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The Effects of Biofuel Feedstock Production on Farmers' Livelihoods in Ghana: The Case of *Jatropha curcas*

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Abstract: The widespread acquisition of land for large-scale/commercial production of biofuel crops in Ghana has raised concerns from civil society organizations, local communities and other parties, regarding the impact of these investments on local livelihoods. This paper assessed the effect of large-scale acquisition of land for production of *Jatropha curcas* on farmers' livelihoods in Ghana. The study was conducted in 11 communities spanning the major agro-ecological zones and political divisions across Ghana. Methods of data collection included questionnaire survey, interviews and focus group discussions. Results show that several households have lost their land to *Jatropha* plantations leading, in some cases, to violent conflicts between biofuel investors, traditional authorities and the local communities. Most people reported that, contrary to the belief that *Jatropha* does well on marginal lands, the lands acquired by the *Jatropha* Companies were productive lands. Loss of rights over land has affected households' food production and security, as many households have resorted to reducing the area they have under cultivation, leading to shortening fallow periods and declining crop yields. In addition, although the cultivation of *Jatropha* led to the creation of jobs in the communities where they were started, such jobs were merely transient. The paper contends that, even though the impact of *Jatropha* feedstock production on local livelihoods in Ghana is largely negative, the burgeoning industry could be developed in ways that could support local livelihoods.

Keywords: *Jatropha curcas*; plantations; biofuels; land alienation; food production and security; employment; Ghana

1. Introduction

In recent years, biofuels have rapidly emerged as a major issue for agricultural development, energy policy, and natural resource management. The growing demand for biofuels is being driven by recent high oil prices, energy security concerns, and global climate change [1]. Consequently, there is growing interest from foreign private investors in establishing biofuel projects in Africa, as well as growing support from bilateral and multilateral donors for incorporating biofuels into government policies and development plans [1–3]. Bassey [3] reveals that many European and American governments, International Financial Institutions such as the World Bank and multinational agribusiness, and oil and transport companies are promoting biofuels as a panacea to world energy needs and the business is touted as a sustainable source of higher income for farmers in Africa and a ready avenue for employment opportunities, especially for the youth [3]. It is argued that biofuels can help to reduce urban pollution and promote rural development, dealing with poverty alleviation challenges. However, in spite of these much acclaimed positive potentials of biofuel plantations to reinvigorate Africa's rural areas, there are still misgivings about the negative environmental and social impacts of large-scale commercial biofuel production.

Estimates on the state of biofuel developments in Ghana are mixed. Available data suggest that several companies from various countries have acquired land in Ghana to cultivate biofuel crops for the production of ethanol and biodiesel. The *Jatropha* projects started taking off well in the country from 2005–2006 and actually reached their peak between 2007 and 2008. A study on the potential impact of large-scale land acquisitions, particularly for biofuel feedstock expansion in Ghana, identified a total of seventeen commercial biofuel developments in Ghana [4]. Dogbevi [5] also asserts that over twenty companies from various countries are in Ghana acquiring land to cultivate non-food crops and other crops for the production of ethanol and biodiesel. According to Schoneveld *et al.* [4], fifteen of the seventeen companies are reported to be foreign-owned and/or financed by the Ghanaian Diaspora, with all but one adopting business models that require large-scale feedstock plantations of more than 1000 hectares. They report that although almost half of the foreign companies involved in plantation development plan in time to engage smallholders through outgrower agreements, no such schemes are yet in place. They reveal that thirteen of the foreign companies focus primarily on the cultivation of *Jatropha curcas*, a plant which produces non-edible oil seeds, one on cassava and another on oil palm. Schoneveld *et al.* [4] further report that, by August 2009, these companies collectively had access to 1,075,000 hectares of land, 730,000 hectares of which is located in the forest-savannah transition zone of central Ghana's Brong Ahafo and northern Ashanti Regions.

Even though biofuel production has the potential to provide a new source of agricultural income in rural areas, and a source of improvements in local infrastructure and broader development, the current land grab by corporations for the large-scale and export-driven expansion of biofuel production has ominous implications for local livelihoods in Ghana. The spread of large-scale/commercial production of biofuel crops, particularly *Jatropha curcas*, in Ghana has raised concerns from civil society organizations, local communities and other parties. This paper therefore seeks to contribute to the debate on the socio-economic implications of industrial plantations of *Jatropha curcas* in Ghana,

focusing on land grabbing and alienation, impact on food production and security, and impact on employment and income generation.

2. Data and Methods

Based on expert advice from the Environmental Protection Agency (EPA) of Ghana, the study was conducted in 11 *Jatropha* communities spanning the major agro-ecological zones and political divisions across Ghana—Lolito and Adidome in the Volta Region; Old Akrade in the Eastern Region; Kobre, Bredie-Camp, Kadelso and Ahenekom in the Brong Ahafo Region; Agogo in the Ashanti Region; and Kpachaa, Kusawgu, and Diare in the Northern Region (Figure 1). Methods of data collection included questionnaire survey, interviews and focus group discussions. A total of 234 respondents were drawn from the 11 communities for the survey using semi-structured questionnaires. A total of 27 different key informant interviews and 64 different focus group discussions (FGDs) were also conducted across the 11 study communities (Table 1). The key informants comprised of opinion leaders, local government representatives and the local chiefs and their elders. Similarly, participants of the FGDs were individuals who were knowledgeable and had interest in issues concerning *Jatropha* investments. These included opinion leaders, local farmers who lost land to *Jatropha* plantations, employees of *Jatropha* companies, chiefs and their elders and the youth. The participants were identified and selected after administering the questionnaires and interviews. Each focus group was usually made up of about 8–10 homogenous participants. Separate discussions were held with different groups as listed above as well as with people of different gender. The large number of FGDs was due to efforts to capture the views of inhabitants of cottages located close to the study communities who were considered part of those communities.

Because of rural sensitivities, initial contact with the respondents was negotiated with the assistance of community administrators such as the Assemblyman or Unit Committee Chairman, who provided the initial list of possible respondents. Subsequent respondents were selected by snowballing. Even though snowball sampling is a non-probability sampling technique and may be subject to biases, it was a useful sampling technique in this study since the research subjects were difficult to locate. Even so, care was taken to minimize the biases by trying to approximate random selection as much as possible. Respondents were residents in the communities who were affected by *Jatropha* cultivation—either Company workers or people who lost land to the Companies. A total of eight *Jatropha* Companies operated in the areas studied—Biofuel Africa, Galton Agro Ltd., Kimminic Corporation, *Jatropha* Africa, Savannah Black Farming and Farm Management Ltd., Anuanom Industries (Anuanom Farms), Integrated Tamale Fruit Company (ITFC) and ScanFarm (formerly, ScanFuel).

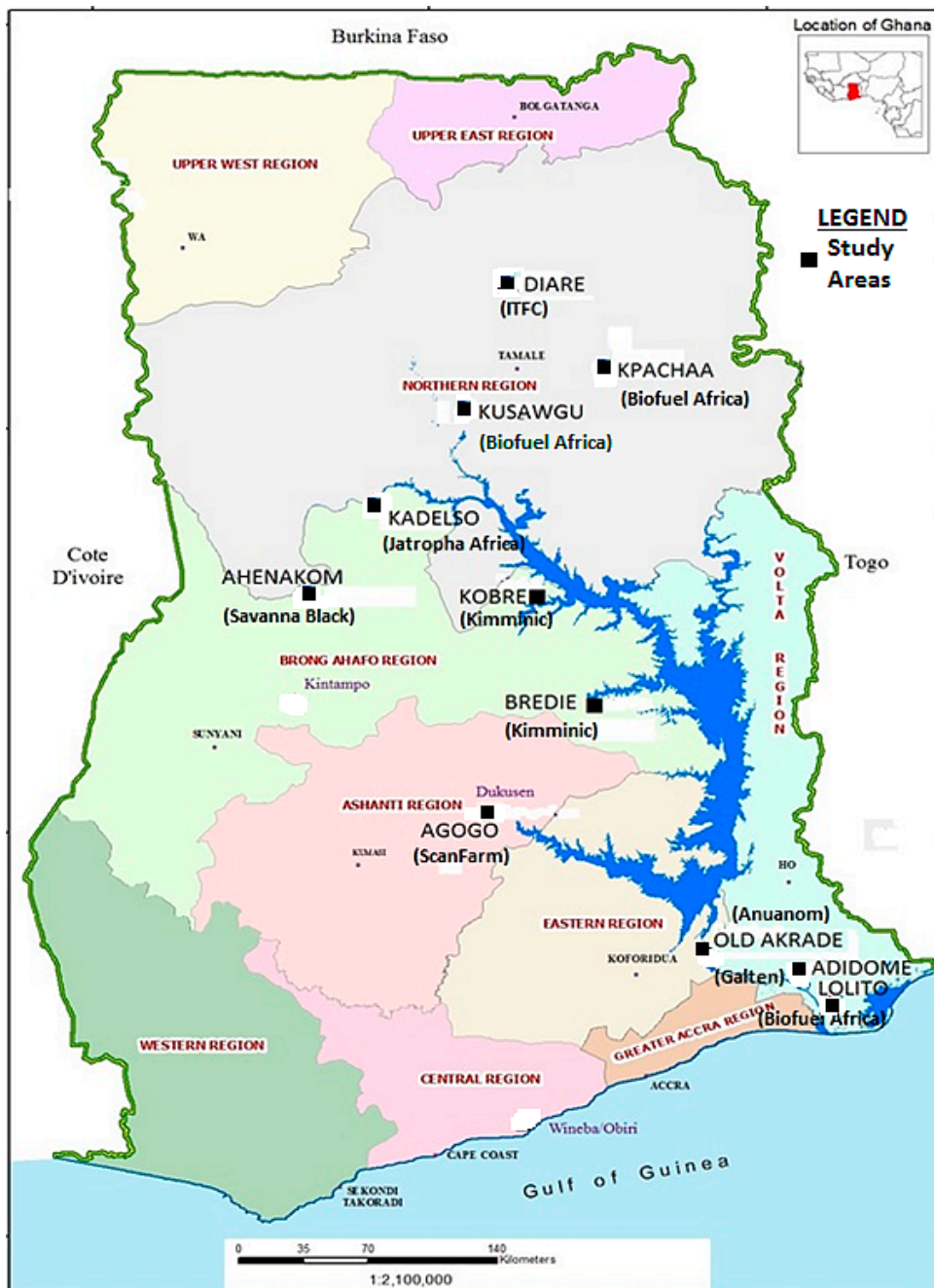
Responses obtained through the questionnaire administration were assigned numerical codes and SPSS was used to summarize and analyze the data. Simple descriptive statistics and frequencies were generated. Cross tabulations of relevant variables were also done to reveal patterns and relationships. Differences in number of respondents reported in the results are due to respondents' inability to answer some of the questions. The analyses were only based on valid responses. These have been explained where they occur in the text.

Table 1. Study sites and corresponding number of respondents and Jatropha Companies.

Name of Study Site	Number of Household Questionnaires Administered	Number of Key Informant Interviews	Number of Focus Group Discussions (FGDs)	Jatropha Company	Country of Origin of Company	Size of Land Acquired (ha)	Cultivation Model
Adidome	12	2	11	Galton Agro Ltd.	Israel	100,000 *	Jatropha-Industrial scale
Old Akrade	-	1	5	Annuamom Industries	Ghana	405 **	Jatropha-Industrial scale
Kobre	50	3	9	Kimminic Corporation	Canada	13,000 *	Jatropha-Industrial scale
Bredie-Camp	-	4	11	Kimminic Corporation			
Kadelso	52	4	-	Jatropha Africa	United Kingdom	120,000 *	Jatropha-Industrial scale
Ahenekom	5	2	8	Savannah Black Farming and Farm Mgt Ltd	United States	202 **	Jatropha-Industrial scale
Agogo	30	4	7	ScanFarm (formally ScanFuel)	Norway	400,000 *	Jatropha and food crops-Industrial scale
Lolito	35	2	13	Biofuel Africa	Norway	27,000 *	Jatropha-Industrial scale
Kpachaa	50	1	-	Biofuel Africa			
Kusawgu	-	2	-	Biofuel Africa			
Diare	-	2	-	Integrated Tamale Fruit Company (ITFC)	Ghana	10 **	Pilot Jatropha plantation; Mango outgrower scheme
Total	234	27	64				

Source: Size of land acquired data compiled from Friends of the Earth (FoE) [6] * and Antwi-Bediako *et al.* [7] **.

Figure 1. Map of Ghana showing the study sites and associated Jatropha Companies in parenthesis.



3. Results

3.1. *Jatropha* Cultivation and Land Alienation

The most direct and immediate impact of *Jatropha* cultivation in Ghana relates to land loss. Loss of rights over customary lands, and the way this is negatively impacting local villagers' livelihoods is a major concern for local communities in Ghana. There are tensions in many areas of the country between private investors, traditional authorities and local communities over rights to use and allocate land. There are specific concerns on whether local people who lose their farming lands to *Jatropha* plantations can be paid adequate compensation to help them explore alternative livelihood opportunities.

3.1.1. Acreages Lost to Jatropha Investments by Households

The majority (54.3%) of the 234 respondents reported that they have lost land to Jatropha investments. For example, in Agogo in the Ashanti Region of Ghana, most farmers reported that, contrary to the belief that Jatropha does well on marginal lands, the land given to the Jatropha Company (formerly ScanFuel Ltd., now ScanFarm Ghana Ltd., Agogo, Ghana) by the chief was a productive or fertile land which was being used to cultivate crops such as maize, yam, plantain, and cocoa. The farmers claim that this has forced them to move to marginal lands which are unproductive or infertile. The sizes of land lost to Jatropha cultivation by 109 respondents who were able to provide this information ranged from 1 to 1000 acres. The majority (69.7%) of the 109 respondents reported that they lost up to 10 acres, 7.3% lost between 11 and 20 acres while another 7.3% lost more than 100 acres (Table 2). Of the 8 people that lost more than 100 acres of land, 2 people lost 850 acres each while 1 person lost as much as 1000 acres.

Table 2. Size of land lost by households to Jatropha investments.

Size of Land Lost (acres)	Number of Respondents	Percent of Respondents
Less than 11 acres	76	69.7
11–20 acres	8	7.3
21–30 acres	4	3.7
31–40 acres	3	2.8
41–50 acres	3	2.8
51–60 acres	1	0.9
61–70 acres	2	1.8
71–80 acres	2	1.8
81–90 acres	1	0.9
91–100 acres	1	0.9
More than 100 acres	8	7.3
Total	109	100

Such land alienations often lead to violent confrontations between local people and Jatropha Companies. The following are excerpts from a key informant interview with an aggrieved farmer in Agogo in the Ashanti Region:

“I resisted the Company taking up my land with a gun. They used to operate at night. I struggled with them for about 3 years. I threatened them with death and they stopped. What I don’t like is that everything on the land is cleared. When the Company leaves, there will be chaos as all boundary markers are gone. No landowner will be able to identify his or her land”.

3.1.2. Consultations with Communities

When asked whether the Jatropha Companies or the Chief/the traditional authority consulted them before their lands were taken up for the Jatropha plantation, the majority (93.5% of 123 respondents) reported that they were not consulted. For example, the Assemblyman of Jimle, a village in the Kpachaa area of the Northern Region, reported the following about Biofuel Africa’s plantation at Kpachaa:

“The affected communities are Kpachaa, Kparchee, Tua, Jachee, Sagbargu and Chegu. No one was consulted and no one knew anything about the start of the project so the people started agitating. Following these agitations, a durbar was held in Tijo at the Tijonaa’s [Paramount Chief of Tijo] palace where the communities were informed that the Company will provide schools, water dugouts or wells and clinics. Apart from two dugouts or wells, all the other promises were not fulfilled before the Company folded up. What took place was not consultation but rather to inform us”.

The assemblyman of a village called Kobre in the Pru District of the Brong Ahafo Region also reported as follows:

“The project [Kimminic Corporation Jatropha plantation] started about 3 years ago. We were there when the Company brought its equipment about to start work on the land. No one had consulted us and we didn’t know anything about them so we drove them away. Our chief who lives in Accra also came and said he knew nothing about it. The Company moved to a nearby community called Konkomba which shares boundary with us. At that place, they erected a pillar and performed some rituals to officially commence work on the farm. The land being cultivated belongs to the chiefs and people of the Kojobofour Traditional Area and not the Konkomba Traditional Area. The Paramount Chief of Konkomba who gave the land is dead. The chief of Kojobofour who was reigning at the time the Company started operations is also dead. We the people of Kobre have never been officially consulted or informed of the Company. Not even the people of Kojobofour, the landowners, have been consulted... Now Kojobofour has got a new chief so the land issue has been ignited again”.

Similarly, the Unit Committee Chairman of Bredie No.1 in the Nkoranza District of the Brong Ahafo Region claimed that:

“The Jatropha Company is called Kimminic and they started about 3 years ago. No one consulted the community before the Company started operating here. We had no community meeting. We do not know the terms of the contract. Everything we know has been through rumours. I learnt that the land stretches from Piegnina to the boundary with the people of Ejura. I don’t know the size of the land area acquired. All we know is that the Company keeps increasing the size of the land under cultivation every year. So far they cultivate Jatropha, soyabeans and maize”.

3.1.3. Payment of Compensations

The majority (85.3% of 116 respondents) also reported that they did not receive compensation for the loss of their land. For example, in Bredie No.1 the Unit Committee Chairman reported that the most affected communities of the Kimminic plantation are Camp and Dasagwa. He indicated that the main problem was the fact that the Company did not give the affected farmers time to relocate. The Company waited until farmers harvested their produce and the land was then immediately taken. No compensation was paid to the affected farmers for the loss of their farmlands because they were settler farmers. The farmers were afraid to approach the Chief directly and complain. He asserted that the

ejection was so abrupt and that was what made the affected people unhappy. He claimed that, in all, about 50 farmers in Camp and Dasagwa lost their lands, some of which have since left the area. The Odikro (Chief) of a village called Old Akrade near Juapong in the Eastern Region also reported as follows:

“... farmers that were displaced by Anuanom Industries (a Jatropha Company) in Old Akrade were between 50 and 100. They were farming maize, cassava, mango, and vegetables. The Company negotiated with the farmers but it did not pay the compensation to the farmers. Only the mango farmer was compensated”.

The vast majority (65.5%) of those that claimed to have received compensation lamented that the compensation they received was inadequate and forced on them. For example, the Assemblyman of Kobre in the Pru District of the Brong Ahafo Region reported thus:

“I know of four people who have received compensation. Compensation was paid for the crops on the field and not for the lost land. The meagre amount they received was based on estimates of the Jatropha farm manager believed to be the value of the crops. For example, someone who had yam on the farm (farm size was not mentioned) was paid only Gh¢ 80 and the yams uprooted”. (At the time of the fieldwork, \$1 was equivalent to Gh¢ 1.5).

Compensation figures provided by interviewees in Agogo in the Ashanti Region were quite patchy and scanty. For example, a key informant who claimed to have fought to resist the alienation of his land to the Jatropha Company reported that the Company invited all landowners to a village called Nsonyameye and told them that they would pay all affected persons Gh¢ 1 per acre lost per year. He claimed that when the landowners refused, they later offered to pay Gh¢ 10 per acre per year. An opinion leader in the community also lamented thus:

“We started to protest through letters and other means. Upon the protest, the omanhene (paramount chief) decided to call a meeting. The farmers were told that they would be offered Gh¢ 2 per acre as compensation for the 50 years duration of the lease. We refused because currently, landowners in this area lease 1 acre for Gh¢ 60 per cropping season. So the offer from the omanhene was not a good deal. Then it was changed to Gh¢ 2 per acre for 15 years. The majority still refused but the Company continued to expand”.

An Assemblyman in Agogo also reported that the Jatropha Company operating in the area (ScanFarm Ltd.) paid farmers who lost their lands only Gh¢ 15 per acre of land lost as compensation. The youth in the community started to agitate since they considered the compensation to be far too small but the Company did not listen to them. He claimed that not all families who lost land received compensation, for example, those who already had problems with the chief. Others also refused the compensation hoping for a better deal.

To verify the alleged compensation figures provided by the affected farmers, the farm manager of ScanFarm Ltd. was interviewed. He claimed that the Company followed all due procedure and obtained all the necessary documents needed for the farm to start. He revealed that when the local people realized that it was a foreign Company that had started operations in the area they started making trouble about compensation. He continued thus: *“So we had to meet them all with the chief*

and negotiate. So all of them (affected farmers) were compensated and now we have no problems with them. We so far have no conflicts again". The farm manager, however, failed to declare the exact compensation amounts paid to the farmers, citing unavailability of data at the time of the interview as the reason.

3.2. Effect of *Jatropha* Cultivation on Food Production and Food Security

Results of key informant interviews and focus group discussions showed that the impact of *Jatropha* cultivation on food production and food security in Ghana is transmitted mainly through land loss. As a result of land loss, households resort to reducing areas under cultivation and increasing cropping intensity, thus shortening the fallow period. These trends have significantly reduced immediate household income levels and food security and are also likely to lead to land degradation and reduced carrying capacity over time.

3.2.1. Effect of Land Loss on Fallow Periods

The loss of land by households has significantly affected the fallow period in the communities studied. Farmers are unable to fallow their farming lands for a longer period due to decline in landholdings. This has led to decline in farm yields over the years. While only 29.37% of 144 respondents were able to fallow their land for less than 1 year before *Jatropha* cultivation in their localities, as much as 39.58% fallowed their lands for less than 1 year after the introduction of *Jatropha*. Similarly, while 25.17% maintained that they fallowed their lands for more than 3 years before the introduction of *Jatropha*, only 16.67% fallowed their lands for more than 3 years after the introduction of *Jatropha* (Figures 2 and 3). The decreasing fallow period clearly shows that local farmers in *Jatropha* plantation areas are losing land to *Jatropha* investments.

Figure 2. Fallow pattern in the study communities before *Jatropha* investments (N = 144).

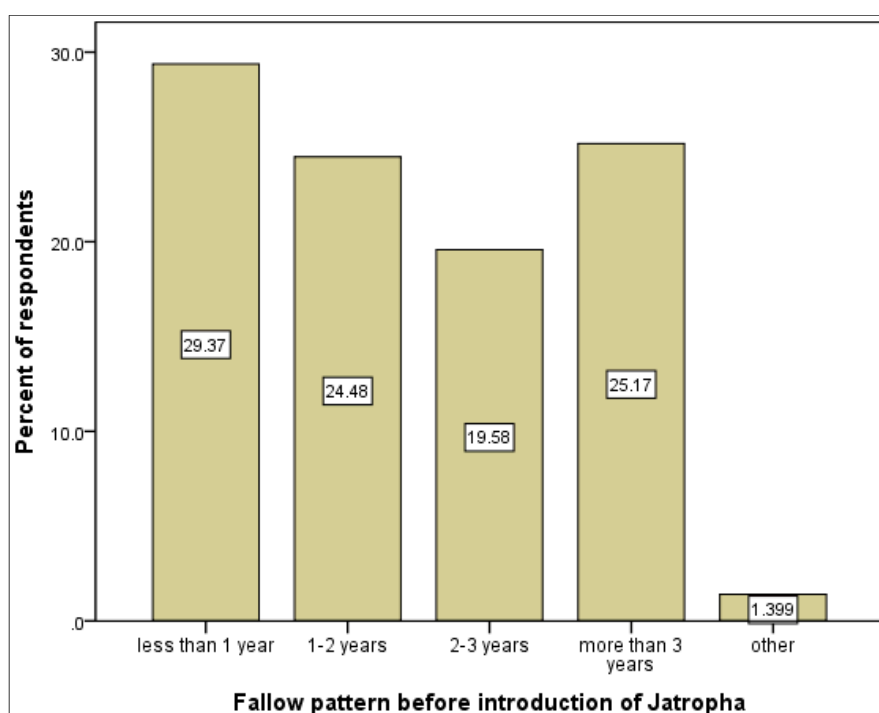
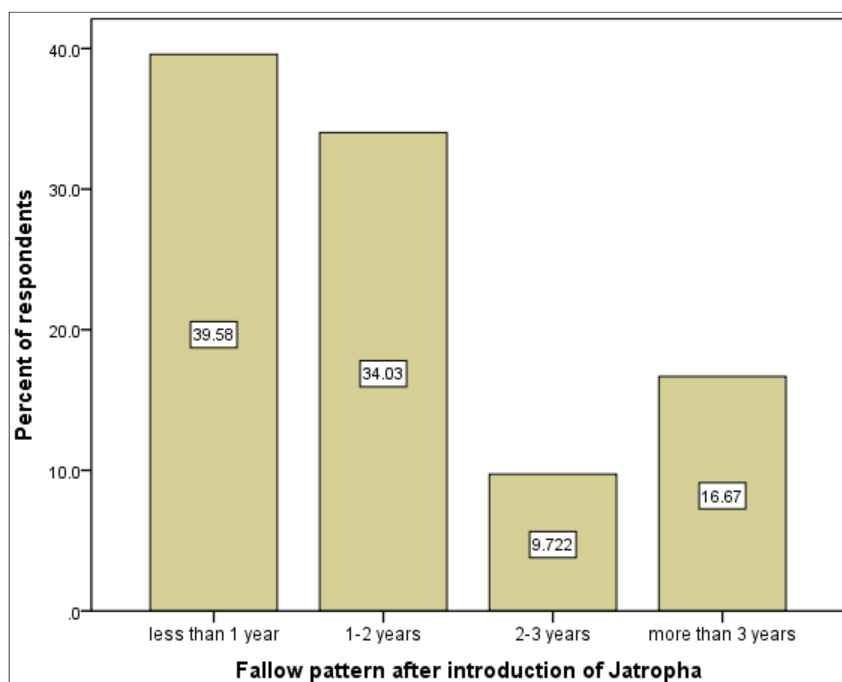


Figure 3. Fallow pattern in the study communities after Jatropha investments (N = 144).

3.2.2. Meeting the Food Needs of Households Before and After Jatropha Plantations

To understand the impact of Jatropha plantations on food production in the communities, the respondents were asked to compare the easiness of meeting their food needs before and after Jatropha feedstock cultivation in their communities. The majority (41.6%) of the 221 respondents who were able to provide information indicated that, in general, their households had surplus food before the establishment of Jatropha plantations, 26.2% said that their food needs were met most of the time, 15.4% reported that their food needs were sometimes met, while 8.6% maintained that their food needs were rarely met. Only 8.1% claimed that there was not enough food for their households. Conversely, only 16.3% of 215 respondents indicated that, in general, their households have food surplus after the establishment of Jatropha plantations. Indeed, 18.1% revealed that there is now not enough food to meet their household needs, 22.3% said they can rarely meet their food needs now, while 27% maintained that they are now able to meet their food needs most of the time (Table 3). The respondents attributed the changes in their ability to meet their food needs to the loss of their land to Jatropha plantations.

Table 3. Households' views on meeting their food needs before and after Jatropha investments.

Easiness of Meeting Food Needs	Before Jatropha Plantations		After Jatropha Plantations	
	No. of Respondents	% of Respondents	No. of Respondents	% of Respondents
Not enough food	18	8.1	39	18.1
Food needs rarely met	19	8.6	48	22.3
Food needs met sometimes	34	15.4	35	16.3
Food needs met most of the time	58	26.2	58	27
Surplus food	92	41.6	35	16.3
Total	221 *	100	215 *	100

* The number of respondents are different because some of them were unable to provide answers.

The situation after establishment of *Jatropha* plantations clearly shows that households are now struggling to meet their food needs. The story of Araba and her daughter, Mbia—victims of land loss in a village called Camp in the Kimminic Corporation *Jatropha* plantation area near Bredie No.1 in the Nkoranza District of Brong Ahafo Region—provides evidence of the current food situation in *Jatropha* plantation areas in Ghana (Box 1).

Box 1. The story of Araba (mother) and Mbia (daughter)—victims of land loss at Camp, a village near Bredie No.1 in the Nkoranza District.

“The Company (Kimminic Corporation, Mississauga, ON, Canada) started the *Jatropha* plantation about 3 years ago. We were here when bulldozers arrived. I thought they were coming to construct our road. They started to destroy the land. My father’s farm had cassava and yam on it. In all about 4 acres were destroyed of which we had about 2 acres of yam. My pepper and okro farms were also destroyed. They did not allow us to harvest. There was also no compensation given to us. No new land was given to us. When my father complained, the Chief of Nkoranza told my father that when he was coming to settle here he did not bring land along so he has no land here. Therefore if the land is taken, he has no right to question that. Those who were farming on Ejurahene’s (Chief of Ejura) lands were better off. Those of us farming on Nkoranzahene’s (Chief of Nkoranza) land all suffered. In all 9 people’s crops were destroyed in this village.

Some people from the village have been employed by the Company—2 women and 6 men. But, those of us whose crops were destroyed have not been employed. They (the Company) kill our sheep and when we complain they threaten to evict us from here. This Company has only brought us suffering. They said they were bringing oil but we have not seen any oil yet. The community has not been helped in any way. They have not promised us anything and have done nothing for us. We used not to buy cassava in this village but now we always buy. We used to hire labor to work on our farms but we don’t do that anymore because our farm sizes are too small now. We used to have so much maize, cassava, beans and yam. Our yam farm is now like this compound. I (the daughter) can even farm it all in a day”.

3.3. Effect of *Jatropha* Cultivation on Employment and Income Generation

Despite the negative impacts of land loss and the associated difficulties in meeting food needs, the cultivation of *Jatropha* led to the creation of jobs in the communities where they were started. However, such jobs were merely transient as most of the *Jatropha* companies have collapsed. Forty two percent (42%) of the 234 respondents interviewed reported that they worked for *Jatropha* plantations. Several reasons were given by those who did not work for *Jatropha* plantations. Many people reported that because the *Jatropha* companies took their land without their consent and without compensation, they did not see why they should work for them. As one man from Agogo puts it: “*How can I work with somebody who has stolen my land?*”. Another man from the same town also reported as follows: “*I am not interested in working for them; they are very corrupt and self-seeking people*”. Some revealed that they did not work for the companies because of the low wages offered employees. They lamented that they could not depend on such low salaries to satisfy the needs of their families. Others claimed that they sought employment in the plantations but they were not successful.

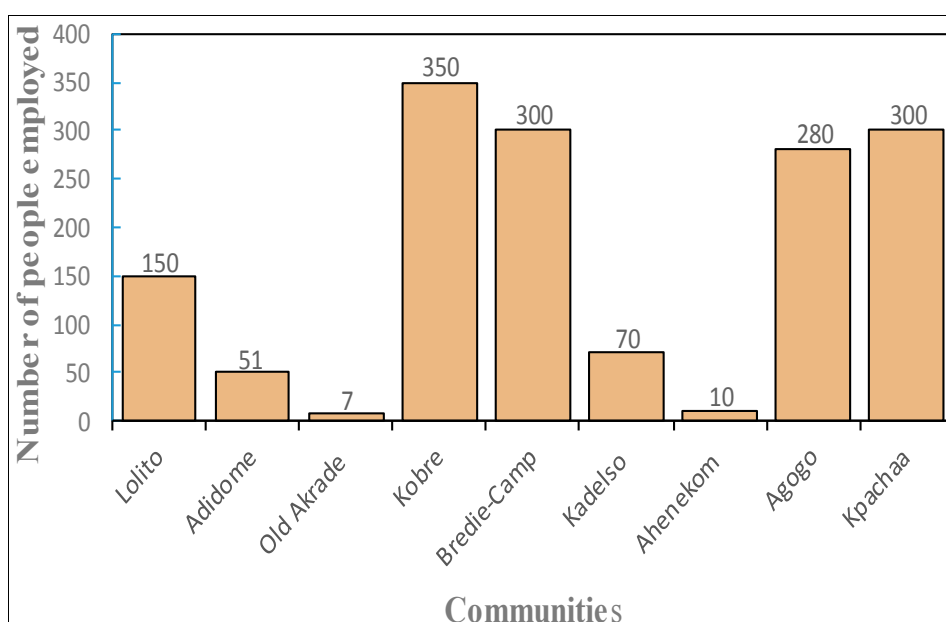
3.3.1. Extent of Employment and Income Generated by Jatropha Plantations

To understand the extent of employment offered by Jatropha plantations and the level of income generated by such employment, the respondents were asked to estimate the number of people employed in the plantations, indicate where the employees came from, whether they worked full or part-time, how often they were employed by the companies and the salaries the employees were paid. Estimates of number of people employed by Jatropha plantations from nine communities where data was available (based on key informant interviews) ranged from 7 to 350 with an average of 169 people per community. The largest employment was found in Kobre with 350 employees, followed by Bredie-Camp and Kpachaa, each with an estimated employee numbers of 300 people (Figure 4). An assertion by the Unit Committee Chairman of Bredie No. 1 in the Nkoranza District of Brong Ahafo Region corroborated the employment figures provided above. He reported as follows:

“From the point of view of employment, the Company (Kimminic Corporation) is doing well. The Company provides employment to the people in this area. The workers’ salaries are taken at the bank and that is good, even though some workers complain that their salaries are small compared to the work they do on the farm”.

The majority (80%) of the respondents said that the employees came from both the local area where the plantations are situated and from outside, 18% indicated that the employees came from the local area, while only 2% claimed that they came from outside the local area. The majority (78%) of the 98 respondents who claimed to have worked for the Jatropha plantations said that they worked full time while 22% indicated that they worked on a part-time basis. Regarding how often the employees worked within the year, the majority (68%) reported that they worked all year round, 12% said they worked seasonally, 16% maintained that they worked intermittently—as and when the Company needed their services, while 4% were engaged in a one-time activity to clear the land.

Figure 4. Estimated number of people employed by Jatropha plantations in the studied communities.



The employee salary figures provided by the respondents varied widely between Gh¢50 and Gh¢500 per month with a mean salary of Gh¢ 98.61. The majority (36.8%) of the 95 respondents who revealed their salaries reported that they earned Gh¢ 80 per month, 10.5% each said they were paid Gh¢ 70 and Gh¢ 150 per month, 13.7% indicated that they earned Gh¢ 100 per month, while 1 person each claimed that they were paid Gh¢ 170 and Gh¢ 500 (Table 4).

Table 4. Monthly salaries of employees of Jatropha plantations.

Employees' Monthly Salaries	Number of Respondents	Percent of Respondents
Gh¢ 50	2	2.1
Gh¢ 60	3	3.2
Gh¢ 70	10	10.5
Gh¢ 75	1	1.1
Gh¢ 80	35	36.8
Gh¢ 85	1	1.1
Gh¢ 88	1	1.1
Gh¢ 90	5	5.3
Gh¢ 95	1	1.1
Gh¢ 100	13	13.7
Gh¢ 110	1	1.1
Gh¢ 120	9	9.5
Gh¢ 135	1	1.1
Gh¢ 150	10	10.5
Gh¢ 170	1	1.1
Gh¢ 500	1	1.1
Total	95	100

Note: At the time of the fieldwork, \$1 was equivalent to Gh¢ 1.5.

Focus group discussion with former plantation workers of Biofuel Africa Ltd. at Lolito in the South Tongu District of the Volta Region revealed that, before the Company folded up, the supervisors and farm managers were being paid Gh¢ 500 per month while fieldworkers were paid Gh¢ 80 per month. Mechanics and machine operators also received between Gh¢ 100 and Gh¢ 200 per month. The workers lamented that, before the Company folded up, their salaries were improving and generally things were getting better. An interview with the former Farm Manager of Jatropha Africa Company at Kadelso also revealed that, when the Company was in operation, an average of 70 fieldworkers were employed, each receiving an initial salary of Gh¢ 70 per month which was later increased to Gh¢ 90 per month. The manager started with a salary of Gh¢ 90 that was later increased to Gh¢ 150 per month. Casual workers were paid Gh¢ 3 per day, with working hours from 9:30am to 1:30pm. One of the watchmen of Biofuel Africa plantation in Kpachaa also reported that he was employed for about 4 years and received Gh¢ 85/month. In Agogo, casual workers of ScanFarm Ltd. were paid Gh¢ 50 per month but permanent workers were paid a bit better. In Old Akraide near Juapong in the Eastern Region, security workers were paid Gh¢ 60 while farm workers received Gh¢ 80. According to these security workers, the salary they received from working in the Jatropha plantation constituted about 30% of their annual income while fishing and farming constituted 40% and 30% respectively.

3.4. Household Economic Situation before and after Jatropha Investments

The economic situation of households in the study communities was assessed by asking respondents whether they considered their households to be poorer, wealthier or the same as their

neighbors before and after *Jatropha* investments/plantations in their localities. Forty two percent (42%) of the 226 respondents who provided responses reported that they were wealthier or better off than their neighbors before the *Jatropha* plantation, 43.4% said that they were the same as their neighbors while 11.1% indicated that they were poorer or less well off than their neighbors before the *Jatropha* plantation. Contrary to these, 32.4% of 213 respondents that provided information indicated that they are wealthier than their neighbors after the establishment of the *Jatropha* plantation, 39.9% said they are the same as their neighbors while 23% maintained that their households are poorer than before (Table 5). The majority of the respondents attributed the decline of the living standard of their households to *Jatropha* plantations which have taken vast areas of land.

Table 5. Economic condition of households before and after *Jatropha* plantations in the various communities in Ghana.

Condition of Household	Before <i>Jatropha</i> Plantation		After <i>Jatropha</i> Plantation	
	No. of Households	% of Households	No. of Households	% of Households
Cannot tell	8	3.5	10	4.7
Poorer/less well off than neighbors	25	11.1	49	23
About the same as neighbors	98	43.4	85	39.9
Wealthier/better off than neighbors	95	42	69	32.4
Total	226 *	100	213 *	100

* The number of respondents are different because some of them were unable to provide answers.

3.5. Impact of *Jatropha* Plantations on the Local Economy

To explore further the impact of *Jatropha* plantations on the local economy as well as the livelihoods of local communities, the respondents were asked to mention the various ways in which they think the *Jatropha* plantations in their localities have positively or negatively impacted their lives. On the positive side, the majority (66.2%) of the 234 respondents reported that the *Jatropha* plantations have created employment in their communities, 26.5% maintained that the plantations have opened up the local economies in terms of business activities, while 14.5% stressed that the plantation have provided the communities with dugouts and boreholes (Table 6). Other positive impacts revealed by the respondents are building of schools and clinics for the local people and maintenance of roads.

The assertion that *Jatropha* companies built schools and clinics for the local people was not supported by the key informants and focus groups. In fact, nearly all the respondents to the key informant interviews and focus group discussions spoke about the lack of support from *Jatropha* companies for infrastructural development in their communities. They said that all the promises the companies made regarding school buildings, clinics, markets, roads, *etc.* have not been fulfilled.

On the negative side, the majority (57.7%) of the respondents complained that non-timber forest products (NTFPs) such as sheanuts and dawadawa have become scarce because the companies have destroyed them, 54.3% said that the *Jatropha* plantations have taken up their lands, while 33.3% maintained that they are unable to produce enough food for their households since the companies have taken their lands. A few (5.6%) asserted that the activities of the *Jatropha* companies have polluted their source of drinking water (Table 6). Most of the respondents who complained that

NTFPs such as sheanuts and dawadawa have become scarce because the Jatropha companies cleared them were from Kpachaa, Jimle and Kusawgu in the Northern Region of Ghana, where Biofuel Africa Ltd has acquired large tracts of land for Jatropha plantation. In these areas, sheanut collection and processing play an important role in the livelihoods of households. For many households, sheanut collection and processing represents the only source of livelihood. The clearance of this important resource for Jatropha cultivation therefore impacts severely on the livelihoods of the local people, especially women.

Table 6. Impact of Jatropha plantations on local people (N = 234 in all cases).

	Impacts	No. of Respondents	% of Respondents
Positive Impacts	Created employment for local people	155	66.2
	Opened up the local economy in terms of business activities	62	26.5
	Provided water well and boreholes	34	14.5
	Built clinics for the local people	11	4.7
	Built schools for the local people	2	0.9
	Provided/maintained our roads	1	0.4
Negative Impacts	Non-timber forest products (NTFPs) such as sheanuts and dawadawa have become scarce because the Company has cleared/destroyed them	135	57.7
	Jatropha plantation has taken up our land	127	54.3
	I am unable to produce enough food for my household	78	33.3
	The water we drink is polluted	13	5.6

Note: Number and percentage of respondents do not add up to 234 and 100 respectively because respondents provided multiple responses.

In the Kusawgu area, the local people succeeded in stopping the Company from clearing the land when they realize that the plantation would mean extensive deforestation and the loss of incomes from gathering forest products, such as sheanuts, and that the promised jobs and incomes were unlikely to materialize but this happened after 2600 hectares of land had already been deforested.

4. Discussion

The rush for biofuels has been largely driven by three main issues: climate-change mitigation, energy security and agricultural development. The idea of producing energy from a reproducible source is readily appealing. However, biofuels relying on large-scale adoption of intensive monoculture practices are almost certain to impact negatively on people and livelihoods. In areas where agricultural lands are already scarce, shifting from fossil fuels to biofuels would exacerbate existing land problems and create particular challenges to food supplies for the poor due to a shift from food cropping to fuel cropping. The situation in Ghana is that of large-scale acquisition of active or fallow agricultural lands for Jatropha plantations causing farmers to look for new farm lands or reduce their area under cultivation.

In Ghana, studies on the impact of large-scale/commercial production of biofuels on local livelihoods are very scarce. Few studies [4,8–12] attempt to assess the current and potential effect of commercial biofuel production on local communities. Even though the biofuel industry in Ghana is still in its early stages, these studies reveal that commercial biofuel production impacts significantly on the livelihoods of local people. For example, German *et al.* [9] report as follows: “Many of the purported ecological and rural livelihood benefits of the biofuel industry have not materialized. Widespread deforestation, the failure of many companies to deliver on promises, heavy reliance by companies on short-term employees, barriers to market entry, and risks borne by outgrowers have undermined the industry’s promise... The losers tend to be customary land users whose livelihoods are undermined by plantation expansion and who face the greatest difficulty in capturing benefits” [9] (p. 1). The failure of the *Jatropha* Companies in this study to honor their promises of building schools, clinics, roads, *etc.* for the various communities might have been a deliberate deception of local people in an attempt to win community support for the commencement of their projects.

Since the rural economy of Ghana is largely agrarian, securing rights to land is a central issue in rural parts of Ghana, with respect to livelihoods, food security, economic growth, and human rights. It is therefore not surprising that land loss, leading to reduced landholdings, shortening fallow periods, increased cropping intensity and, ultimately, food insecurity, were the immediate consequences of the establishment of *Jatropha* plantations in the study communities. More than 80% of the lands in Ghana is under customary ownership [13–15]. These customary lands are held by various stools or skins (see below), families or clans, and are managed by custodians—chiefs or family heads [16]. By virtue of this, the chiefs hold the allodial interest (see below), which is the highest proprietary interest known to exist in customary land [15–19]. This gives the chiefs the right to lease large areas of customary lands to investors without consulting the current land users. Thus, the boom in biofuels feedstock cultivation in Ghana has given rise to the alienation of some local communities from communally owned lands [11].

A stool refers to a particular land-owning group represented by a stool chief. It also refers to a community governance or administrative structure similar to dynasties [20]. A skin in northern Ghana is the equivalent of a stool in southern Ghana. The “allodial” title is coined on a Latin term “allodium” used in feudal medieval Europe (1241) originally to designate the relationship of Simon de Montfort to some of his lands in France. It describes an absolute power of allocation but not necessarily a title of personal use [21].

Nyari [12] narrates a story of how a Norwegian biofuel company took advantage of Ghana’s traditional system of communal land ownership and the current climate and economic pressure to claim and deforest large tracts of land in the Kusawgu area in Northern Ghana with the intention of creating “the largest *Jatropha* plantation in the world”. In this area, like most parts of Ghana, over 80 percent of the land is held under communal ownership and more than 70 percent of this land is managed by traditional rulers or chiefs on behalf of the members of their traditional areas. He reports that “bypassing official development authorization and using methods that hark back to the darkest days of colonialism, this investor claimed legal ownership of these lands by deceiving an illiterate chief to sign away 38,000 hectares of land with his thumbprint” [12] (p. 1). This is a clear case of land grabbing and community disempowerment. Such massive land alienations fail to appreciate the African meaning and value of land to the community. For the affected communities, it signifies

an ominous future where the community's sovereignty, identity and their sense of community is lost because of the fragmentation that the community will suffer.

The study also revealed that the *Jatropha* Companies had very little or no consultation with current land users before the commencement of their projects. This affected the quantum and type of compensation offered, generally regarded to be inadequate by the farmers. These shortcomings were partly due to illiteracy on the part of the farmers, the lack of biofuel policy and legal framework guiding investments, and possibly reinforced by the land tenure arrangements described above and therefore the Companies found no need to consult and adequately compensate the land users. Schoneveld *et al.* [4] report that in all the biofuel plantations assessed in the central Ghanaian regions of Brong Ahafo and Ashanti, households were required to relinquish landholdings for the purpose of plantation development. Directly affected households at the majority of plantation areas were not consulted by the Biofuel Company, nor did they formally assent to transferring their land. They maintain that, with the exception of one Company that promised to pay approximately US\$ 1 per acre per year to those losing land, no formal compensation measures have been proposed by other companies or by the relevant Traditional Authorities. "Essentially, the Traditional Authorities have the authority to re-allocate community land at their discretion, often with no formal downward accountability to community members who enjoy no formal rights to the land they use" [4] (p. 4). The high dependency on on-farm activities creates high household vulnerability to external shocks of this kind.

Recounting the local impacts of large-scale land acquisitions for biofuel plantations, Schoneveld *et al.* [4] revealed one case in which an area of approximately 800 hectares was claimed by a Company for *Jatropha* cultivation (from a 15,000 hectare lease). They indicate that an estimated 55% of the land area was formerly under usufruct rights, forming part of a system of shifting cultivation, with the remaining land under secondary forest cover. About 70 households from three communities were involuntarily vacated from their lands following the 2008 growing season without any form of restitution. For two of the villages this equated to between 40% and 50% of households. They report that, on average, nearly 60% of the total landholdings of those households that lost their land were acquired by the Company. Only 20 percent of households were able to obtain some replacement land, with most households unsuccessful in recovering both the quantity and quality of land lost to the plantation. These households cited increasing land scarcity and land quality concerns as key obstacles. They assert that settler farmers, most of who migrated from the northern part of Ghana, were the worst affected as they lost disproportionate amounts of land, with almost 75 percent of land losers stemming from this group despite being a minority. They maintain that the situation is more critical because of the absence of a biofuel policy to guide the acquisition of land for large-scale biofuel plantations and protect the vulnerable and the poor from land alienation.

Similar land grabs are occurring elsewhere in Africa. Millions of hectares are being grabbed with little concern for the poor who are bound to face displacement and for the impact that this will have on family farms and other small-scale farms and food production on the continent. It is reported that a South Korean firm, Daewoo Logistics, plans to buy a 99-year lease on over a million hectares of land in Madagascar for the production of 5 million tonnes of corn a year by 2023, and to use another 120,000 hectares for the production of palm oil [2,22]. The deal is estimated to cost the Company

about USD\$ 6 billion over 25 years and is acclaimed as the biggest of its kind in the world. It is claimed that the land to be parceled off to Daewoo Logistics covers arable land about half the size of Belgium [2] and, for a mostly arid country with three food crisis situations in five years, this is a huge challenge indeed. Although the crops are said to be for food, the lesson for land and land rights is the same for biofuels. In Tanzania, there is a proposed plan to cultivate sugarcane on over 400,000 hectares of the Wami Basin by a Swiss Company in which it is estimated that more than 1000 small scale rice farmers will be displaced [11]. Similarly, in Uganda, plans to clear off half of the Mabira Forest Reserve located at the edge of Lake Victoria met with strong civil resistance in October 2007 [11]. That move would have destroyed the source of livelihood of several thousand households.

According to Ewing and Msangi [23], several studies have identified linkages between the usage of feedstocks in biofuel production and international food price increases. These studies indicate that food prices are expected to continue to rise over the next decade in response to biofuel consumption targets adopted in the U.S. and E.U. They report that despite these indications, some countries for whom food security and poverty reduction are still an issue have initiated crop-based biofuel development and set forth national blending targets for energy use within the transportation sector.

Large-scale agricultural enterprises can produce numerous benefits to affected communities. One of the most obvious and direct benefits is employment and income generation. This research showed that, for people who gained employment with the *Jatropha* plantations, the income they received was supplementary to agricultural income. The employees were therefore better off. Schoneveld *et al.* [4] report that, two large foreign companies involved in *Jatropha* plantations in Ghana estimate that 60 full-time employees will be required per 1000 hectares under cultivation, representing 0.06 employees per hectare. At the plantation that they studied in Ghana, approximately 120 persons (both part time and full time) were employed for an area of approximately 800 hectares (0.15 employees per hectare). However, they state that as this plantation is still in the labor-intensive land preparation and planting phase, this number will likely reduce. There is therefore significant risk that many employees will lose steady employment once trees mature and expansion ceases. They claim that this has already occurred at one *Jatropha* plantation (100 hectares), where the original workforce of approximately 50 reduced to four within four years. Thus, sustainability of jobs provided by biofuel plantations is a key issue.

5. Conclusions

This paper assessed the effects of large scale cultivation of *Jatropha* on farmers' livelihoods in Ghana. Large-scale commercial *Jatropha* cultivation in Ghana appears to have a lot of negative impacts on local communities. Several farmers in *Jatropha* plantation areas have lost their lands to *Jatropha* investments leading to reduced fallow periods, low crop yields, and food insecurity. The situation is more critical because of the absence of a biofuel policy to guide the acquisition of land for large-scale biofuel plantations and protect the vulnerable and the poor from land alienation. While community cultivation of biofuel crops for local use may be a sustainable source of higher income for farmers, the current land grab by corporations for the large-scale and export-driven

expansion of biofuel production has ominous implications. One of the key positive impacts of *Jatropha* plantations in Ghana was the creation of employment in the communities where these plantations were established, however, such jobs were lost few years after the establishment of the plantations. This raises questions about the sustainability of jobs created by *Jatropha* investments.

Even though the impact of *Jatropha* feedstock production on local livelihoods in Ghana is largely negative, the industry could be developed in ways that promote farmers' livelihoods. The cultivation of biofuel crops by smallholder farmers as well as through outgrower schemes should be promoted to ensure that local farmers derive tangible benefits from the emerging biofuel industry. For the outgrower scheme, guaranteed markets and prices will ensure security for farmers. Projects that aim at meeting community energy needs have better prospects of bringing positive returns to the communities where they are implemented as has been demonstrated by similar community-focused projects in Mali. Action is needed to protect smallholder farmers who bear a disproportionate cost of the emerging biofuel industry.

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Author Contributions

The study was conceived and designed by both authors. Both authors contributed equally to the data collection and analysis. Emmanuel Acheampong, the lead author, led the write up of the paper. The authors have read and approved the final published manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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