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A Comprehensive Study on the Livelihood Implications of Transitioning from Cocoa to Rubber Plantation in Ghana

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Abstract

Cocoa has long been a cornerstone of Ghana's agricultural sector, contributing significantly to the country's economy and providing livelihoods for millions of smallholder farmers. However, various factors have led some farmers to explore alternative crops like rubber as a means of diversifying their income sources and adapting to changing agricultural conditions. Against this backdrop, the study aims to explore the livelihood implications of transitioning from cocoa to rubber plantations among farmers in the Manso Amenfi district. Using a cross-sectional survey with 384 participants, we analysed our data with descriptive and inferential statistics. Cocoa farmers are shifting to rubber production because of decline in cocoa yields (28.1%). They anticipate the transition will bring an increase in their income (62.5%). About 51.0% were open to sharing their experiences with other cocoa farmers considering a similar shift. Farmers age (5%) and farm size (5%) are the key socio-economic factors that influence farmers' land use shift behavior. High price of rubber (mean = 4.36) and personal belief that rubber plantation will do better than cocoa (mean = 4.26) are the key knowledge and behavioral factors that influence farmers shift behavior. There is a significant association between the farmer's land use shift and standard of living (5%).

Keywords: Cocoa, rubber, livelihood, land use shift, decline

INTRODUCTION

A land use shift occurs when a portion or the entire land area is changed from one use to another (Azadi *et al*., 2022). In agriculture, land-use shifts are common. For instance, food crop farms are frequently converted into plantations, plantations are frequently converted into horticulture crops (Huang *et al.*, 2023). It denotes the re-allocation of a farm's productive resources, such as equipment, labor, capital, and land, into new activities or farm enterprises. Therefore, farmers frequently switch their attention from older, less lucrative crops to newer, more lucrative ones (Singh, 2020).

Cocoa, being Ghana's key agricultural export product and main source of income, has significantly contributed to the country's socioeconomic progress for many years. It provides employment to over 2 million Ghanaians in various facilities such as farms, processing plants, and product marketing centres. Despite the fact that most cocoa farmers in Ghana are small-scale producers who cultivate an average of 7 acres, the commodity contributes over USD 2 billion to the Ghanaian economy every year (Gakpo, 2018).

Ghana accomplished a significant milestone by producing over 1.14 million tonnes of cocoa in the 2020/2021 harvest season. There was a decline in cocoa production for the 2021/2022 period (-34%). An approximately 750,000 tonnes for the 2022/2023 crop season was realised. However, the forecast for the 2023/2024 cocoa crop season points to a significant decline in production. The dwindling returns from cocoa has prompted farmers to consider rubber production (Oduro, 2020; Tsiboe, 2021).

Meanwhile, the last ten years have seen a sharp increase in the demand for rubber on a global scale (IRSG, 2019; Ali *et al.*, 2022). Ghana also saw a 74% rise in rubber production, from 9,000 metric tonnes in 2000 to 19,000 metric tonnes in 2009 (Kwadzo, 2015). Currently, Ghana produces 52,000 metric tonnes of rubber, and by 2030, production is anticipated to increase to 70,000 metric tonnes (Kuwornu *et al*., 2019). This can have a great effect on farmers' livelihoods (Min *et al.*, 2017) which consists of the skills, possessions (access, claims, resources, and stores), and activities required for a means of subsistence (Krantz, 2001; Kumar *et al*., 2019).

Research has indicated that a number of factors influence farmers to convert their land into other uses. Savari *et al.* (2021), Gao *et al.* (2022), and Rose *et al*. (2018) indicated geophysical factors, biological factors, production factors, economic factors, farm characteristics, and household or individual characteristics. Household and individual characteristics such as age, educational level, prior experience, and household size influence farmers' motivation and ability to convert from one farm enterprise to another (Dessart *et al*., 2019). In addition, production constraints comprising availability and accessibility of credit, farm inputs, and labor influence the decision of farmers to engage in a certain farming enterprise (Despotovic *et al*., 2019). Kwadzo (2015) carried out a study on enterprise shift behavior among cocoa farmers with smallholdings in Mpohor-Wassa East District of Ghana and revealed that 74.7% of cocoa farmers have shifted from cocoa to rubber plantations. They found that investment outcome perception and family size were the determining factors in cocoa farmers' enterprise shift behavior. Ishak *et al*. (2021) conducted a study on causes and patterns of shift from rubber plantations to palm oil farms among smallholder farmers in Batik Nau, Indonesia and found that about 10.4% of rubber plantations were converted to palm oil plantations. Farmers shifting from rubber plantations to palm oil was caused by inefficient labor use and low prices of rubber. The expansion of big commercial rubber plantations into major cocoa producing districts in Ghana is causing cocoa farmers to transition (Gakpo, 2018).

The existing literature on farmer land use shift behavior in agriculture often overlooks the underlying causes, with many considering the phenomenon as natural and unremarkable. While previous studies have touched upon some factors influencing land use shift behavior, they have generally lacked comprehensive empirical data on determining factors and the direct impact on farmers' livelihoods. Furthermore, these studies have not adequately addressed how enterprise shift behavior impacts farmers' overall livelihoods. As a result, there is a significant gap in the literature regarding the relationship between land use shift behavior among farmers and its implications for their livelihoods. Therefore, the purpose of this study is to pinpoint the key factors influencing land use shift behavior from cocoa to rubber plantations and how it affects livelihood. The specific objectives of the study are to: 1) assess farmers' perceptions of land use shift; 2) determine the factors influencing farmers' land use shift from cocoa production to rubber plantations;

and 3) examine the association between land use shift and farmers livelihoods.

MATERIALS AND METHODS

Study Area

The study was conducted at Manso Amenfi in the Western Region of Ghana. The study district is among the main cocoa-producing areas in Ghana. In addition, it is one of the districts where land is increasingly being converted from cocoa production to rubber plantations. The primary economic activity in the district is agriculture, as it employs 80% of the economically active labor force. Cocoa is the major cash crop grown in the district, along with other cash crops, including oil palm and rubber. Aside from cash crops, other food crops are produced in the district, including tomatoes, garden eggs, rice, maize, plantains, and cassava. Generally, food production is on a subsistence basis, with low output per yield. The area experiences two rainfall patterns. The major rainfall (wet season) occurs in May–July, and the minor rainfall occurs in September–October. There is a dry spell starting from November to March. The mean annual rainfall ranges between 1200 and 1500 mm. The mean maximum temperature of the district is 30 °C, and the mean minimum temperature is 22 °C. The relative humidity is generally high, with an annual mean of 80–90% (GSS, 2018).

Research Design

In order to investigate the shift in behaviour among smallholder cocoa farmers, the study employed a cross-sectional survey with a quantitative approach. A cross-sectional research design accurately measures respondents' behaviours or attitudes towards a specific farm enterprise preference at a specific point in time (Creswell, 2014). Thus, a cross-sectional study was used, as data were collected only once from the study respondents within a brief span of time. A cross-sectional survey research design with a quantitative approach is appropriate for analysing cause-and-effect connections between the variables being studied (Ghauri *et al*., 2020).

Sampling Technique

A population can be defined as a well-defined group of people or objects having some common observable features that are being examined. The population for this study comprised all cocoa farmers in Manso Amenfi District in the Western Region of Ghana. Data from the Manso Amenfi Cocoa Health and Extension Division (CHED) showed that there are 10,107 registered cocoa farmers in the district. Out of the 10,107 registered cocoa farmers, the Yamane formula was used to calculate the sample size, which resulted in 384 cocoa farmers.

The district was purposively chosen due to the observable phenomenon of land use transition from cocoa to rubber cultivation. The stratified random sampling method was used to group the respondents into two groups: farmers who have converted their land from cocoa to rubber plantations and farmers who have not converted their land into rubber plantations. A combination of snowball sampling and a convenient sampling method were used to select 192 respondents from each stratum.

Data Collection

Data were sourced from only primary sources, thus, farmers. The primary data were collected through the use of a structured questionnaire. The structured questionnaire contained mainly close-ended questions. Closed-end questions allowed the researchers to give detailed responses to a specific research question, thus making it easier and simpler

to compare responses across respondents. The questionnaire was structured around the objectives of the study. Prior to the actual data collection, the questionnaire was pre-tested with twenty (20) respondents from Wassa Amenfi Central Municipal to determine whether respondents could truly understand the questions. Questions that were seemingly difficult to understand were reconstructed. Other information obtained during the pre-test was used to refine the questionnaire.

Data Analysis

Data was analysed using Statistical Package for Social Science (SPSS) version 19 and Microsoft Excel. The descriptive statistical tools such as frequency, percentage, mean and standard deviation were used. We used a Likert scale; 1-1.49 (Strongly disagree), 1.50-2.49 (Disagree), 2.50-3.49 (Neutral), 3.50-4.49 (Agree), 4.50-5.00 (Strongly agree) to assess the knowledge/behavioural factors influencing farmers' land use shift behavior. We employed inferential statistics, such as the chi-square test of independence, to examine the relationship between land use shift and its impact on farmers' livelihoods. This statistical method allowed researchers to determine whether there is a significant association between the two categorical variables, in this case, the transition from cocoa to rubber cultivation and effects on farmers' livelihoods. By comparing observed frequencies of land use shift with expected frequencies under the null hypothesis of no association, researchers assessed whether the observed association between the two variables was statistically significant. Additionally, we also used the binary probit model to identify and analyse the factors that influence farmers' decisions to shift their land use practice. The probit model was made possible because the dependent variable is binary, with only two possible outcomes. In this study, the dependent variable could be whether farmers shifted their land use from cocoa to rubber cultivation (1 for "yes" and 0 for "no"). The binary probit model helped to analyse the factors (independent variables: sex, age, education, marital status, land ownership, farming experience, access to extension service, household size, income) that influence farmers' decisions to shift their land use practices (dependent variable) (Kwadzo *et al*., 2013; Fasha & Minde, 2020).

Table 1. Explanatory variables and their measurements in the regression model

Variable	Description	Measurement	Type of variable	Expected sign
Age	Age of respondents	Number of years	Continuous	+
Gender	Gender of respondents	1 = female, 0 = otherwise	Dummy	
Marital status	Marital status of farmer	1 = married, 0 = otherwise	Dummy	-
Household size	Household size of farmer	Number of people in the family	Continuous	+
Education	Farmer's educational level	School years	Continuous	+
Farm size	Size of farm	Number of hectares	Continuous	+
Extension	Access to extension	1 = yes, 0 = otherwise	Dummy	+
Farming experience	Farmer's experience	Number of years in farming	Continuous	+
Income	Income from cocoa	Total income from cocoa (in USD)	Continuous	-

RESULTS AND DISCUSSION

Demographic Profile of Respondents

In Table 2, the study revealed that 159 land converters, representing 82.8%, were males, while only 33 respondents, representing 17.2%, were females, while the non-converters had 135 (70.3%) males and 57 (29.7%) females. The marital status of the respondents revealed that the majority (75.0% of land converters and 85.4% of non-converters) were married, while only a few respondents were divorced, widowed, or separated. In addition, the study showed a low level of education among the respondents, as 96 (50.0%) were land converters and 78 (40.0%) were non-converters. The highest educational level was junior high or middle school, while only 4 (2.6%) of the land converters had completed tertiary education. It was further revealed from the study that 181 land converters, representing 94.1%, reported the availability of labor, while 114 (59.4%) of non-converters stated labor availability. Approximately 90 (46.9%) of the land converters and 120 (62.5%) of the non-converters stated that they belong to the farmer group. Among the 192 land converters, 138 (71.9%) were household heads, 81 (42.2%) had access to extension service, and 35 (18.2%) had access to credit (Table 2).

Regarding the age, it was shown that the minimum age of the land converters was 25 years, the maximum age was 61 years, and the average age was 47.1 years. It was shown that the minimum age of the non-converters was 30 years and the maximum age was 82 years, with an average age of 52.8 years. The minimum farming experience among the land converters was 6 years, and the maximum was 40 years, with an average farming experience of 26.5 years. The minimum farming experience among the non-converters was 10 years, and the maximum was 58 years, with an average farming experience of 31.2 years. The household size of the land converters was 2 (minimum), average (8.0), and maximum (12). In terms of farm size, it was revealed that the minimum farm size of land converters and non-converters was 1.2 ha (Table 2).

Land Use Shift from Cocoa to Rubber Plantation

In line with objective one, Table 3 reveals that the primary reasons for converting from cocoa to rubber plantations were a decline in cocoa yields (28.1%), climate change-related factors (23.4%), higher profitability of rubber (20.8%), pest and disease issues in cocoa production (17.7%), and market demand for rubber. All these factors are capable of persuading cocoa farmers to convert their cocoa farms to rubber plantations, as every farmer, like any businessperson, carries out his operations for profit. Moreover, farmers are likely to convert their cocoa farms to rubber plantations if climate change, pests, and diseases are affecting the cocoa farms and the farms are not yielding the anticipated results. In the agricultural context, a shift from one initiative to another denotes the re-allocation of a farm's productive resources, such as equipment, labor, capital, and land, into new activities or farm enterprises (Huang *et al*., 2023). Therefore, farmers frequently switch their attention from older, less lucrative crops to newer, more lucrative ones (Singh, 2020). To mitigate the challenges faced by cocoa farmers and promote sustainable agricultural practices, efforts should be made to provide farmers with information and resources to make informed decisions about crop diversification and land use optimization, ensuring the long-term viability of cocoa farming and the livelihoods of cocoa-producing communities.

Among the respondents who had shifted their cocoa farms to rubber plantations, they expected that their land conversion would increase their income (62.5%), while 32.3% stated that they expected a significant increase

Table 2. Demographic profile of the respondents

Discrete variables	Land converters	Non-converters
	Freq. (%)	Freq. (%)
Gender		
Male	159 (82.8)	135 (70.3)
Female	33 (17.2)	57 (29.7)
Member of farmer group		
Yes	90 (46.9)	120 (62.5)
No	102 (53.1)	72 (37.5)
Marital status		
Married	144 (75.0)	164 (85.4)
Single	38 (19.8)	14 (7.3)
Divorced	3 (1.6)	2 (1)
Widowed	3 (1.6)	5 (2.6)
Separated	4 (2.50)	7 (3.6)
Labor availability		
Yes	181 (94.3)	114 (59.4)
No	11 (5.50)	78 (40.6)
Educational qualification		
Non-formal education	32 (16.6)	40 (20.8)
Informal education	5 (2.6)	10 (5.2)
Primary school	25 (13.0)	55 (28.6)
JHS/Middle school	96 (50)	78 (40.0)
SHS/Technical/Vocational	30 (15.6)	8 (4.2)
Tertiary	4 (2.6)	0 (0.0)
Household head		
Yes	138 (71.9)	90 (46.9)
No	54 (28.1)	102 (53.1)
Access to extension		
Yes	81 (42.2)	98 (51.0)
No	111 (57.8)	94 (49.0)
Access to credit		
Yes	35 (18.2)	48 (25.0)
No	157 (81.8)	144 (75.0)

Continuous variables	Minimum	Average	Maximum
Age (years)			
Land converters	25	47.1	61
Non-converters	30	52.8	82
Farming experience (years)			
Land converters	6	26.5	40
Non-converters	10	31.2	58
Household size (persons)			
Land converters	2	8.0	12
Non-converters	2	5.4	18
Farm size (ha)			
Land converters	1.2	4.9	26.7
Non-converters	1.2	2.8	20.2

in their income. Approximately 114 (59.4%) respondents stated that they anticipate short-term financial challenges during the shift process, while 78 (40.6%) stated otherwise. This can be explained as follows: during the shift process, apart from the fact that it takes years (approximately 6 years) to yield benefits from the rubber, costs are incurred during land preparation and the hiring of labor. In effect, the waiting years before the rubber matures pose short-term financial challenges to the farmers. Short-term financial challenges farmers' face during land use shifts were also reported by other studies such as Rondhi *et al*. (2018) and Islam *et al*. (2020). Creating collaborative initiatives between government agencies, financial institutions, and agricultural extension services can help farmers navigate

Table 3. Land use shift from cocoa to rubber plantation

Land use shift from cocoa to rubber plantation	Frequency	Percentage
Primary reason for shift		
Higher profitability of rubber	40	20.8
Decline in cocoa yields	54	28.1
Market demand for rubber	19	10.0
Pest and disease issues in cocoa	34	17.7
Climate change-related factors	45	23.4
How do you expect the shift to a rubber plantation will impact your income?		
Significantly increase	62	32.3
Increase	120	62.5
Stay the same	10	5.2
Decrease	0	0.0
Significantly decrease	0	0.0
Do you anticipate any short-term financial challenges during the shift process?		
Yes	114	59.4
No	78	40.6
Environmental measures taking during the shift process		
Replanting some cocoa trees	19	10,0
Implementing sustainable rubber farming practices	50	26.0
Soil conservation measures	16	8.3
Wildlife conservation efforts	0	0.0
Water resource management	12	6.3
None	95	48.4
Are you seeking any certifications (e.g., organic, sustainable) for your rubber plantation?		
Yes	71	37.0
No	121	63.0
Do you have any long-term plans for your rubber plantation, such as expansion or diversification?		
Yes	135	70.3
No	57	29.7
Are you open to sharing your experiences and knowledge with other cocoa farmers considering a similar shift?		
Yes	98	51.0
No	94	49.0

the transition period more effectively and ensure their long-term success in rubber cultivation.

The study further showed that almost half (48.4%) of the respondents did not put any environmental measures in place during the shift process. Only a few respondents stated that they put environmental measures in place, which include implementing sustainable rubber farming practices (26.0%), replanting some cocoa trees (10%), soil conservation measures, and water resource management (6.3%). Moreover, 121 (63%) of the respondents stated that they are not seeking any certifications for their rubber plantations. However, 135 respondents, representing 70.3%, stated that they have long-term plans for the expansion of their rubber plantations, while 51% stated that they are open to sharing their experience and knowledge with other cocoa farmers. It can be explained that the rubber plantation is yielding the anticipated results for farmers in comparison to cocoa production. Tetteh *et al*. (2019) reported similar results where farmers, apart from expanding their rubber plantations, were also persuading other farmers to convert their cocoa farms to rubber plantations. There is a need to raise awareness about the importance of seeking certifications for rubber plantations, such as organic or sustainable certifications, which can enhance market access and ensure compliance with environmental standards. Moreover, facilitating knowledge-sharing platforms and networks among farmers can encourage the exchange of experiences and best practices, ultimately

fostering the adoption of sustainable and environmentally friendly approaches to rubber cultivation. By promoting environmental stewardship and sustainable practices in rubber farming, stakeholders can mitigate potential negative environmental impacts and contribute to the long-term sustainability.

Socioeconomic Factors Influencing Land Use Shift

In line with objective two, Table 4 showed that among these socioeconomic factors, age, household size, being a household head, farm size, educational level, access to extension, and labour availability significantly influenced farmers' shift behavior. From the study, it was revealed that age had a significant negative relationship with farmers' land use behavior. This indicates that increasing farmers' age by one year decreases shift behavior by 3.4% and vice versa. This shows that younger farmers were more willing to engage in converting their cocoa farms to rubber plantations than older farmers. It can be explained that the younger cocoa farmers have more time, energy, and resources for land shifts, unlike the older cocoa farmers. Moreover, a farmer's age affects both his investment choices and his acceptance of new technology. Younger farmers are more likely to start a new business, while elderly farmers are less likely to do so (Borda *et al*., 2018). This pattern might be explicable by the fact that a farmer's investment increases over time as a result of capital accumulation. However, as people get closer to retirement, they are less likely and motivated to start new businesses (Greiner, 2016). According to Aubert *et al*. (2012), different ages of Canadian farmers had different views about the adoption of precision agriculture (older farmers were more likely to be hostile), and a predetermined level of innovativeness was also a significant determinant. In Ethiopia, Gebrehiwot & van der Veen (2015) discovered a link between adopting risk management measures and increasing farmer age.

It was revealed that access to extension services had a significant negative influence on farmers land shift behavior. This implies that increasing farmers' access to extension services decreases their shift behavior. This is because farmers who had access to extension services were persuaded against shifting from their cocoa farms to other land uses. The provision of accurate information and good communication were important influences on behavior and education-based behavioural interventions. For instance, Zamasiya *et al*. (2017) established a connection between the availability of extension services and the execution of policies aimed at adapting to climate change. According to Micha *et al*. (2015), the availability of important information influenced the decision to continue

Table 4. Socioeconomic factors influencing farmers' land use shift behavior

Variables	Coefficient	Standard error	Marginal effects
Gender	0.6147	0.0817	0.010
Age	-0.8810 **	0.0362	-0.034
Marital status	0.6215	0.1013	0.020
Household size	0.7439 *	0.0531	0.029
Household head	0.8530 *	0.0690	0.016
Farm size	1.0712 **	0.1438	0.031
Educational level	0.8340 *	0.0691	0.025
Access to credit	2.1382	0.6301	0.011
Access to extension	-0.9018 *	0.3945	-0.014
Farming experience	0.4470	0.0682	0.013
Farmer group	0.4015	0.0683	0.008
Labor availability	0.5483 *	0.1014	0.015
No. of obs. = 384, LR chi^2 (12) = 132.4, Prob>chi^2 = 0.000, Pseudo R^2 = 0.8173.			

NB: * (10%), ** (5%)

growing vines. Pino *et al*. (2017) established a connection between the implementation of water conservation measures and the availability of extension services and information.

The household size of the respondents had a positive and significant effect on farmers' shift behavior. This indicates that increasing the respondent's household size by one member increases his land use shift behavior by 2.9%. This implies that increasing the respondent's household size increases labor availability for rubber plantations. The size of a farmer's household has a significant impact on their decision to invest in a particular farm venture (Liu *et al*., 2018).

In addition, the study showed that labor availability had a positive and significant influence on farmers shifting behavior. This shows that increasing the availability of labor increases farmers' behavior towards land use shifts. This is because shifting from cocoa cultivation to rubber plantations necessitates labor for land preparation. In agreement, Yu *et al*. (2021) reported that production limitations, including the availability of labor, are recognised to influence the farmer's choice to engage in a specific farm operation.

Being a household head also had a positive and significant effect on farmers' land use shift behaviour. This can be explained as being the household head, which means that the farmer has an influence in the family. Many cocoa farms in Manso Amenfi District are family owned, and a farmer being a household head implies that they can decide to convert the cocoa farm to a rubber plantation. Quisumbing *et al*. (2015), in their study, reported that household heads had the power to dictate the direction of a family agricultural enterprise.

At a significant level of 5%, the study showed that the farm size of respondents had a positive and significant influence on farmers' shift behavior. The study showed that increasing farmers' farm size by one hectar increases farmers' land use shift by 3.1%. This means that farmers with larger farm sizes are more likely to convert their cocoa farms to rubber plantations. Farm characteristics do affect a farmer's choice to invest in a specific farm operation (Okeyo *et al*., 2020). According to research by Lemken *et al*. (2017) into the factors' influencing arable farmers' adoption of mixed cropping, farm size was a significant factor.

The study further showed that the educational level of farmers had a significant and positive effect on farmers' land use shift behavior. At the 10% significant level, it was revealed that increasing farmers' educational level by one year increases farmers' behavior towards land use shift by 2.5%. It is well recognised that a farmer's level of education influences his choice to invest in a specific farm business. The more education a farmer has, the better equipped they are to weigh the benefits and drawbacks of a certain business and make an investment decision. According to Eggers *et al*. (2015), a farmer's willingness to invest in a particular agricultural enterprise may be negatively impacted by his or her ignorance of and inability to evaluate data regarding the benefits and costs of that enterprise. Throughout the collection of articles that were reviewed (Gholamrezai & Sepahvand, 2017; Issa & Hamm, 2017; Mekonnen *et al.*, 2017), education levels were linked to the adoption of a variety of behaviors.

Knowledge/Behavioral Factors Influencing Farmers' Land use Shift Behavior

In line with objective two, Table 5 reveals the knowledge and behavioural factors that influence farmers' land use shift behavior. The knowledge factor mean ranges from 3.79 to 4.36, with a composite mean of 4.09.

Table 5. Farmers' knowledge/behavioral factors influencing their land use shift behavior

Knowledge factors	Mean	Std. dev
High price of rubber	4.36	0.15
Low level of pests and disease attack in rubber plantation	4.31	0.12
Can grow in low soil fertility	4.29	0.15
Ability to withstand drought and adverse weather conditions	4.19	0.29
Low price of farming inputs (e.g., fertiliser, pesticide, etc.)	4.13	0.19
Adequate knowledge on rubber cultivation	3.87	0.16
Readily available sponsor (funds) for rubber plantation	3.81	0.61
Early maturity of rubber	3.79	0.50
Composite mean	4.09	
Behavioral factors	**Mean**	**Std. dev.**
I have a bigger cocoa farm size	4.05	0.89
Experience in rubber plantation	3.91	1.06
Personal belief that rubber plantation will do well than cocoa	4.26	0.83
There is readily availability of labour for rubber plantation	4.18	0.86
There is ready market for rubber	4.15	0.91
Rubber plantation is more profitable than cocoa	4.23	0.85
I have converted my cocoa farmland to rubber plantation due to family or friend's advice	4.01	0.92
The cost of establishing rubber plantation is less as compared to cocoa production	4.09	0.90
I am young and have more years to cultivate rubber	4.02	0.98
My cocoa is dying due to pests and diseases	4.06	0.94
Composite mean	4.10	0.91

Notes: 1-1.49 (Strongly disagree), 1.50-2.49 (Disagree), 2.50-3.49 (Neutral), 3.50-4.49 (Agree), 4.50-5.00 (Strongly agree).

This implies that the respondents agreed that knowledge factors influenced their land use shift behavior. The knowledge factor that was ranked first as influencing farmers' use shift behavior was the high price of rubber (mean = 4.36). It is reported that rubber has a high price, and this awareness among farmers influences them to convert their cocoa farms to rubber plantations (Chambon *et al*., 2016). Sutherland (2011) conducted a study to demonstrate how farmers' beliefs towards the viability of a market for their produce influenced people's perceptions of organic farming. Jones *et al*. (2015) discovered that dairy producers were more inclined to place a high priority on herd health if there was a perceived market benefit. The importance of perceived market benefits was further demonstrated by research by Herath & Wijekoon (2013) on organic coconut farming. Therefore, it is obvious that rewards based on the open market may have an impact on farmers' behavior. The next knowledge factors that influenced farmers behavior to convert their land were low levels of pests and disease attack in rubber plantations (second; mean = 4.31), rubber can grow in low soil fertility (third; mean = 4.29), and the ability to withstand drought and adverse weather conditions (fourth; mean = 4.19). The constraints imposed by geophysical and biological factors may influence a farmer's choice to engage in a specific farming venture. A farmer may decide to steer clear of a certain farm venture due to restrictions like soil infertility, the risk of drought or flood, water scarcity, and pest or disease infestation. Production and yield risks have been linked to unfavourable weather, diseases, and pests. Pests and disease can significantly reduce the yield (Subramanian *et al*., 2021). Farmers may need to redirect agricultural resources to another business due to the predominance of specific pests and diseases (Ullah *et al*., 2015).

The behavioral factors influencing farmers land use shift behavior range from 3.91 to 4.26, with a composite mean of 4.10. This implies that the respondents agreed that behavioral factors influenced their land-shifting behavior. The behavioral factor that recorded the highest mean score was the farmers' personal belief that rubber plantations will do better than cocoa (mean = 4.26), followed

by the fact that rubber plantations are more profitable than cocoa (mean = 4.23) and the readily available availability of labor for rubber plantations (mean = 4.18). Other behavioral factors that influence farmers land use shift behavior were the ready market for rubber (mean = 4.15), the cost of establishing rubber plantations is less as compared to cocoa production (mean = 4.09), and cocoa is dying due to pests and diseases (mean = 4.06). The remaining behavioral factors were that farmers believe they are young and have more years to cultivate rubber (mean = 4.02) and the shifting of cocoa farmland to rubber plantations due to family or friends' advice (mean = 4.01). Farmer decision-making is significantly influenced by the opinions of their trusted advisors, peers, friends, and family. Through the offering of formal or informal counsel, as well as through the use of social pressure, the opinions of reliable individuals may have an impact on agricultural behavior (Bell *et al*., 2016). Similarly, social pressure exerted by farmers' fathers was discovered to be a significant influence in a study by Martnez-Garca *et al.* (2013) on factors influencing dairy farmers' decisions to embrace enhanced grassland management. The willingness of farmers to engage in pro-environmental management was found to be significantly influenced by societal pressure and social norms in the Mills *et al*. (2017) study. Study of improved grassland management among small cattle farmers also found that societal pressure and social norms influence farmers' behavior Borges *et al*. (2016). In fascinating research on French wine growers, Kuhfuss *et al.* (2016) discovered that farmers were more likely to sign up for a management program if they thought that a sizable portion of their colleagues would do the same. In conclusion, it may be inferred that advisor networks, peers, and family have a significant impact on behavior in addition to individual attributes.

Land Use Shift and Farmers Livelihood

In line with objective three, Table 6 illustrates the relationship between land use shift behavior (from cocoa to rubber plantations) and various aspects of farmer livelihood. First, there is a notable impact on farming income, with a p-value of less than 5%, indicating statistical significance. This suggests that farmers who transition to rubber plantations experience a significant increase in their income compared to those who continue with cocoa farming. Similarly, transitioning to rubber plantations is associated with increased access to land, as indicated by the p-value being less than 5%. This implies that farmers making this shift have better access to land resources, which can positively influence their agricultural activities and overall livelihoods. Moreover, the transition to rubber cultivation has a significant impact on farmers' standard of living and social status, with both variables having p-values less than 5%. This suggests that farmers who shift to rubber plantations experience improvements in their living standards and social standing within their communities. Additionally, the acquisition of farm equipment, electronics, and transportation machines is significantly associated with transitioning to rubber plantations, as indicated by the p-values being less than 5%. This implies that farmers engaging in rubber cultivation are more likely to acquire these assets, which can enhance their productivity and quality of life. In agreement, Nath *et al*. (2013) and Esekhade *et al.* (2019) reported that rubber plantations improve farmers' livelihoods by increasing their income, enabling them to acquire farm and transportation equipment, and improving their social status.

Extension services should expand to offer farmers specific training and technical assistance for rubber cultivation. Workshops,

Table 6. Association between land use shift behavior and farmer livelihood

Statements	Chi^2	Pr
Rubber plantation has helped me joined farmer group	0.89	0.376
Rubber plantation has increased my farming income	7.02	0.038 *
Rubber plantation has increased my knowledge on farming practices	1.24	0.228
Rubber plantation has increased my access to land	6.05	0.043 *
Rubber plantation has increased my access to credit	2.13	0.116
Rubber plantation has increased my standard of living	8.16	0.018 *
Rubber plantation has increased my social status	6.85	0.032 *
Rubber plantation has helped me acquire farm equipment	7.10	0.040 *
Rubber plantation has helped me acquire electronics	8.07	0.021 *
Through rubber plantation, I have built my house	2.51	0.110
Through rubber plantation, I have acquired transportation machine	6.34	0.039 *
Through rubber plantation, I have acquired livestock	1.85	0.194

demonstrations, and field days can help farmers acquire the knowledge and skills needed to successfully manage rubber plantations, including best practices for planting, maintenance, pest and disease management, and harvesting. Promotion of environmental conservation measures to minimise negative impacts on ecosystems and biodiversity as farmers transition to rubber cultivation will be necessary. To support farmers in their transition to rubber plantations and address social challenges that may arise during the shift process, we should implement community-level initiatives. This could include peer-to-peer learning networks, community-based organisations, and social welfare programmes aimed at improving the well-being of farmers and their families.

CONCLUSIONS

The transition from cocoa to rubber plantations in Ghana represents a strategic response to the challenges faced in cocoa production, particularly the decline in cocoa yields, besides diversifying farmers' income where rubber cultivation may offer higher profitability compared to cocoa farming. The decision to convert land from cocoa to rubber is influenced mainly by socioeconomic factors, increase in farmers' standard of living and personal belief that rubber plantation will do better than cocoa. The livelihood implications of transitioning from cocoa to rubber plantations in Ghana are multifaceted and complex. The transition from cocoa to rubber plantations may have broader implications for agricultural sustainability and environmental conservation. The shift to rubber plantations may also impact local communities and rural economies beyond the immediate livelihoods of farmers. It is crucial to consider the social and economic dynamics of the transition process, including potential disruptions to existing cocoa value chains and the need for supportive policies and infrastructure to facilitate the transition. While the shift offers the potential for increased income and improved livelihoods for farmers, it also poses challenges related to market uncertainties, environmental sustainability, and social dynamics. There is a sense of community collaboration, knowledge exchange and capacity building between rubber and cocoa farmers.

REFERENCES

Ali, M.F.; S.H. Sulong; K. Julius; C. Smith & A.A. Aziz (2022). Using a participatory system dynamics modelling approach to inform the management of Malaysian

rubber production. *Agricultural Systems*, 202, 103491.

Aubert, B.A.; A. Schorse dez & J. Crimando (2012). IT as enabler of sustainable farming: An empirical analys of farmer's adoption decision of pracision agriculture technology. *Decision Support Systems*, 54(1), 510–520.

Azadi, H.; A.A. Barati; S.N. Nooghabi & J. Scheffran (2022). Climate-related disasters and agricultural land conversion: Towards prevention policies. *Climate and Development*, 14 (9), 814–828.

Bell, A.; W. Zhang & K. Nou (2016). Pesticide use and cooperative management of natural enemy habitat in a framed field experiment. *Agricultural Systems*, 143, 1–13.

Borda, A.J.; B. Sarvan; J.N. Balogh (2018). Generation change in agriculture: A systematic review of the literature. *Economies,* 11(5), 129.

Borges, J.A.R.; L.W. Tauer & A.G.O. Lansink (2016). Using the theory of planned behavior to identify key beliefs underlying Brazilian cattle farmers' intention to use improved natural grassland: A MIMIC modelling approach. *Land Use Policy*, 55, 193–203.

Chambon, B.; F. Ruf; C. Kongmanee & S. Angthong (2016). Can the cocoa cycle model explain the continuous growth of the rubber (*Hevea brasiliensis*) sector for more than a century in Thailand? *Journal of Rural Studies*, 44, 187–197.

Creswell, J.W. (2014). *A Concise Introduction to Mixed Methods Research*. SAGE Publications.

Despotovic, J.; V. Rodic & F. Caracciolo (2019). Factors affecting farmers' adoption of integrated pest management in Serbia: An application of the theory of planned behaviour. *Journal of Cleaner Production,* 228, 1196–1205.

Dessart, F.J.; J. Barreiro-Hurle & R. Van Bavel (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics.*

Eggers, M.; M. Kayser & J. Isselstein (2015). Grassland farmers' attitudes toward climate change in the North German Plain. *Regional Environmental Change*, 15, 607–617.

Esekhade, T.U.; S.O. Idoko; C. Okwu-Abolo; S. Mesike; I.K. Okore; E.S. Osazuwa & P.O. Anegbeh (2019). Improving rubber smallholder's livelihood through rubber based agroforestry systems and mixed farming-The Nigeria experience. ***In:*** *Proceedings of the 2019 International Rubber Workshop* (pp. 02–05).

Essougong, U.P.K.; M. Slingerland; S. Mathé; W. Vanhove; P.I. Tata Ngome; P. Boudes; L.S. Woittiez & C. Leeuwis (2020). Farmers' perceptions as a driver of agricultural practices: Understanding soil fertility management practices in cocoa agroforestry systems in Cameroon. *Human Ecology*, 48(6), 709–720.

Fasha, G.S. & A. Minde (2020). Livelihood assessments among smallholder farmers in the southern agricultural growth corridor in Tanzania: lessons from households in Ihemi Cluster. *Tanzania Journal of Agricultural Sciences*, 19 (2), 116–130

Gakpo, J.O. (2018). *Rubber Plantations are Displacing Ghana's Small Cocoa Farms.* Agriculture. Alliance for Science.

Gao, J.; G. Song & S. Liu (2022). Factors influencing farmers' willingness and behaviour choices to withdraw from rural homesteads in China. *Growth and Change*, 53 (1), 112–131.

Gebrehiwot, T. & A. Van Der Veen (2015). Farmers prone to drought risk: why some farmers undertake farm-level risk-reduction measures while others not? *Environmental Management*, 55, 588–602.

Ghauri, P.; K. Grønhaug & R. Strange (2020). *Research Methods in Business Studies.* Cambridge University Press.

Gholamrezai, S. & F. Sepahvand (2017). Farmers' participation in water user association in western Iran. *Journal of Water and Land Development*, 35(1), 49.

Greiner, R. (2016). Factors influencing farmers' participation in contractual biodiversity conservation: A choice experiment with northern Australian pastoralists. *Australian Journal of Agricultural and Resource Economics*, 60(1), 1–21.

GSS (2018). *Rebased 2013-2018 Annual Gross Domestic Product*. April 2019 Edition. Ghana Statistical Service.

Herath, C.S. & R. Wijekoon (2013). Study on attitudes and perceptions of organic and non-organic coconut growers towards organic coconut farming. *Idesia*, 31(2), 5–14.

Huang, S.; S. Ghazali; H. Azadi; S.M. Moghaddam; A.H. Viira; K. Janeckova & A. Kurban (2023). Contribution of agricultural land conversion to global GHG emissions: A meta-analysis. *Science of the Total Environment*, 876, 162269.

IRSG (2019). *Rubber Statistical Bulletin, October-December*. Vol. 74:4-6. International Rubber Study Group. Changi, Singapore.

Ishak, A.; E. Fauzi; S. Rosmanah & Y. Sastro (2021). Patterns and causes of conversion of smallholder rubber plantation to oil palm (case in Batik Nau sub district, Bengkulu Utara Regency). ***In:*** *E3S Web of Conferences,* Vol. 306, p. 02020). EDP Sciences.

Islam, M.M.; A. Jannat; A.R. Dhar & T. Ahamed (2020). Factors determining conversion of agricultural land use in Bangladesh: Farmers' perceptions and perspectives of climate change. *GeoJournal*, 85, 343–362.

Issa, I. & U. Hamm (2017). Adoption of organic farming as an opportunity for Syrian farmers of fresh fruit and vegetables: An application of the theory of planned behaviour and structural equation modelling. *Sustainability*, 9(11), 2024.

Jones, P.J.; A. Marier; R.B. Tranter; G. Wu; E. Watson & C..J. Teale (2015). Factors affecting dairy farmers' attitudes towards antimicrobial medicine usage in cattle in England and Wales. *Preventive Veterinary Medicine*, 121(1–2), 30–40.

Krantz, L. (2001). The sustainable livelihood approach to poverty reduction. *SIDA. Division for Policy and Socio-Economic Analysis*, 44, 1–38.

Kuhfuss, L.; R. Préget; S. Thoyer & N. Hanley (2016). Nudging farmers to enrol land into agri-environmental schemes: The role of a collective bonus. *European Review of Agricultural Economics*, 43(4), 609–636.

Kumar, H.; B.W. Pandey & S. Anand (2019). Analysing the impacts of forest ecosystem services on livelihood security and sustainability: A case study of Jim Corbett National Park in Uttarakhand. *International Journal of Geoheritage and Parks*, 7(2), 45–55.

Kuwornu, J.K.; E.A. Adanu & G.T. Kwadzo (2019). Financial viability of rubber production: Empirical evidence from Ghana. *Journal of Management Sciences Suratthani Rajabhat University*, 6(1), 17–44.

Kwadzo, G.T.; J.K. Kuwornu & I.S. Amadu (2013). Food crop farmers' willingness to participate in market-based crop insurance scheme: Evidence from Ghana. *Research in Applied Economics*, 5(1), 1.

Kwadzo, M. (2015). Factors determining enterprise shift behaviour among smallholder cocoa farmers in the Mpohor-Wassa East district in the Western Region of Ghana. *Journal of Economics and Sustainable Development,* 6 (10), 74–76.

Lemken, D.; A. Spiller & M. von Meyer-Höfer (2017). The case of legume-cereal crop mixtures in modern agriculture and the transtheoretical model of gradual adoption. *Ecological Economics*, 137, 20–28.

Liu, T.; R.J. Bruins & M.T. Heberling (2018). Factors influencing farmers' adoption of best management practices: A review and synthesis. *Sustainability*, 10(2), 432.

Mahob, R.J.; P.B.N. Etam; L. Dibog; R. Babin; A.V. Voula; D. Begoude; Y.G.F. Toguem; L. Baleba; P.A.E. Ndongo & C.F.B. Bilong (2018). Assessment of the effect of cocoa mosquito mirid true bug, Helopeltis. *International Journal of Biological and Chemical Sciences*, 12(4), 1865–1875.

Martinez-Garcia, G.G; P. Dorward & T. Rehnuman (2013). Factors influencing adoption of improved grassland management by mode soale doing farmers in control nexies and the implications for future research on smallholders adoption in developing countries. *Livestock Science*, 152(2-3), 220–238.

Mekonnen, S.A.; G. Koop; T.J. Lam & H. Hogeveen (2017). The intention of North-Western Ethiopian dairy farmers to control mastitis. *Plos One*, 12(8), e0182727.

Micha, E.; F.J. Areal; R.B. Tranter & A.P. Bailey (2015). Uptake of agri-environmental schemes in the less-favoured areas of Greece: The role of corruption and farmers' responses to the financial crisis. *Land Use Policy*, 48, 144–157.

Mills, J.; P. Gaskell; J. Ingram; J. Dwyer; M. Reed & C. Short (2017). Engaging farmers in environmental management through a better understanding of behaviour. *Agriculture and Human Values*, 34, 283–299.

Min, S.; J. Huang; J. Bai & H. Waibel (2017). Adoption of intercropping among smallholder rubber farmers in Xishuangbanna, China. *International Journal of Agricultural Sustainability*, 15(3), 223–237.

Nath, T.K.; M. Inoue & M. De Zoysa, M. (2013). Small-scale rubber planting for enhancement of people's livelihoods: A comparative study in three South Asian Countries. *Society & Natural Resources*, 26(9), 1066–1081.

Oduro, B.; O.O. Apenteng & H. Nkansah (2020). Assessing the effect of fungicide treatment on cocoa black pod disease in Ghana: Insight from mathematical modelling. *Statistics, Optimization & Information Computing*, 8(2), 374–385.

Okeyo, S.O.; S.N. Ndirangu; H.N. Isaboke; L.K. Njeru & J.A. Omenda (2020). Analysis of the determinants of farmer participation in sorghum farming among small-scale farmers in Siaya County, Kenya. *Scientific African*, 10, e00559.

Pino, G.; P. Toma; C. Rizzo; P.P. Miglietta; A.M. Peluso & G. Guido (2017). Determinants of farmers' intention to adopt water saving measures: Evidence from Italy. *Sustainability*, 9(1), 77.

Quisumbing, A.R.; D. Rubin; C. Manfre; E. Waithanji; M. Van den Bold; D. Olney; N. Johnson & R. Meinzen-Dick (2015). Gender, assets, and market-oriented agriculture: Learning from high-value crop and livestock projects in Africa and Asia. *Agriculture and human values*, 32, 705–725.

Rondhi, M.; P.A. Pratiwi; V.T. Handini; A.F. Sunartomo & S.A. Budiman (2018). Agricultural land conversion, land economic value, and sustainable agriculture: A case study in East Java, Indonesia. *Land*, 7(4), 148.

Rose, D.C.; C. Keating & C. Morris (2018). Understanding how to influence farmers' decision-making behaviour: A social science literature review. *Agriculture and Horticulture Development Board.* University of East Anglia

Savari, M.; H.E. Damaneh & H.E. Damaneh (2021). Factors influencing farmers' management behaviours towards coping with drought: evidence from Iran. *Journal of Environmental Planning and Management,* 64 (11), 2021–2046

Singh, S. (2020). Farmers' perception of climate change and adaptation decisions: A micro-level evidence from Bundelkhand Region, India. *Ecological Indicators*, 116, 106475.

Subramanian, K.S.; S. Pazhanivelan; G. Srinivasan; R. Santhi & N. Sathiah (2021). Drones in insect pest management. *Frontiers in Agronomy*, 3, 640885.

Sutherland, L.A. (2011). "Effectively organic": Environmental gains on conventional farms through the market? *Land Use Policy*, 28(4), 815–824.

Tetteh, E.N.; K. Twum-Ampofo; A. Abunyewa; P.P. Acheampong; I. Nunoo; J.N. Berchie; B.M. Dzomeku; E.A. Adjei; F. Frimpong; V. Logah; C.M. Ocansey; S. Yeboah; P. Amankwa-Yeboah; L.D. Acheampong & H.O. Tuffour (2019). Logistic analysis of factors and perception of smallholder rubber farmers to intercrop: A case study involving rubber and plantain intercropping system in Ghana. *Agricultural and Food Science Journal of Ghana*, 12, 1024–1039.

Toma, L.; A.W. Stott; C. Heffernan; S. Ringrose & G.J. Gunn (2013). Determinants of biosecurity behaviour of British cattle and sheep farmers—A behavioural economics analysis. *Preventive Veterinary Medicine*, 108(4), 321–333.

Tsiboe, F. (2021). Chronic sources of low cocoa production in Ghana: New insights from meta-analysis of old survey data. *Agricultural and Resource Economics Review*, 50(2), 226–251.

Ullah, R.; D. Jourdain; G.P. Shivakoti & S. Dhakal (2015). Managing catastrophic risks in agriculture: Simultaneous adoption of diversification and precautionary savings. *International Journal of Disaster Risk Reduction*, 12, 268–277.

Yamane, T. (1967) *Statistics, an Introductory Analysis*, 2nd Ed., Harper and Row, New York, USA.

Yu, L.; C. Chen; Z. Niu; Y. Gao; H. Yang & Z. Xue (2021). Risk aversion, cooperative membership and the adoption of green control techniques: Evidence from China. *Journal of Cleaner Production*, 279, 123288.

Zamasiya, B.; K. Nyikahadzoi & B.B. Mukamuri (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management*, 198, 233–239.

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