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Keywords: *land deal shocks, multivariate probit, response strategies, para rubber, ahanta west, ghana.*

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Households' Response Strategies to Rubber Land Deal Shocks in the Ahanta West District, Ghana

Christina Appiah-Adjei [α] & Isaac Gershon Kodwo Ansah [σ]

Abstract- **Sustainability of food crop production depends on secure land tenure arrangements. Yet, food crop farmers in many developing countries face various land deals and land grabbing that often deprive them of their sources of livelihoods. One source of land deal shocks in the Ahanta West district of Ghana is the massive production of Para rubber. This study examined food crop farmers' perceptions of rubber land deal shocks and the corresponding response strategies used to cope and adapt in the Ahanta West district of Western region. The survey found a total of nine (9) key response strategies, with participation in off-farm activities being the most dominant, while seasonal migration was the least used coping measure. A multivariate probit model was used to analyze the factors determining the choice of response strategies. The findings indicate that households' perceptions, household size, farm size, distance to nearby community market, years of rubber ownership, age, sex, years of education, land source and land tenure are significant determinants of various response strategies adopted. Furthermore, there are both synergies and trade-offs in the use of these response strategies. Sustaining food production to ensure livelihood of the poor requires revisiting the land tenure arrangements in the study area, to ensure proper land demarcation for cash crop and food crop production in the district.**

Keywords: land deal shocks, multivariate probit, response strategies, para rubber, ahanta west, ghana.

I. Introduction

Agriculture remains the only sector that employs majority of the people in rural, peri-urban and urban Ghana, as in most developing countries. Besides employment, agriculture provides the bulk of food consumed by the people in the country. Specifically, in the western region of Ghana, rural, peri-urban and urban folks generate their livelihoods through the production of food and/or cash crops. In the past two decades, one of the important and apparently profitable cash crops that has attracted great interest in the Western and Central regions of Ghana is Para rubber (*Hevea brasiliensis*). Since its introduction in 1898 and subsequent establishment of a rubber plantation in 1957 at Dixcove in the Western region, it has assumed an important position in the economy of this region. Ahanta West district in the Western region of Ghana is an area where rubber is predominantly grown and viewed as 'White Gold' because of its relative profitability. The establishment of the rubber factory in the district underscores the importance of rubber production in the area.

In the district, the common case is that farmers who cultivate food crops are mostly tenants because they do not have their own lands, while cash crop producers are often landlords that own lands. Consequently, food crop farmers often rent lands from land owners or enter into various kinds of land contractual arrangements with the landlords. Therefore, sustainable source of land-based livelihoods for the food crop farmers depend on their continued use of the land allotted to them by the landlords. According to report by Rubber Board (2004) smallholder farmers who cultivate rubber in countries such as Thailand is about 90% of total farmers that produce rubber; in India and Malaysia, this is about 89%, while in Indonesia it is approximately 83% of total rubber farmers. Thus, rubber production is mostly done by smallholder farmers in these countries. However, the case is different in Ghana where rubber production is commercialized with the bulk of it produced by large scale commercial outfits. Recently, smallholder farmers are losing their lands for food production because the relative affluent and powerful in society are consistently taking over rubber production in the district.

These developments have displaced most smallholder farmers from food crop production and other land markets, and consequently rendered them landless. The socioeconomic implications of these dynamics are reported to be significant and large (Yeboah et al., 2017). As a result, land acquisition and use patterns have changed dramatically following the pressure on land generated by rubber production. In addition, the commercialization of land for real estate establishment has increased due to the recent oil find in the region. Lands that were initially allocated as communal, family or lineage properties for which the chiefs and family heads served as custodians, and so were not sold out have now had a new fate. Various families have their family and share cropped lands sold or rented out for many years of rubber production (rubber has an estimated economic lifespan of 35 years, including 5 years of immature stage and about 25 years of productive stage). While many food crop farmers have completely lost their lands, other farming households have the sizes of their food crop farming

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lands drastically reduced, and those who do not own lands are heavily affected and devastated.

Furthermore, within the cultural context of Ghana there are often strict adherence to gender roles. For example, women are mostly seen as responsible for provision of food at household level (King & Bugri, 2013). In the Ahanta West district, these gender roles are also well observed, where women are primarily responsible for food crop production. Therefore, these land deals and their consequences mean a lot for the livelihood of women and their families. If attention is not paid to these events, it could mimic the well-known 'Dutch Disease' phenomenon, where the discovery of one resource may work to retard the development of an area (Corden, 1984). To avoid a possible 'Dutch Disease' scenario, it may require that proper regulations on land use are enacted to reduce the heavy dependence of livelihoods on rubber production in the district.

Since the onset of massive rubber land deals, undocumented evidence suggests that food crop production in the Ahanta West district has been declining consistently. Major staple crops in the district such as cassava, maize, and vegetables are no longer readily available. Therefore, prices of these commodities have increased significantly. The consequences of these high prices on the livelihoods of the resource poor farmers are reported in the local media, community radios and social gatherings. The implications of these dynamics on livelihoods, and the perceptions held by the natives concerning rapid conversion of food crop lands to rubber lands are not documented. Many land owners and family heads continue to sell out their lands for rubber production without considering the very survival of other people whose livelihoods depend on the arable lands that are being quarantined for many years of rubber production. Land is no longer a secure source of livelihood for landless and poor farmers in the rural communities. Due to the shifted attention to rubber production, 'land grabbing' in the district seems to be at its peak. This has led to significant unemployment in the local economy (since majority of the people were food crop farmers), and some of the affected folks are continually resorting to illegal mining (galamsey), sand winning, stone extraction, which are newsworthy issues recently discussed in the Ghanaian media.

Previous research in the domain of natural rubber production have focused on the environmental implications, costs and profits (Aggrey, 2014; Boakye, 2015; Dararath et al., 2011; Mensah, 2014; Yeboah et al., 2017), while giving little or no attention to the impacts that the rubber land deals have on food crop production and farmers' livelihoods. For example, Mensah (2014) investigated the environmental impacts of rubber processing, with focus on land destruction by rubber crumbs and the chemical effects during processing. Boakye (2015) contributed to the literature by investigating the effects of rubber plantations on the nutrient status of soils established under different land use systems. This research revealed that rubber establishment impacted somewhat positively on most of the soil quality parameters analyzed. Finally, Dararath et al. (2011) projected higher profit returns for producing rubber compared to food crops such as maize and cassava production.

While the available literature is noted for narrowing their study to environmental implications and profitability analyses, this study seeks to unravel societal perceptions of affected food crop farmers and how they cope and adapt to these events. Therefore, this study specifically addresses the following three research questions. (1) How do food crop farmers perceive the issue of rubber land deals in the district as a livelihood issue? (2) What coping and adaptation mechanisms are used by food crop farmers affected by rubber land deals in the district? (3) What factors determine the type of coping and adaptation strategies adopted?

The next section describes the research methods, which highlights the study area and sample, as well as the analytical framework. After the methods section, the results and discussions follow, before the last section concludes and provides policy implications for the study.

II. Materials and Methods

a) Study area and data

This study was conducted in Ahanta West district in the Western region of Ghana. The district is one of the largest producers of natural rubber and oil palm in the region. According to Ghana Statistical Service (2016), the district covers a land mass of 591 square kilometers. It shares boundaries with Nzema East Municipal on the west, Tarkwa–Nsuaem Municipal and Mpohor Wassa-East district to the north, and Sekondi-Takoradi Metropolitan Assembly to the east. The district is boarded to the south by the Gulf of Guinea, and the southernmost part of Ghana lies in the district at Cape Three Point where the recent oil find has its focal unit. The district is approximately 25 kilometers from the central business district of Takoradi, and this enhances businesses and trade in particular. According to the 2010 Population and Housing Census the population of the district is relatively young, with over 47% within the age group of 0-17 years.

The district is predominantly rural (70.5%) and has over 123 settlements, with Agona Nkwanta as the district capital. The district is located in the wettest region of Ghana, experiencing a double maxima rainfall of over 1,700 millimeters annually. This abundant rainfall supports agrarian activities in the district, more especially rubber production. Agriculture is therefore the major economic activity undertaken in the district. It is estimated that about 47% of the active population is

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directly involved in agricultural production (WRCC, 2016). Major food crops produced include cassava, plantain, maize, rice and vegetables. Prominent cash crops are natural rubber and oil palm. As reported by GSS, (2014) the estimated average farm size is about one acre per farmer which could be due to numerous industrial and rural developmental activities that are ongoing in the district.

The data for the study was obtained through a cross-sectional survey of farmers solely engaged in food crop production in the district. A total of five communities was selected randomly from within the district including Abura, Agona nkwanta, Apemanim, Ewusiejoe and Dixcove. For each community, a total of 40 respondents were selected with the exception of Abura and Apemanim where 65 respondents each were queried. This was based on the extent of rubber production in the various communities. Close to about equal weight was however accorded to both males and females with the former dominating by one respondent. However, respondents were purely food crop farmers in the areas specified. In total, 250 selected respondents were queried through administering a questionnaire as a survey instrument. Table 1 provides the details of the sampled communities.

Table 1: Distribution of respondents' number across the district

Community	Number of Respondents	Percentage
Apemanim	65	26
Abura	65	26
Agona nkwanta	40	16
Ewusiejoe	40	16
Dixcove	40	16

b) Analytical framework

i. *Econometric modeling of factors that influence adoption of coping and adaptation strategies.*

A multivariate probit (MVP) model is applicable whenever multiple binary decisions are involved for the same individuals. According to Lassafre et al. (1992), the MVP model is the best approach to employ for the study involving joint-decision making process of resource allocation between different strategies and identification of their potential substitutability or complementarity. The multivariate probit analysis explicitly assumes that the error terms across the decisions available are normally distributed with mean vector zero.

The data set shows that there are about nine main response strategies that are used by those affected by the rubber land deal shocks. Therefore, to quantify the factors that influence the coping and adaptation strategies adopted by food crop farmers, the MVP model is employed. We assume that there is an underlying unobserved and unmeasured variable, Y_a^* that is proportional to the unobserved utility that conditions the choice of each of the response strategies. The MVP model is specified as

$$Y_{ia}^* = \beta_{ia} X_{ia} + \epsilon_{ia} \quad (1)$$

where, $Y_{ia} = (a = 1,2 \ldots \ldots .9)$ represents the vector of dependent variables (that is the response strategies used by the various farmers); X_{ia} represents the set of explanatory variables (such as age, household size, sex) that affect farmers' decision to choose a particular response strategy; β_{ia} represents a vector of unknown parameters of interest and ϵ_{ia} represents the vector of error terms. Thus, the MVP model is a model of 9 dependent variables, which is generally specified as;

$$Y_{i(1\ldots9)}^* = \beta_a X_a + \varepsilon_i \quad (2)$$

The latent dependent variables are observed through the decision to make use of a particular response strategy or not, such that

$$Y_{ia}^* = \begin{pmatrix} 1 \; if \; y^* > 0 & a \; particular \;\; response \;\; strategy \;\; is \; chosen \\ 0 \; if \; y^* \leq 0 & the \; particular \;\; response \;\; Strateg \; y \; not \; chosen \end{pmatrix} \quad (3)$$

Accordingly, 14 variables, assumed to have an association with the choice of the 9 response strategies, were selected and tested in the multivariate probit, which are defined in table 2 below.

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Table 2: Variable with their definitions and a priori expectation with respect to response strategies

Variable	Definition and measurement
Off-farm	1 if household adopted off-farm activity as response strategy, 0 if otherwise
Agricultural intensification	1 if household adopted agricultural intensification as response strategy, 0 if otherwise
Change food consumption pattern	1 if household changed food consumption pattern as response strategy, 0 if otherwise
Livestock rearing	1 if household adopted livestock rearing as response strategy, 0 if otherwise
Seasonal migration	1 if household used seasonal migration as response strategy, 0 if otherwise
Credit for family expenditure	1 if household used credit acquisition as response strategy, 0 if otherwise
Credit for productivity	1 if household used credit for productivity as response strategy, 0 if otherwise
Savings	1 if household adopted savings as response strategy, 0 if otherwise
Beg food	1 if household begged for food as response strategy, 0 if otherwise
Household size	Total number of members eating from same pot
Market	1 if market is available, 0 if otherwise
Distance to community market	Distance to community market in walking minutes
Distance to district	Distance to district capital measured in minutes
Farm size	Total farm size for food crop production measured in acres.
Perception index	Measured on a scale of -2 (strongly disagree) to 2 (strongly agree).
Years of rubber ownership	Number of years of owing rubber by self and friends measured in years
Age	Age of respondents in years
Sex	1 = female 0 = male
Marital status	1 if married, 0 if single/separated
Education	Years of education of respondents
Abusa	1 if the farmer has Abusa agreement on cropped land, 0 if not
Abunu	1 if the farmer has Abunu agreement on cropped land, 0 if not
Deed/lease	1 if the farmer has Deed agreement on cropped land, 0 if not
Quasi-freehold	1 if the farmer has quasi-freehold agreement on cropped land, 0 if not
Extended Family	1 if the farmer source its cropped land from extended family, 0 if not
Husband	1 if the farmer sourced cropped land from husband, 0 if not
Non-family member	1 if the farmer sourced cropped land from non-family members, 0 if not
Rented	1 if the farmer sourced cropped land by renting, 0 if not
Inherited	1 if the farmer sourced cropped land by inheritance, 0 if not
Purchase	1 if the farmer sourced cropped land by purchasing, 0 if not
Land deal shock	1 if a farmer has completely lost land, 0 if partial loss or farm size has reduced.

III. Results and Discussions

a) Perceptions on Rubber land deals in the district

To understand how people perceived the effect of the rubber land deals on their welfare, a number of perception questions were posed to the respondents to rate the extent to which they agree or otherwise with the fact that land deals affected their livelihood activities and general wellbeing. The rating starts from -2 (strongly disagree) to 2 (strongly agree). The central value of zero corresponds to neutrality to the statement posed. This means that all values larger than 1 support agreement of the phenomenon, while values close to -2 support disagreement.

The results in table 3 indicate that the respondents strongly agree that the rubber land deals in the district has led to higher food prices, low food availability, reduced food crop production and high cost of land. It is evident that these perspectives are related in one way or the other. The high cost of land arising from the land deals means that the food crop farmers, who are often poor, cannot afford land rental prices. This leads to reduced food crop production, since cultivation of large areas of land becomes impossible, which implies limited food supply and consequently, higher food prices. On the other hand, respondents disagreed with the notion that intensive rubber cultivation causes the illegal mining; they emphasized that illegal mining has been in existence even when rubber plantation was not of interest. Also, respondents emphasized that because of the land deals, the future availability of land cannot be assured. To this end, respondents disagreed with the idea of encouraging the next generation to venture into rubber production mainly because of its profitability. However, respondents were neutral or indecisive on the impacts of rubber land deal on family and community social relationships, as well as the provision of numerous off-farm jobs to the people.

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Table 3: Perceptions of rubber land deals on welfare indicators

Perception variable	Mean	Std. dev.
Rubber production has made household welfare worse off	-.164	1.494671
Rubber production has affected economic life of family	.032	1.257498
Rubber production has affected education of children	-.052	1.219527
Rubber production has affected social relations within the family	.168	1.290907
Rubber production has affected social relation in community	.124	1.285002
Food prices are rising due to rubber production	1.180	1.227038
Food is not readily available due to rubber production	1.104	1.167319
Food crop production has decrease compared to previous years	1.088	1.151329
There is no cultivation of large areas of food crop due to rubber production	.996	1.256303
I now use more fertilizer than previous years of minimal rubber production	.428	1.449559
Youth engage in illegal mining due to rubber production	-.744	1.52307
Family land will be available to future generation despite intense rubber production	.696	1.348651
People face challenges in acquiring land due to rubber production	.892	1.209208
Women face more challenges in securing land than men	.864	1.139605
Land are costly nowadays than previous years due to rubber	1.076	1.171201
Due to rubber production I earn higher income form food crops	.06	1.161809
Due to rubber production I earn higher returns from off-farm work	0	1.130092
There are more off-farm jobs due to rubber production	-.22	1.113805
There is an improvement in overall wellbeing of my family due to rubber production	.256	1.013198
The next generation should be encouraged to venture into rubber production	.54	1.277076

b) *Response strategies to cope with or adapt to Rubber land deal shocks*

The land deal shocks come in two main forms. The first is where food crop farmers are completely deprived of their farming lands, and the second is where the farm size has reduced. A total of 3 composite coping strategies were reported to be used by the respondents in situations where they completely lose their food crop lands due to rubber cultivation. These strategies can be classified into participation in off-farm activities (petty trade, artisanry etc.), change in consumption patterns (relying on less preferred foods, limiting food variety etc.) and seasonal migration (migration to district capital, migration to regional capital, etc.).

As is evident from table 4, the major strategy used for dealing with rubber land deal shocks is petty trading, while the least is photography. This means that majority of the respondents engages in off-farm activities followed by those that alter their food consumption patterns, while only few travels seasonally in and out of the district. The strategic location of the study area could be attributed to many people using petty trade as a coping mechanism. This is because the district market serves a lot of traders and consumers from major towns like Tarkwa, Takoradi and several other urban towns.

On the other hand, composite total of 2 coping strategies that were used by respondents who had their farm sizes reduced as a result of 'land grabbing' for rubber cultivation. These are further classified into agricultural intensification (fertilizer application, herbicide application etc) and livestock production (goat, grasscutter etc), as reported in table 4. However, the other 4 response strategies are used in all cases of rubber land deals.

Table 4: Coping and adaptation strategies used to deal with rubber land deal shocks

Complete Loss of Land				*Partial Loss of Land*		
Response strategy	Freq.	%		Response strategy	Freq.	%
Petty trade	156	62.4		Fertilizer application	136	54.4
Artisanry	74	29.6		Herbicide application	30	12.0
By day Labor	119	47.6		Intercropping	92	36.8
Casual labor	14	5.6		Labor intensification	26	10.4
Beads making	13	5.2		Snail rearing	14	5.6
Photography	5	2.0		Goats/sheep rearing	156	62.4
Consume less preferred food	88	35.2		Grasscutter rearing	14	5.6
Limit food variety	63	25.2		Poultry rearing	132	52.8

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Limit size of meals	46	18.4				
Reduce meals times	87	34.8				
Rely on help	10	4.0				
Restricts consumption	46	18.4				
Migration to district capital	15	6.0				
Migration to regional capital	45	18.0				
Migration outside region	41	16.4				

It can be seen from the results that livestock rearing is used frequently by the people when they have to cultivate small food crop farms due to reduced land sizes. This is probably due to the fact that livestock rearing requires less resources, and individuals can rear them in their homes with limited expenditure on feeds.

Majority reported of making use of intensified farming, which they reported is coupled with huge cost which at times becomes difficult to afford. However, the importance of intensified farming or agricultural production cannot be ruled out, since it could, at least, enhance their output per acre and improve profits from farming.

c) Long term response strategies

Table 5 reports that frequency distribution of the various strategies that farmers use as long-term measures towards rubber land deals. Respondents were also queried on the specific response strategies that they have or intended to put in place in the long term to address the land deal issues. From the field survey, 90.4% said they make use of off-farm activities such as petty trade and by-day labor, among others. Majority of them reported of offering their labor services to the rubber company (Ghana Rubber Estates Limited) on causal basis. In this instance, farmers engage in activities such as slashing, tapping, nursery management, spraying, and similar activities for daily wages. However, the returns made from these services are not adequate for meaningful livelihoods, since the wages are meagre, and also the activities are associated with various health implications. Besides those who serve as laborers, others engage in petty trading due to their strategic location.

Furthermore, about 71% of the respondents employed livestock rearing as a long-term strategy. This included domestic animals such as goat, grasscutter and poultry etc. In addition to providing income, the livestock activities serve as a means of wealth and prestige to the owners. It was reported that snail and grasscutter rearing was a niche response strategy that few people engage in but with huge potential returns. The respondents emphasized that such enterprises needed only a small piece of land, which makes it more efficient to even combine with other ventures on any available small piece of land.

Table 5: Distribution of long term adaptation strategies

Response strategy	Frequency	Percentage
Off-farm activity	226	90.4
Agricultural intensification	108	43.2
Consumption pattern change	106	42.4
Livestock rearing	178	71.2
Seasonal migration	60	24.0
Consumption credit	99	39.6

About 43% of the respondents reported of using agricultural intensification as a long-term strategy. Majority were found to be making use of either fertilizer application or intercropping. Soil fertility tend to decline in situations where land fallowing is hindered due to continuous shrinking of farm sizes. This emphasizes the conclusion made by Giller et al., (2006) and Tittonel et al., (2007) that smallholder farmers are largely unable to benefit from the current yield gains offered by plant genetic improvement due to their farming on depleted soils that are non-responsive to fertilizer application. Therefore, the sustainability of intensification must be considered in dealing with land deal shocks. Nevertheless, the health implications of such acts must not be overlooked.

Unlike those engaging in strategies that do not temper with their consumption, about 42% of the respondents at one time or the other tend to alter their consumption patterns. This comprises of limiting food variety, limiting the size of meals and restricting adult's food consumption for the children etc. Although this strategy to some extent helps to deal with land deal shocks, it is not to be recommended since it has serious nutrition security implications. The fact that some people resort to these kinds of strategies highlights on how adequate food nutrients are forgone to survive these shocks. Such strategies could expose respondents to certain diseases due to poor food and inadequate nutrients intake.

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Also, 39.6% respondents said they accessed credit as a long-term strategy. The sole aim for accessing credit is for families to smooth consumption and also invest in farm production activities. Majority of these credits is acquired from money lenders and family members, which is sometimes coupled with exorbitant interest rates. Farmers gave various reasons why they tend to use informal credit sources, including market imperfections such as collateral demands, guarantees, high interest rates in the formal banking sectors which impedes their access. If market imperfections are minimized, to some extent this strategy may help. Furthermore, few of the respondents reported of employing seasonal migration in and out of the district as a long-term strategy to combat the rubber land deal shocks. Although few engage in this strategy, it becomes relevant only if they are able to make good living at the other destinations chosen. However, this can lead to draining out potential agricultural labor from the farming communities.

d) Determinants of household coping and adaptation strategies towards Rubber rand deal shocks

The multivariate probit model allows identifying the possible correlation among different response strategies. There is a variation in the combination of response strategies indicating a possibility that farmer's choice of one response strategy could correlate with others. In view of that, the correlation coefficient across the residuals of the multivariate probit is calculated (see table 6). Positive correlation coefficients indicate the possibility of using two strategies together (complimentary) and negative sign indicates that one strategy could be used instead of the other (substitutes).

There is a positive significant correlation between acquiring credit for family consumption and change in consumption patterns, credit for farm production and credit for consumption, begging for food from individuals and off-farm as well as soliciting food from individuals and seasonal migration at 10%, 1%, 5% and 5% level of significance respectively. For example, credit for farm production and credit for consumption were found to be complementary practices. This means that households that seek credit for production reasons are also more likely to seek credit to support their family in consumption smoothing. From the literature, this helps farmers to make productive use of the acquired loans for production and also helps smoothen their consumption all year round. This justifies the assumption and finding that farmers using multiple response strategies.

Table 6: Correlation between different response strategies

	Agricultural intensification	off-farm	Change in consumption pattern	Livestock rearing	Seasonal migration	Access consumption credit	Access production credit	Rely on savings	Beg for food
Agricultural intensification	1								
off-farm	-0.120* (0.120)	1							
Change in consumption pattern	-0.329*** (0.010)	-0.155 (0.120)	1						
Livestock rearing	0.123 (0.110)	-0.075 (0.130)	-0.052 (0.109)	1					
Seasonal migration	-0.015 (0.108)	0.169 (0.123)	0.020 (0.113)	-0.325** (0.112)	1				
Access consumption credit	0.086 (0.115)	0.040 (0.138)	0.199* (0.111)	0.058 (0.121)	-0.130 (0.115)	1			
Access production credit	0.108 (0.106)	-0.012 (0.123)	0.068 (0.107)	0.062 (0.116)	-0.143 (0.109)	0.570*** (0.084)	1		
Rely on Savings	0.111 (0.125)	0.123 (0.140)	-0.126 (0.124)	0.029 (0.129)	-0.078 (0.121)	-0.115 (0.130)	-0.292** (0.180)	1	
Beg for food	0.137 (0.165)	0.380** (0.194)	0.095 (0.167)	-0.150 (0.187)	0.379** (0.134)	0.192 (0.180)	-0.104 (0.179)	-0.232 (0.166)	1

*The significance level is indicated as follows: ***1%, **5%, *10%. Joint significance test of independent equations Chi-square (154) = 251.48; Prob>Chi2=0.000 N=250 Note: standard errors in bracket*

There is a negative significant correlation between agricultural intensification and off-farm activities, change in consumption pattern and agricultural intensification, seasonal migration and

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livestock rearing as well as savings and production credit at 10%, 1%, 5% significance levels respectively. This is so because time spent in seasonal migration lowers the amount of time left to dedicate to livestock rearing. For example, farmers can choose to either make use of agricultural intensification or participation in off-farm activities and vice versa. Whereas the main motive for a farmer to intensify is to generate more output and/or profit, off-farm activities also help in generating revenues as well. Thus, a farmer will find it more prudent to specialize in either agricultural intensification or off-farm activities due to the fact that either of the said response strategies requires some amount of funds/capital and maximum attention to achieve their said response strategies.

e) Determinants of adoption of response strategies

Household size was found to have a significant positive relationship with the probability of using response strategies such as off-farm activity and change in consumption patterns at 10% level. Larger households will need to adopt either off-farm activity or change in consumption patterns in order to cope with the shock imposed. Usually, larger family size means more mouths to feed and larger food expenditure. Where the options to earn more income to support consumption is limited due to partial or total loss of land, it becomes necessary to probably adopt a change in food consumption patterns. The poverty literature has it that *"people living in larger and generally households with younger members are typically poorer"* (Lanjouw et al., 2001). This finding is in consistent with Iqbal et al. (2015) that increasing family sizes induces off-farm participation but contrary to Rana et al. (2012) who found that increase in household size increases the possibility of engaging in farm activities rather than off-farm activities.

Distance to nearby community market was found to have a significant positive influence on livestock rearing, credit for family consumption and credit for production. The hypothesis regarding distance to markets is that the farther away a village or a household is from input and output markets the lower the likelihood that they will make use of an improved technology (Kassie et al., 2013). But contrary to other studies, the results rather depict distance as an incentive for respondents to choose livestock rearing, credit for family consumption and credit for production. But it is contrary to studies by Mohammed (2003) and Quoc (2012) that distance to market had negative effects on loan acquisition for either family consumption or farm production. Respondents might not consider the cost involved in accessing credit due to their quest to offset negative effects due to rubber land deals. However, distance to district capital was found to have negative but significant relationship with the probability of choosing livestock rearing as response strategy.

It was relevant to identify whether farm size had any influence on households' response strategies used. The result portrayed farmers' likelihood of engaging in off-farm activities, soliciting for food and credit for family expenditure at 5%, 5% and 10% significant levels respectively. This is in line with the findings of Iqbal et al. (2015) which emphasized that increasing farm size increases the chances that respondents would venture into off-farm activities. One could reason that increasing farm size makes it possible to obtain higher farm earnings, which could in turn make it possible to venture into other off-farm activities.

Table 7: Parameter estimates from multivariate probit for estimating determinants of Response Strategies

Explanatory variables	Off-farm activity	Agricultural intensification	Change in consumption patterns	Livestock rearing	Seasonal migration	Credit	Credit for productivity	Savings	Beg for food
Household size	**0.096*** (0.056)	0.017 (0.045)	**0.077*** (0.046)	0.005 (0.047)	0.057 (0.048)	-0.015 (0.051)	0.046 (0.049)	0.026 (0.055)	-0.113 (0.079)
Market	-0.190 (0.239)	-0.085 (0.100)	-0.135 (0.192)	-0.144 (0.205)	-0.147 (0.202)	0.267 (212)	0.041 (0.200)	0.213 (0.220)	0.375 (0.308)
Distance	0.057 (0.042)	0.029 (0.033)	0.035 (0.026)	**0.119*** (0.037)**	0.023 (0.031)	**0.057* (0.030)**	**0.055* (0.032)**	0.078 (0.051)	-0.039 (0.063)
Minute to district	0.016 (0.021)	0.005 (0.017)	-0.028 (0.017)	**-0.055*** (0.019)**	0.025 (0.018)	0.001 (0.018)	-0.004 (0.017)	-0.009 (0.021)	0.038 (0.027)
Farm size	**0.079** (0.033)**	0.008 (0.024)	-0.008 (0.023)	0.028 (0.026)	0.024 (0.025)	**0.046* (0.026)**	0.032 (0.025)	-0.023 (0.029)	**0.081** (0.038)**
Perception index	**-0.323** (0.136)**	**-0.178* (0.107)**	0.161* (0.096)	0.025 (0.107)	**0.232** (0.111)**	**-0.443*** (0.110)**	**-0.337** (0.110)**	**-0.250* (0.141)**	0.224 (0.199)

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Years of rubber ownership	-0.036 (0.029)	0.007 (0.023)	-0.006 (0.023)	**-0.053** (0.026)**	**-0.054** (0.025)**	0.029 (0.025)	0.012 (0.024)	-0.014 (0.027)	0.043 (0.040)
Age	**-0.050*** (0.017)**	0.008 (0.014)	**0.024* (0.014)**	0.001 (0.014)	-0.007 (0.014)	0.020 (0.015)	0.013 (0.014)	-0.017 (0.016)	-0.010 (0.020)
Sex	**0.622** (0.287)**	0.159 (0.213)	0.033 (0.204)	0.235 (0.225)	**-0.446* (0.233)**	-0.029 (0.230)	**0.515** (0.222)**	0.128 (0.266)	0.205 (0.349)
Marital status	-0.369 (0.256)	0.286 (0.200)	0.113 (0.198)	0.291 (0.210)	0.178 (0.212)	0.037 (0.218)	-0.014 (0.206)	-0.369 (0.253)	-0.429 (0.299)
Years of education	0.019 (0.022)	-0.003 (0.018)	-0.000 (0.017)	**-0.054** (0.019)**	0.020 (0.018)	-0.022 (0.019)	0.012 (0.018)	**0.065** (0.022)**	**-.111** (0.038)**
Land source									
Extended Family	0.373 (0.324)				-0.050 (0.294)	-0.279 (0.241)	-0.627 (0.641)	0.280 (0.391)	-0.990 (0.925)
Husband	-0.079 (0.438)				0.298 (0.379)	0.117 (0.332)	-0.561 (0.672)		-1.658 (1.049)
Non-family member	**0.627* (0.340)**				**0.616** (0.297)**		-0.507 (0.623)	0.027 (0.352)	-1.131 (0.868)
Rented	4.616 (133.662)				0.371 (0.739)	0.184 (0.645)		-0.646 (0.879)	
Inherited						-0.277 (0.318)	-0.800 (0.673)	0.137 (0.455)	-0.643 (0.987)
Purchase	-0.382 (0.408)				0.589 (0.405)	0.033 (0.355)	-0.360 (0.683)	0.165 (0.557)	-0.747 (1.058)
Land Tenure									
Abusa		**0.572* (0.344)**							
Abunu		4.618 (120.478)			0.197 (0.639)		-0.185 (0.629)		
Deed/lease		-0.121 (0.197)			-0.287 (0.353)		-0.486 (0.333)		
Quasi-freehold					0.069 (0.341)		-0.165 (0.316)		
Shock form	0.056 (0.267)	-0.107 (0.217)	0.006 (0.212)	-0.203 (0.236)	0.162 (0.220)	-0.288 (0.220)	-0.057 (0.218)	-0.304 (0.271)	-0.069 (0.329)
Constant	1.308 (0.907)	-0.821 (0.686)	-1.036 (0.655)	0.473 (0.708)	-0.581 (0.802)	**-1.906** (0.757)**	-1.393 (0.998)	0.796 (0.865)	-0.364 (1.358)

Perception of respondents concerning rubber land deals significantly and positively influenced their decisions to make use of changing consumption patterns and seasonal migration at 10% and 5%, respectively. In line with finding by Rana et al. (2012), perception was found to be a major driving force in famers' decision making process. Thus, the more farmers perceive that rubber land deals is a livelihood issue, the higher the likelihood of making use of changes in consumption patterns or seasonal migration. However, perception had a negative but significant influence on credit for family consumption (at 1% level), off-farm activities (at 5% level), production credit (at 5% level), agricultural intensification (at 1% level), and savings (at 10% level).

Results from table 7 indicates that years of rubber ownership by respondent's friends, families and themselves also influence the use of seasonal migration

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and livestock rearing as response strategies. According to World Bank (2010), people only migrate if they make poor living back home. However, the result in this study contradicts studies by Kosec et al. (2018) who indicated that individuals diversify their livelihoods through migration when subject to land scarcity. However, it is less likely for respondents to migrate in the study area possibly due to relatively better living conditions in their area compared to other destination. As years of rubber ownership prolongs it is less likely to engage in livestock production. This is consistent with findings by Tuner (2004), which stated that land is an important asset that supports production of livestock. Thus it is less likely for respondents to engage in livestock rearing when years of rubber ownership prolong due to land scarcity.

Age of a respondent was found to have a negative and significant (at 1% level) relationship with the probability of engaging in off-farm activities. This means that older farmers are less likely to engage in off-farm activities. In line with studies by Vanwey (2013) and Beyene (2008), accumulation of knowledge through education, skills and network as individuals age suggest that the likelihood of working off the farm initially increases with age and decline later in life course. According to these studies, older farmers have higher farm productivity and hence their reservation wage. Though ageing may also increase off-farm productivity, the studies argue that this may not be as strong as productivity from farm, thus influencing such decisions. However, age of a respondents was associated with a positive influence on the probability to use change in consumption patterns as a response strategy. Thus, older respondents are more likely to change their consumption patterns when faced with partial or total loss of food crop land. This is in line with studies that find that people "tend to eat less and make different food choices as they get older" (Drewnowski et al., 2001), which implies that the aged will be seen particularly using response strategies such as change in consumption patterns. Such strategies have undesirable health implications as outlined in the literature (Drewnowski et al., 2001).

Sex of respondents had a positive significant effect on the choice of off-farm activities and production credit as response strategies and were significant at 5% level. Females are more likely to acquire credit for production than males. This can be partially due to the fact that the men are actively engaged in cash crop production and thus have more funds to support their agricultural activities, unlike the women who are mainly into subsistence food crop production, often with little or no funds to support their activities. Also, over 70% of Ghana's agricultural production done by smallholder farmers is mostly women, who normally have limited access to production resources, especially with credit as their biggest challenge. Therefore, confined to their key roles as food crop farmers, women usually access credit to boost their production activities. This finding disagrees with Akudugu et al. (2009) who stipulated that credit access by men outweighs that of women. However, sex had a negative but significant influence on the choice of response strategy such as seasonal migration at 10% significance level. This means that females are less likely to seasonally migrate than males. This can be due to mutual understanding that females play important caregiving roles for both the young and elderly left behind. Thus, the male seeks for sources to support them back home.

Years of formal education acquired by a respondent was found to positively affect the likelihood of farmers choosing savings as a response strategy. This supports the work of Mishra et al. (2009) that the higher a person is educated the more likely they would save. Thus, a year increase in formal education makes it more likely for respondents to make use of savings as response strategies. However, years of education showed a negative but significant influence on livestock rearing and soliciting for food from either family members, friends or relatives. Also, the more one is educated the less the likelihood of using begging for food as a response strategy, because the educated are expected to acquire some form of descent work rather than begging.

Land source that consists of whether land was acquired from extended family, husband, non-family member, rented, inherited, purchase was also assessed on its influence on the choice of response strategies. Land sourced from non-family members was positively significant on the likelihood of farmers choosing seasonal migration and off-farm activity at 5% and 10% respectively. Thus farmers with land sourced from non-family members are more likely to seasonally migrate than those that were sourced through inheritance. This can be due to the diverse land use security between the two sources, since farmers are better secured on land inherited than lands given to them for use by non-family members, which then induces the rate of migration when faced with the land deal shocks. Land tenure consisting of Abusa, Abunu, Deed/lease and Quasi-freehold was also found to exert positive significant effects on farmers' choice of agricultural intensification as a response strategy when faced with rubber land deal shocks. Farmers with tenure arrangement as Abusa are more likely to engage in agricultural intensification than those with quasi-freehold tenure arrangement. This is because the more secured your land the higher the probability of investing more in improving its productivity. It must be highlighted that agricultural intensification includes fertilizer application, herbicide application, intercropping and labor intensification, of which some are capital intensive. The result is in line with the findings of Manyong et al., (2000) that some form intensification is facilitated by improved form of tenure security.

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IV. Conclusions

The study was motivated by the massive commercial rubber production in the Ahanta West district, in the Western region of Ghana at the expense of food crop production, which has made many food crop farmers landless. Using 250 food crop farmers from the district, we sought to understand how these farmers perceive land deals for commercial rubber production as a livelihood issue, and the corresponding strategies they use to deal with such shocks. Furthermore, we were interested in the factors that drive the choice of the various response strategies, which was accomplished using the multivariate probit model. The results from the analysis revealed that respondents affected by land deal shocks make use of the following response strategies: off-farm activity, agricultural intensification, change in consumption patterns, credit sourcing and seasonal migration etc. Farmers' perceptions of commercial rubber production as a livelihood issue to some extent made respondents engage in response strategies such as seasonal migration however, respondents were willingly engaging in credit sourcing despite their perception of the situation at hand. Studies furthermore reveals that majority of the cropped land were soured from non-family members with quasi-freehold tenure agreement. This translates into land insecurity that respondents are subjected to in the study area. Off- farm participation was the preferred response strategy due to the strategic positioning of the district. Other factors informing the choice of response strategies are household size, farm size, age, sex etc.

Based on the results, the following policy measures are recommended. Credit acquisition either to support family expenditure or to improve productivity was among the most preferred response strategies that was used unconditional. Therefore, it is important that policies that support microfinance establishment and proper operation are implemented to make credit readily available to farmers. This can help to offset the negative effects imposed by rubber land deals in the study area. Also, Land tenure agreement must be revisited in the study area. Restructuring land rights could lead to a positive impact on food security and broader development outcomes, such as household investment, agricultural productivity, women's empowerment and nutrition. Since secured land rights is threatened in the area due to rubber production, an effort to improve it will ensure secure land rights, which could motivate farmers to invest more in their lands and improve agricultural productivity. Finally, farmers must be supported with more viable off-farm income-earning activities to help recover the losses in revenue due to rubber production. Priority must be given to women.

Data Availability

Data for this manuscript is available from the authors upon a reasonable request.

Declaration of Interest Statement

The authors declare that they have no conflict of interest.

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