing enthusiasm for the propagation of Jatropha plant for the biofuel production in its agronomic characteristics (Openshaw, 2000), such as pest and drought resistance, produce more oil, produce high yield, require low plant nutrient to do well, has the ability to grow on marginal land and therefore do not compete with food production (Jongschaap et al., 2007).The portion shaded in green indicates the specific locations of the Jatropha projects globally.



Sources: Janske van et al. (2014)
Figure 1: The Size and distribution of Jatropha projects globally

Distribution of Jatropha Production and its effects on rural population in Ghana

The quest for the governments of Ghana to substitute national consumption of fossil fuel with 10% and 20% bioenergy by 2020 and 2030 respectively couple with other reasons such as favourable political and physical environment have created the enabling environment for the cultivation and production of biofuel (Hamenoo, 2014). These have led to outflow of several Jatropha companies in the country. According to Hamenoo (2014), there are 17 biofuel companies in the country with 15 owned by foreign nationals. Jatropha plantation consisted of Jatropha plantation by foreign owned companies. Schoneveld (2011a) asserted that out of the total land acquired by Jatropha companies about 1,075,000 ha of lands situated in the forest-savannah transition zone which includes Ashanti, Northern and Brong Ahafo Regions of Ghana by foreigners.

In terms of income several studies have proven that cultivation of Jatropha for biodiesel production yields positive livelihood outcomes of the local people (Kidido and Kuusaana, 2014; Balogun and Salami, 2016). According to Boamah (2010), at the highest point close to 400 workers were employed in the Jatropha

plantation. The skilled worker was earning a monthly wage ranging from GH₵ 200 to GH₵ 1000 and this includes machine operators, mechanics, field supervisors and fieldworkers whilst the unskilled workers were receiving a monthly salary between GH₵77 to GH₵150 and they also include security men, fire volunteers and field workers. Moreover, Sulle and Nelson (2009) conducted a study in a village in Tanzania and found out that the Jatropha investors paid some compensation to the displaced people. However, Danso (2015) noted that the income generated from the Jatropha initiative is not enough to improve the living condition of the displaced people.

The expansion of biofuel industry can decrease local as well as national food insecurity through increasing food prices and changes in the pattern and the system of land acquisition processes for food production (Balogun & Salami, 2016).The continuous increase in production of biofuel will displace the production of food crops for human consumption from productive arable lands (Mueller, Anderson, & Wallington, 2011) and this has ramifications for food security. Boamah (2010) reported contrary to the crisis narratives that express dire food security implications of biofuels, the Jatropha project rather improved household food security through wages for plantation workers, improved petty trading, as well as increased food production.

Adaptation Options for Different Poverty Levels

Tanner and Mitchell (2008) used autonomous adaptation, market-based adaptation and policy driven adaptation concepts to explain the adaptation options available to various categories of poverty with a system. According to them, an individual, household and the community adapt to external force base on their poverty levels. They further explained that different poverty groups has cope or adapt autonomously (by themselves) by using some of or all of the factors indicated under each of the columns in the Table 2.1. In the same vein, households and individuals can adapt through a market driven strategies under each poverty level. They finally, explained that public policies can drive the adaptation process of individual, household and the community under each of the poverty levels indicated in Table 1.

Table 1 Adaptation options for different poverty levels

Poverty levels					
Types of Adaptation	**Always poor**	**Usually poor**	**Cyclical poor**	**Occasional poor**	**Never poor**
Autonomous Adaptation	• Sale or auction of last assets • Child labour • Conflicts, crime and sex work • Move to more the exposed area • Use of fragile ecological assets	• Intra-community transfer • Sending younger children to work • Migration • Relying on Extended family • Conflicts, crime and sex work	• Seasonal migration • Less risky production • Engage I multiple work at long hours • Investment in social capital	• Diversify livelihood • Invest in social capital assets	• Investment in multiple economic assets • Buy drought resistant seeds (new technologies) • Diversifying livelihoods • Invest in ethical option
Market based adaptation		• Promote micro savings, micro credits and micro insurance • Cattle insurance	• Weather indexed insurance • Cattle insurance • Promote micro savings, micro credits and micro insurance • Selling off assets	• Weather indexed insurance • Promote micro savings, micro credits and micro insurance • Selling off assets	• Crop insurance • Farm assets assurance and domestic insurance • Price hedging
Public policy driven adaptation	• Social pensions • Assisted migration • Decentralizing natural resource management and ecological rehabilitation • Nutrition services • Cash for work schemes • Conditional cash transfer	• Community restocking • Subsidized seed bank • Decentralizing natural resource management and ecological rehabilitation • Cash for work	• Community restocking • Improved remittances schemes • Subsidized seed bank • Improved climate information • Ecosystem rehabilitation • Irrigation schemes	• Improved remittances schemes • Improved climate information • Employment assurance schemes • Social; assurance schemes • Irrigation schemes and urban provisions	• Taxing to pay for adaptation of the poor • Marketing of green agenda • Incentives for adaptation and migration choice

Source Tanner and Mitchell (2008b, p. 10)

Adaptation Strategies in Response to the Effects of Ongoing Large Scale Jatropha Plantation on the Livelihood of Host Communities

The responsive strategies people use to respond to the effects of large scale Jatropha plantation on their livelihood varies from geographical areas. Schoneveld (2011) observed that those who were affected by large scale land deals in the Brong-Ahafo Region of Ghana responded to the effects of displacement on their livelihood by engaging in shea nut processing, charcoal production, mushroom rearing, game and medicinal plant to generate income. Similarly, Mahoney (2012) revealed that people adapted with the effects of large-scale land acquisition for Jatropha plantations in Kisarawe District in Tanzania to improve their livelihoods by producing charcoal for sale. Relocation was also observed by Boamah (2010) was a responsive strategy. Relocation in some places was initiated by the Jatropha company while in some places done by the affected people to areas where there is available land for farming. Danso (2015) indicated in a study on the impact of household's loss of land to Jatropha plantations in Northern Ghana that land accessibility was not the issue with farmers but rather accessing land that is close to their homes. Also, Schoneveld, (2011) respectively revealed that farmers who lost their lands depended on marginal land for farming. Also, affected farmers have changed their farming system from shifting cultivation and land rotation to constant farming on the available land. As farmers lose land to Jatropha plantations, attention is shifted to increasing output with the available land. According to Hamenoo (2014) identified agro-chemical use among people affected by Jatropha plantations in the Asante Akim North District as one of such technologies. Hamenoo (2014) identified agro-chemical use among people affected by Jatropha plantations in the Asante Akim North District as one of such technologies. The inception of Jatropha did not affect food security for households which adopted agro-chemical use since output levels generally improved. Nonetheless, expenditure on agrochemicals also increased putting additional burden on households. Even though concerns have been raised about the appropriateness in the use of agro-chemicals, Hamenoo (2014) recommended that extension services should be provided for affected communities in other to improved output and maintain the environment.

Material and Methods

Research design

This study was conceptualized within the case study framework which allowed both qualitative and quantitative data to be collected to build a holistic understanding of the case (Lucy, Jackson & Usher, 2006). This research design was chosen based on the nature of the research question(s) and the feasibility for data collection.

Study setting and Population

The district covers a surface area of 2714.1 sq. km and has a population density of 30.1 persons per square kilometre (see Figure 2). The target population was 94,930 with overwhelming majority (91.1%) of the population residing in the rural areas of Mion District (Population and Housing Census, 2021). The population structure depicted a distribution of 47,162 males, 47,768 females, 497,035 within the ages of 15 - 64years and 44,414 illiteracy level among the populace. Moreover, over 85,044 people living in the rural area depending on agriculture specifically, agro-based for their livelihood. Based on these statistics, the rural population of Kpachea, Jimle, and Kpalkore served as the accessible population.

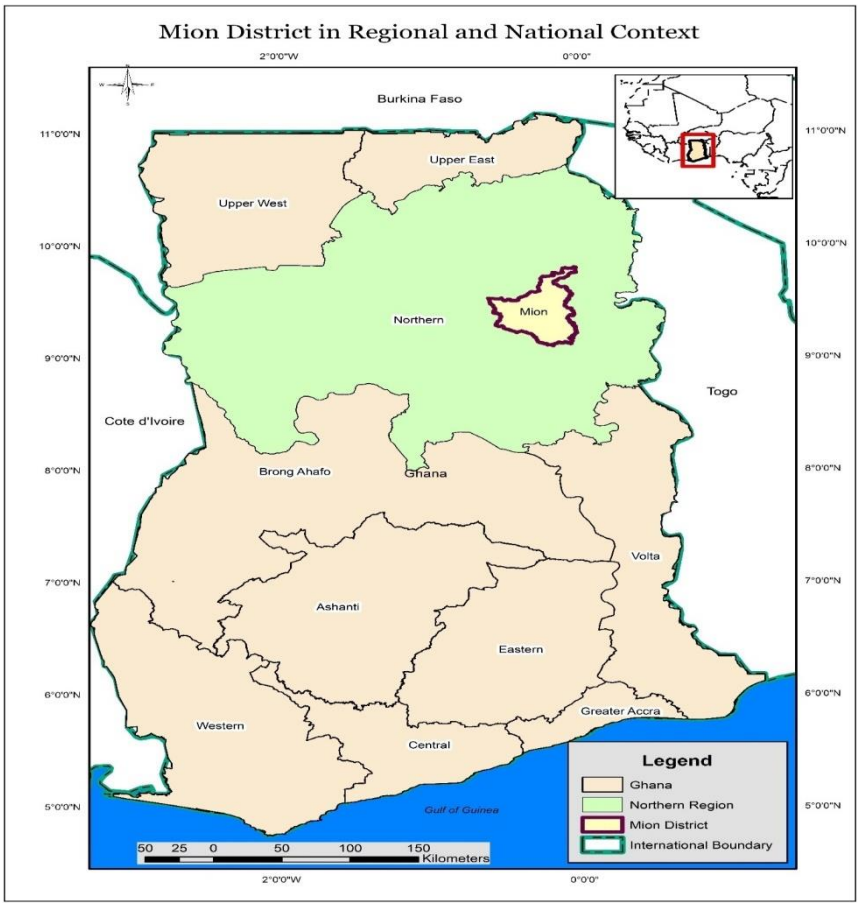


Figure 2: Study Communities in the Context of Ghana

Sample and Sampling Technique

The quantitative data were obtained from households in three communities which were selected for the study namely; Kpachaa, Jimle and Kpalkore. The criteria for inclusion of communities were:

i. communities that lost lands to the Jatropha Company;
ii. communities that benefited from the Jatropha project and;
iii. communities where the large scale Jatropha plantations have been abandoned.

The EPI info 7 software developed by the United State Centres for Diseases Control and Prevention was used to compute the required number of households. A sample frame of 280 households in the three communities lead to the sampling size 140. Table 1 shows the total number of households in the three communities was used as the sampling frame.

Table 2 Unit of Enquiry sample frame and sample size

Units of Enquiry	Population	Average household size	Sampling frame	Sample size
Kpachaa	800	9.3	86	43
Jimle	1050	9.3	113	56
Kpalkore	750	9.3	81	41
Total	**2600**		**280**	**140**

Source: (DPCU, 2017)

Multi stage sampling technique was employed in the study. The communities engaged in the study were purposively selected based on the community selection criteria outline above. Then a simple random sampling technique was further employed to select the households from the three communities for the household survey. The first day was devoted for marking the housing unit in the three communalities. This was done the researchers and three research assistants. For each community, the housing unit numbers and names of the household's heads were written on pieces of paper and placed in a box. Using the proportionate simple random technique, the papers were drawn without replacement until the

required sample size for each of the communities was obtained (see Table 1 for the required sample size from each community).

Data Collection Instruments

Close-ended questionnaire and semi-structured interview guide were used to gather data from the participants. The semi-structured interview guide was used to elicit responses to answer research question 1 while the close-ended questionnaire was administered to the 140 sample size to solicit responses to address research question 2.The close-ended questionnaires were administered to the heads of households selected for the study. The semi-structured interview guide were designed to gather data from key informants such as heads of households, Chiefs and Assembly.

Focus group discussions with women and men groups in the affected communities were also organized. Following the work of Manoranjitham et al. (2007), 10 members of the women group and 10 members of the men group were engaged separately for the focus group discussion. The selections of the participants were based on group members who were natives of the communities and were married before the company started operating in the affected communities. All interview spanned from 30 to 35 minutes. The researchers clearly explained to all participants the reason for conducting this study before beginning to engage them in any form of data collection. The consent of the participants were sought, participants confidentiality assured, voluntary participation in the study guaranteed as well pseudonym used to conceal the true identity of participants

Data Analysis

The qualitative data acquired from the field work was processed by coding, finding patterns and categorizing the data set into themes. This helped to explore the relationship between the variables in helping to make a logical and systematic series of evidence. The framework for the qualitative analysis employed in this study was in three stages: 1) data familiarization. The detailed notes (transcriptions) were read after completion, and the researchers noted emerging common responses and patterns given by the respondent. 2) Affirmation of patterns (the notes were then read a second time to confirm the commonalities discovered during the first read-through). During this stage particular attention was paid to livelihood strategies and its effects on the livelihood outcomes of the affected communities. 3 creation of *index (*the themes were subsequently applied to the textual form of all the transcribed data using the QDA Miner software. Quantitative data obtained from the close-ended questionnaire was analysed using frequency, percentage, mean and standard deviation.

Results

Table 3 presents the socio-demographic characteristics of respondents.

Table 2 Socio-demographic characteristics of respondents

Variables	Frequency	Percentages (%)
Gender		
Male	138	98.6
Female	2	1.4
Age		
Less than 20	-	-
0–30	4	2.9
31–40	49	35
41–50	44	31.4
51–60	28	20
61 and above	15	10.7
Marital status		
Single	-	-
Married	138	98.6
Divorced	2	1.4
Widowed	-	-
Separated	-	-
Level of education		
No formal education	117	83.6
primary school	2	1.4
JHS/Middle school	6	4.3
SHS/Technical/Vocational	15	10.7
Tertiary	-	-
Community member status (Origin)		
Migrant	9	6.4
Native	131	92.6
Households who lost their land to the Jatropha company		
Yes	56	40
No	84	60

Source: (Field Data, 2017)

The majority of the respondents were males138(98.6%) and 121(86.44%) of the total household heads were between 31 and 60 years. This implies that most of the household heads are within their economically active age. Sex and marital status of the respondents are key in understanding the livelihood situations of households. Mostly, married couples are able to pool together their resources to improve their households' livelihood assets and outcomes (Jiao et al., 2017). On the other hand, single people are likely to have very limited livelihood resources that can help them achieve better livelihood outcomes. The livelihood adaptation situation among males are perceived to be better than females. The study discovered that illiteracy rates among household heads was very high (83.6) in the study communities. High illiteracy rate might be one of the major factors that determined the choice of communities for the Jatropha initiative because Jatropha biofuel initiative does not require labour with much knowledge and skills. From the Table 1, it is evident that 40% lost their land to the Jatropha company, whilst 60% did not lose their land to the company.

Research Question 1: What are the adaptation strategies employed by household after the closure of large scale Jatropha investment?

The adaptation strategies employed by the locals of Mion District can be grouped into two main categories. They are land related and non-land related adaptation strategies. The non-land related strategies included petty trading and migration whereas the land related strategies include acquisition of land from other communities, sharing land with relatives or friends, intensive farming on the available land, encroachment into the land of the Jatropha company, off-season farming, mixed farming and mixed cropping. However, some households adapted dual or multiple adaptation strategies depending on the household size. The themes derived from the participants responses indicated that they engage in the following strategies.

Intensive farming on the available land
The results from the study shows that thirty-one (31) households representing (51.7%) responded to the adverse effects of the abandoned Jatropha plantation on access to farmland, income levels, crop output levels, and employment status by intensifying crop production on their available land. According to those households, they could have accessed land elsewhere but that would be stressful as well as increased their cost of production. Therefore, they decided to embark on intensive farming on the land available of their household. This was expressed as:

> *"We were disposed of our farmland, so the only best option was to try and increase production on the available land" (Male, FGD).*

Mixed cropping
The study found that mixed cropping was one of the short and long term strategies employed by the households in response to the reduction in crop output due to loss of land and difficulty in access to farmland for the expansion of farm size and crop production observed in the study. It was revealed from the study that 11 households representing 7.9% of the total households adapted by engaging in mixed cropping system. Some of the mixed cropping farming used by the households were (yam and rice), (maize and sorghum), (groundnut, maize and sorghum) and (maize-millet).and (yam and millet). A male FDG participant stated

> *"We needed to survive by planting different kinds of crop on the same piece of land to increase our crop output and ultimately our income levels" (Male, FGD).*

Shared land with relatives or friends
The survey data shows that some of the households mitigated the effects of loss of farmland through long term lease of land to the Jatropha company by borrowing land from friends and relatives to farm. It was also revealed that 6 households representing4.2% of the entire households acquired lands from friends and relatives. According to them, those they borrowed land from had land because they were not affected by the phenomenon.

Acquisition of land from other communities
Another adaptation strategy adopted by the households to address the effects of loss of farmland to the Jatropha Company and difficulties in access to farmlands due to long term lease of land to the Jatropha Company was acquisition of farm land in other communities to increase crop yield. The number of households who used this strategy to mitigate the effects of the long-term land lease and the abandonment of the Jatropha plantation were 5 representing 3.6 % of the entire respondents.Below is a quotation from the focus group discussion:

> *"I have acquired 10 acres of land in Salankpang to add up to the small land I was left with after the company acquired part of my land" (Male, FGD).*

Pettytrading

Petty trading was an adaptation strategy adopted by some affected households in response to the effects of abandoned Jatropha plantation on loss of employment and reduction in household's income. It was revealed from the study that 3 households representing 2.1% of the total households engaged in petty trading to improve their income level. Respondents exclaimed that

> *"After the company left, things were very difficult, so I borrowed money from my brother and added a little money saved when the plantation was in operation for my wife to start selling provision on table top" (Female, FGD).*

Migration

Migration was also identified as a responsive strategy adopted by households to address the effects of abandoned Jatropha plantation on households' inability to access farmlands in affected communities. The study found that 7 households representing 5% of the respondents adapted by migrating to search for a better opportunity to improve their living conditions.

> *"My son migrated to Tamale after the company abandoned the Jatropha initiative because he lost his employment and access to land to expand our farm size was also a problem" (Female, FGD).*

Encroachment

After the Jatropha Company abandoned the land, 10 households representing 7.1% encroached the company's land despite warning gave by the chief not to farm on the land of the company. They claimed that since the land is not being utilized by the company, they will farm on it until the Jatropha company start using the land again. The quotation from the focus group discussion that expressed this thought was:

> *"The land is idle and so few of us are farming on part of it. The company cannot dispose us of our land and leave it without serving any purpose. Even though we are afraid that the company will take legal action against us, but what can we do? The land is our major source of livelihood" (Female, FGD).*

Off-Season Farming

Off-season farming was one of the adaptation strategies adopted by the households living in the affected communities. The study revealed that 10 households representing 7.1% adopted by engaging in off-season farming. According to them they chose to respond to the effects of lost land and low crop output by engaging in off-season farming. The study further revealed that it was possible for them to engage in off- season farming because they were able to access water from the dam to irrigate their farms. This responsive strategy helped the people to produce all year round and also gain income during the lean season. This is what a respondent said during the focus group discussion:

> "*Because I lost part of my farmland to the Jatropha company, I had very small farmland left but it was closer to the dam and so when the company abandoned the plantation, I started farming there during the lean season because I had the opportunity to use the dam to irrigate my farm" (Female, FGD*).

Multiple strategies

Some households combined two or more of the adaptation strategies identified to address the adverse effects of long-term lease of land and the abandoned Jatropha initiative on the livelihood of households living in the affected communities. The study revealed that 12 households representing 8.6% of the entire households adopted multiple strategies. The households who adopted multiple adaptation strategies were of the view that one strategy was not enough for them to be able to address the adverse effects of the long-term land lease and the abandonment of the Jatropha plantation.

Research question 2: What is the impact of the adaptation mechanisms adopted by household on their livelihood outcomes?

As heads of households have indicated that they are engaged in some adaptation strategies, it was imperative that crop output from the various households be determined. This was intended to highlight the food security issue of the affected communities. The findings is shown in Table 4.

Table 4 Households crop output

Crop Type	Periods	Mean	Standard deviation	Number of respondents
Maize (bags)	During	16.2	9.6	137
	After	17.4	10.2	137
Cowpea (bags)	During	3.5	1.7	
	After	3.5	2.2	53
				53
Rice (bags)	During	8.5	4.7	75
	After	10.4	6.5	75
Yam (Tubers)	During	1478.9	1089.7	88
	After	1461.3	1080.8	88
Groundnut (bags)	During	11.3	6.3	24
	After	10.4	5.1	23
Soya bean (bags)	During	7.8	4.0	42
	After	8.9	4.1	42
Cassava (bags)	During	12.5	5.7	14
	After	13.4	8.4	14

Source: (Field Data, 2017)

The crop output derived from the adaptation strategies of the heads of the household have direct relationship to the income. Table 5 presents that monthly income from the various adaptation strategies. It is through this means the impact of household adaptation strategies can be ascertained.

Table 5 Descriptive statistics for monthly income of various adaptation strategies

Coping and adaptation strategies	Minimum (GH₵)	25th percentile (GH₵)	Mean (GH₵)	50th percentile (GH₵)	75th percentile (GH₵)	Maximum (GH₵)	Number of households
Intensive farming on the available land	34.0	58.7	78.8	77.2	92.6	172.9	31
Off-season farming	76.6	84.8	103.7	92.6	122.0	151.3	10
Mixed cropping	46.3	50.9	73.3	77.2	89.5	112.7	11
Shared land with relatives or friends	66.4	69.9	81.8	72.6	97.6	117.0	6
Acquisition of land from other communities	40.1	52.5	80.9	83.4	108.1	111.2	5
Petty trading	52.5	52.5	74.6	84.9	86.5	86.5	3
Migration	51.0	58.7	86.5	75.6	117.3	126.6	7
Encroachment	39.8	54.6	82.0	90.9	105.4	116.4	10
Multiple strategies	81.2	84.9	95.0	90.5	100.7	132.7	12

Source: (Field Data, 2017)

The result from Table 4 indicate that household's monthly income of the various adaptation strategies shows that the adaptation strategy that yielded the highest average monthly income was off-season farming with an average of Gh₵103.7 (US$23) whilst adaptation strategies that produced the lowest average monthly income was mixed cropping with an average monthly income of Gh₵73.3 (US$16.3). This imply that households who engaged in off-season farming were better off in terms of income generation than those who used other adaptation strategies to address the adverse effects of the long term lease of land. From the focus group discussion, one plausible reason for this is that food prices in the lean season are mostly very high which imply high income from the sale of their crop output resulting to higher income. Another reason was that households engaging in off-season farming are able to earn all year round. The study can therefore conclude that off-season farming was the best adaptation strategy in response to the effects of the abandoned Jatropha plantation on household's income.

On the part of households' wellbeing the adaptation strategies were to improve the wellbeing of the people substantially. However, it revealed that the adaptation strategies adopted by the affected communities were able to marginally improve the income level, educational level, health care and other indicators of wellbeing. According to the respondents, they have not been able to come out with any effective short term and long term strategies to address the benefits they lost after the closure of the Jatropha initiative. However, there is the existence of households' vulnerability. The households in the affected communities are still highly susceptible to low prices of farm produce, diseases, fire outbreak and low yields in spite of the adaptation strategies adopted by the households living in the affected communities. Vulnerability is still high because the households have very limited assets to respond effectively to these stresses and shocks. Vulnerability in terms of access to farmland has decreased marginally due to the adaptation strategies adopted by the households in response to access to farmland. The affected households in the affected communities are still highly susceptible to food insecurity, low income, fire outbreak, low market prices, poor harvest and low yields even though, they have adopted adaptation strategies to reduce these forms of vulnerabilities (see Table 6).

Table 6 Households' Vulnerability

Types of Vulnerabilities	Extent of the vulnerability					
	Low vulnerability		High vulnerability		Unchanged vulnerability	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Low prices of farm produce	7	6%	99	70.7%	34	24.3%
Diseases	12	8.6%	66	47.1%	86	61.4%
Fire outbreak	5	3.6%	12	8.6%	123	87.9%
Low yields	6	4.3%	78	55.7%	56	40%

Source: (Field Data, 2017)

Discussions

There have been extensive account on the effects of large scale Jatropha investment when the plantations are still ongoing (Acheampong & Betey, 2013; Danso, 2015; Sulle and Nelson, 2009; Timko, Amsalu, Acheampong, & Teferi, 2014).However, current academic is unclear on livelihood adaptation of large scale land investment and its effects on the households in the host communities after the initiatives have been abandoned. The findings of the study suggest that households have adapted to the effects of the abandoned large scale Jatropha initiative on their livelihoods by engaging in off-season farming, acquiring farmland from other communities, sharing land with relatives or friends, migration or relocating to other areas, intensive farming on the available land, petty trading, encroachment of the land of the Jatropha company and multiple strategies. The adaptation strategies of employed by the study respondents is in consonance with the findings of Boamah (2010). Boamah (2010) posited that some of the affected people relocated to areas where there is available land for farming. Also, the findings of this study confirms Schoneveld (2011) assertion that those who were affected by large scale land deals in the Brong-Ahafo Region of Ghana responded to the effects of displacement on their livelihood by engaging in shea nut processing, charcoal production, mushroom rearing, game and

medicinal plant to generate income. The study revealed that intensification of farming on the available land after the company acquired their land and abandoned was the most common adaptation strategies adopted by the households whilst petty trading was the least adopted adaptation strategy. This implies that most of the households could not mount any better adaptation strategy than to practice intensive farming on the land left after the Jatropha Company displaced them of their land. Since the rural communities in Ghana are largely agrarian communities, acquiring rights to land is a crucial concern in rural communities of Ghana. Therefore, choice of adaptation strategies such as acquiring farmland from other communities, sharing land with relatives or friends, migration or relocating to other areas, intensive farming on the available land put much burden on livelihoods, food security, economic growth, and human rights of households in the host communities. This phenomenon also hampers the achievement of no poverty, zero hunger and good health and wellbeing elements of the sustainable development goal.

It was revealed from the men focus group discussion that most of the adaptation strategies adopted by men are land related activities such intensification farming on the available land, acquisition of land from other communities for commercial, encroachment of the company's' land for subsistence farming, whiles that of women were non land related activities such petty trading and migration. This is consistent with study by Mersha and Laerhoven(2016) in Ethiopia. They found that the gender-based difference in choices of adaptation measures differs in gender. On-farm adaptation measures, such as cropping time adjustment, crop diversification, planting cash crops and soil conservation, were reported as important adaptation measures, especially by male household heads. This that implies that the livelihood situation of men largely hinges on land use activities.

Households' livelihood situation was expected to be restored since the company had abandoned land. However, this rather worsened their livelihood situation due to improper policies, ineffective land administration institutions and lack of transparent large scale land acquisition process. It was found in this study that the adaptation strategies have yielded marginal positive effects on households' income, food production and wellbeing but has worsened household's vulnerability and ability to sustain the natural resource base. With respect to income, the best adaptation strategy which is off-season farming had an average monthly income of GH₵ 103.7(US$ 25.3) which is below the poverty line. The impact of the adaptation strategies had marginal positive effects on household's income partly because the Ministry of Food and Agriculture, local authorities and the district assembly failed to intervene and ensure reversion of the land to the owners. It is also partly due to the failure for the above mentioned institutions and agencies to help affected households to adopt better adaptation strategies. Marginal increase in income and crop output also caused marginal improvement on household's wellbeing. This is in line with Scoones (1998) assertion that rural livelihood is mostly dependents on natural resources such as arable land for survival. However, household's vulnerability dwindled due low income, loss of land and ineffective adaptation strategies. Similarly, since most of the adaptation strategies are characterized by excessive exploitation of the land and other natural resource base, it had negative effects on the use of the natural resource base. This finding corroborate the projection made by Danso(2015)in Yendi Municipality of Ghana that if proper mechanisms are not put in place to ensure the smooth running of large scale Jatropha initiatives and it collapses, it will have negative effects on the livelihood of people living in the affected communities. The implication is that even though the adaptation strategies have minimised some of the effects of the abandoned Jatropha initiative, the livelihood situation of the households are worse off as compared to the initial operation of the Jatropha company.

Conclusion and Recommendations

Assessing the livelihood adaptation mechanisms adopted by heads of household to improve their livelihood opportunities, it can be concluded that intensive farming, mixed cropping, shared land with relatives or friends, acquisition of land from other communities, petty trading, migration, encroachment, off-season farming and multiple strategies were the key adaptation strategies employed by the locals as a result of the closure of the Jatropha plantation. Notwithstanding the households in the affected communities adaptation of several strategies to respond to the effects of the abandoned Jatropha plantation of their livelihood, the adaptation strategies have yielded marginal positive effects on the livelihood outcomes. Based on the findings of the study, it is recommended that, district town and

country planning officials, chiefs and leaders should evaluate the land agreements policies for large scale land lease. This will enable them identify the lapses in the policy document which affect the rural population after seizure of operations of the plantation company. Also, given that over 90% of the populace are into farming activities and access to land to expand their farm is very difficult, local government together with the local authorities and non-governmental organisations should come out with an alternative source of livelihood choices such as financing shea butter, bee keeping and smock weaving to help improve their livelihood situations. Furthermore, there should be some engagement among the locals to establish alternative adaptation mechanism should the company seize to operate. Moreover, the land lease should be done within a midterm period with subsequent renewal. This will create an enabling environment to allow the rural population to return to their land if the company decide to stop operating. These policies should include reversionary clause in case the land is abandoned by the proponent of the project or they fail to fulfil their promises.

Notes

1. As at the time of this research U.S dollar rate was 1 dollar to 4.1 Ghana (XE Currency Converter 2017).
2. Income levels and crop output of respondents are significant indicators of household well-being and standards of living.

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