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Do transaction costs influence farmers' to sell at the farm gate or alternative markets?

Evidence from smallholder rubber in Liberia

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Abstract

Transaction costs and other factors have proven to be major constraints to food crops farmers' access to improve market. There is limited empirical evidence that the same is true for non-food crops specifically natural rubber. This study determined the effect of transaction costs and socioeconomic factors on smallholder natural rubber farmers' decisions to sell their produce at the farm-gate to itinerant traders or the alternative markets in Liberia. Cross-sectional data was collected from 200 smallholder natural rubber farmers in Gibi and Kakata districts through multistage sampling. A binary logistic regression model was employed to determine the choice of selling outlets used by farmers. The results indicate that the choice of selling outlets is significantly influenced by transaction costs specified as distance to the nearest market, ownership of transport means, access to market information and time taken to find potential buyers and socioeconomic variables, access to extension services and household size. The study recommends that policy could aim at establishing market support services in the form of market information systems and affordable means of transportation to enhance access to up to date market information on trading partners and prices.

Keywords: Liberia, natural rubber, transaction costs, farm-gate, selling outlet

1. Introduction

Natural rubber is the most important agricultural export commodity in Liberia and a source of income for many rural dwellers. The sector is dominated by small and medium farms and covers more than 5 percent of the agricultural land (GoL, 2010). According to Tyson (2017), natural rubber accounted for about 85 percent of the total export earnings from 2003-2010. Liberia was ranked the 14th highest producer of natural rubber in the world and second in Africa with a total output of 60,000 metric tonnes per year in 2015 (Daly *et al*. 2017).

Liberia has one of the lowest GNI per capita of US$ 667 and ranked 181 out of 189 countries in the United Nation Development Programme (UNDP) 2018 Human Development Index report (UNDP, 2018; World Bank, 2019). More than half (54 percent) of the population lives below the poverty line of US$ 1.90 per day and the greatest level of poverty is in the rural farming areas with 77 percent (Outlook, 2017; World Bank, 2018). Despite the contributions of natural rubber to export earnings and livelihoods, there is still low income and high poverty rates among the farmers. About 58 percent of rural smallholder natural rubber farmers' lives below the poverty line (World Bank, 2018).

In order for Liberia to meet the Sustainable Development Goal 8 (SDG 8) focusing on "sustainable economic growth and full productive employment", there is a need to increase the production and commercialization of natural rubber to enhance farmers' income and foreign exchange earnings.
Most of the natural rubber produced in Liberia by smallholder farmers is sold at the farm-gate to itinerant traders. Farmers are unable to access high price markets due to the low quality of natural rubber produced (cup lump rubber), poor roads network, limited information on potential buyers, and long distances to markets increasing transportation costs. Most of these factors constitute what is termed as transaction costs. Transaction costs are costs related to the act of exchanging ownership rights of economic assets, which in this case is natural rubber. It includes the costs of organizing, bargaining, buying and selling, information search costs for products, and the costs of ensuring contracts are obeyed and enforced (Ortmann & King 2007a ; de Silva *et al*. 2008). Poor road condition and long distances to markets translate into high transaction costs which force farmers to sell at low farm-gate prices, thereby reducing their income and entrenching them in the vicious cycle of poverty (Sigei *et al*. 2013)

Transaction costs can be categorized into fixed and variable costs. Fixed transaction costs do not vary with the volume of commodities traded in the market, but rather the frequency of trade. They serve as decision-making tools for smallholder participation in the market. They consist of the costs of: (i) looking for potential buyers, (b) negotiations and bargaining and (c) monitoring and supervision of contracts, especially when commodities are exchanged for credit (Key *et al*.2000). Variable transaction costs vary with the volume of each unit of a commodity traded in the market, and they also serve as decision-making tools for farmers to sell at farm-gate or the market and the volume of the commodity to be transported to the market. They include transportation costs to the market for sales, the time taking to transport commodity to the market, and storage fees (Key *et al*. 2000; Jagwe & Machethe, 2011). Excluding production costs, these transaction costs determined the actual price farmers receive from the sales of their commodity. According to Williamson (1985) and Ortmann & King (2007b), high transaction costs resulting from poor infrastructures such as telecommunication, road and farmers' support services (credit, extension, and information) serve as a major determinant of the level of farm income in sub-Saharan Africa.

Different programs, including the Smallholder Tree Crop Revitalization Support Project (STCRSP), have been introduced by policymakers to improve the road condition in order to reduce transaction costs and increase the commercialization of smallholder farmers in Liberia (IFAD, 2013). However, the program has not yielded much gain as commercialization rate is still low at 55 percent among cash crop farmers (GoL, 2017). Therefore, there is a need to identify other means of minimizing the high transaction costs faced by smallholder natural rubber farmers and increase the rate of commercialization. Collective action has been seen as one of such ways (Fischer & Qaim, 2012). Through collective action, farmers can satisfy stringent marketing requirements, which if undertaken individually will require high transaction costs (Markelova *et al*. 2009).

In order to increase the level of commercialized rubber production in Liberia, there is a need to improve the potential of smallholder farmers to produce a marketable surplus and reduce transaction costs that serve as a major barrier to accessing high price markets. Improving the livelihoods of smallholder rubber farmers in Liberia through commercialization calls for understanding factors influencing farmers' choice of selling outlets (IFAD, 2013).

Previous studies, Fafchamps & Hill, (2005), Jagwe & Machethe, (2011), Shiimi *et al*. (2012), Kuma, *et al*. (2013), Nguthi, (2015), and Abu *et al*. (2016) determined factors influencing farmers choice of marketing outlets. These studies found that the choice of marketing outlets depends on access to market information, membership of a farming group and ownership of transport means. Similarly, Woldie & Nuppenau (2009), Kadigi, (2013), Mabuza *et al*. (2014), and Maina *et al*. (2015) examined the role of transaction costs in determining smallholder market participation and the choice of market

outlets used. They revealed that household size and monitoring and enforcement costs of contracts determined the choice of selling outlets and extent of market participation. However, these studies focused on the effect of transaction costs on food crops, which is different from the current study that focuses on non-food crops. While transaction costs and other factors have proven to be major constraints to food crop farmers' access to improved market, there is limited empirical evidence that the same is true for non-food crops, specifically natural rubber (Jagwe *et al*. 2010). One exception is Randela *et al*. (2008) who find that transaction costs and other related factors, determined market participation of smallholder cotton farmers in South Africa. There remains a dearth of knowledge about factors that constrain smallholder natural rubber farmers from accessing high price markets. This has resulted in little efforts being made to reduce transaction costs in natural rubber marketing. There is a need to better understand what factors limit smallholder natural rubber farmers from accessing high price markets and this article attempts to do that.

This study differs from previous studies in that, Liberia experienced fourteen years of crisis that destroyed the productive and commercial sectors, resulting in poor development of infrastructures, specifically roads and telecommunication (Radelet, 2007). The previous transaction costs studies were conducted in countries with more developed agriculture infrastructures and support services. Based on these factors and institutions such as laws, the findings of these studies may not be applicable to Liberia because transaction costs vary from one country to another, and from one enterprise to another. Natural rubber is unique as a crop because is bulky and weight 55-60-percent water content and the harvesting is at least 120 days per year, indicating that it requires a ready market for sales and the frequency of the transaction is high (Jayanthy & Sathyabama, 2005; Manivong, 2007).

The rest of the paper is organized as follows. The second section presents the theory the study is based on and the characteristics of natural rubber. The third section presents the methods, which begins with the analytical framework, the description of the variables used in the empirical model and study areas and sampling design. The results and discussion in section four begin with a descriptive analysis of the data and ends with the results of the logit model discussed. The fifth section concludes and provides policy recommendations for the findings.

2. Theoretical background

This study is based on transaction costs theory in the New Institutional Economics (NIE) which argues that market exchange, for example, the exchange of agricultural commodities is not costless (Coase, 1937). Neo-classical economists assumed that information is costless and perfect without uncertainty, but transaction costs economics maintains that every transaction is associated with costs such as search cost, negotiation cost, and monitoring cost, hence gathering information is not costless. For instance, in the selling of natural rubber there are adverse selection and moral hazard problems caused by asymmetry information between producers and consumers (Stiglitz, 1988; Hernandez-Espallardo *et al*. 2009). The NIE hypothesized that institutions such as collective action and social capital are transaction costs, minimizing arrangements which may evolve with changes in the nature and source of information cost and can help overcome the information asymmetry problems (Williamson, 1985).

2.1 Asset specificity

This is a situation where an asset has a single or limited use outside the enterprise it was purchased for. Natural rubber is asset specific because it has a limited number of buyers and the assets used in production cannot be used or have limited use in another enterprise. For example, platform balance and chemical balance used in natural rubber production. The natural rubber latex harvested is a

whitish liquid and similar in appearance to dairy milk. The latex obtained from the farm or plantation is called fresh latex or field latex. Since it takes eight hours to coagulate naturally, it can be affected by impurities that reduce the quality and price received by farmers (Jayanthy & Sankaranarayanan, 2005; Thanh & Hoi, 2008). The high asset specificity exposes smallholder farmers to high transaction costs because the refusal of a buyer to buy at a better price forces the farmer to negotiate or search for another buyer, thus increasing their search and negotiation costs (Williamson, 1985; Gulbrandsen & Haugland, 2000).

3. Materials and Methods

A household's selling decision is influenced by institutional and socioeconomic conditions while the supply of agricultural commodities depends on variable transaction costs such as the transportation cost of goods to the market, time taken to transport goods to the market, and storage fees. The choice of household selling outlet can be modeled between two options: sell at farm-gate or alternative markets. The dependent variable is discrete and binary, hence a binary logit model is employed to Determine such influence.

$$Y_i = \begin{cases} 1 \;\; if\ a\ farmer\ sells\ at\ farm-gate \\ 0 \;\; if\ a\ farmer\ sells\ at\ alternative\ markets \end{cases} \quad (1)$$

Logistic regression used a cumulative logistic distribution function. Though there are some drawbacks of the logit model such as no normality and linearity, there are two practical advantages over the probit models; (i) the cumulative distribution function of the logit model is not complicated and (ii) the inverse linear transformation of the logit model is directly interpretable as log-odds (Klieštik *et al*. 2015).

Following McFadden (1974) and Wooldridge (2015), the probability that individual i sells at the farm-gate can be modeled as:

$$\text{prob}\,[y_{ij} = 1]\ \frac{\exp \theta' X\prime}{1+\exp \theta' \mathrm{X}_\iota} = \Lambda(\theta' X_i) \quad (2)$$

Where;

i	=	Individual farmer
j	=	Choice of selling outlets (1= farm-gate, 0= alternative markets)
X	=	A vector of explanatory variables such as market distance travel and other socioeconomic conditions.
θ	=	The parameter to be estimated
Λ	=	Logistic distribution function

The unobservable error term ε of the logit model is assumed to follow a logistic probability distribution whose cumulative density distribution function (F) is specified as:

$$\mathrm{F}'\,(\,\theta'\mathrm{X}_i\,) = \Lambda\ (\theta' X_i)\,[1-\ \Lambda\,(\theta' X_i) \quad (3)$$

Where; F′ represents the cumulative distribution function of the logistic distribution(Λ). The rest of the variables are defined in equation 2.

The probability of individual i selling at the farm-gate can be empirically estimated as:

$$P_r\,[\mathrm{Yi} = 1] = X_i\,\theta_i + \varepsilon_i \quad (4)$$

Y_i is the decision made by individual households, whether to sell at farm-gate or alternative markets, θ is the parameter to be estimated and ε_i is the unobserved error term of farmers. The parameter estimates of logit model provide only the direction of the effect of the explanatory variables on the dependent variable, but they do not represent either the real magnitude of change (Demeke & Haji, 2014). To measure the magnitude of the effect of the explanatory variables on the predicted probability of household's choice of selling outlets (sells at the farm-gate or alternative markets), marginal effects are estimated (Anderson & Newell, 2003).

$$\theta_m = \left[\frac{\partial(\theta_\iota X_\iota + \varepsilon_\iota)}{\partial\,\theta_\iota X_\iota}\right]\beta_\iota \quad \text{Marginal effects for continuous explanatory variables} \quad (5)$$

$$\theta_m = P_r\,[Y_{i=1}] - P_r[Y_{i=0}] \quad \text{Marginal effects for dummy variables.} \quad (6)$$

Where m is the marginal effect, the rest of the variables are defined in equation 2.

3.1 Description of variables used in the empirical model

Several factors influence smallholder natural rubber farmers' choice of selling outlet. These factors include both socioeconomic, institutional and transaction costs factors. The independent variables capturing transaction costs include access to market information, time taking to find buyers, distance to the nearest local market, and ownership of transport means. The independent variables capturing the socioeconomic and institutional factors hypothesized to influence the choice of selling outlets include farm size, gender, and household size, access to extension services, training in natural rubber production and marketing, and group membership. These variables were used to estimate the predicted probability of the dependent variable. Table 1 gives a description of the independent variables hypothesized to influence households choice of selling outlets.

Table 1: Description of hypothesized variable influencing household's choice of selling outlets

Variable Dependent variable	Description	Measurement of variables	Hypothesized sign
Choice of selling outlets	A binary variable indicating the decision to sell at farm-gate or alternative markets	Dummy (1=farm-gate, 0= otherwise)	
Independent variables			
Socioeconomic and institutional variables			
Gender	Gender of the household head (farmer)	Dummy: (1=male, 0= female)	+
Household size	Number of people dependent on the household head for food	Continuous	-
Farm size	Size of land cultivated for NR[a]	Dummy (1= 0-10 acres, 0= >10 acres)	-
Access to extension service	Household access to extension services from 2017-2018	Dummy: (1=Yes, 0=No) -	
Training	Access to training on NR[a] production and marketing from 2017-2018	Dummy(1=Yes, 0= No)	-
Group membership	Member of a farmers' group or organization	Dummy (1=Yes, 0=No)	-
Transaction costs variables			
Access to market information	Household have access to market information	Dummy (1=Yes, 0=No)	-
Time taken to find buyer	Number of hours taken to search for buyers for NR[a]	Dummy (1=<8 hours, 0= >8 hours)	±
Distance to nearest market	Average distance to the nearest local market	Kilometer	+
Ownership of transport means	Ownership of bicycle, motorbike, and vehicle	Dummy (1=Yes, 0=No)	-

[a] **Note: Natural rubber (NR)**

The choice of the independent variables used in Table 1 is based on past empirical studies on factors influencing market participation and choice of marketing outlets used by farmers. In relation to socioeconomic factors, Randela *et al*. (2008), Jagwe *et al.* (2010), Jagwe & Machethe (2011) and Mabuza *et al*. (2014), showed that group membership, household size, and farm size is positively correlated with the likelihood of selling in the market. Group membership brings about a reduction in transaction costs through collective marketing. With group membership, farmers can receive information about the price through calls or text messages that improve their bargaining power while trading.

Furthermore, Sigei *et al*. (2015), Abu *et al*. (2016) and Maina *et al* (2015) show a positive influenced of the gender of the household, and access to extension services on the likelihood of selling at the market. Male-headed households are more likely to access distant marketing outlets because they have better negotiation skills and are wealthier and resourceful than their female counterparts, allowing them to own vehicles and more productive assets. (Jagwe & Machethe 2011).Training in latex production enables farmers to access high value markets that require quality. Additionally,

training in agronomic practices and the use of improved seed increases productivity. This helps farmers to access markets that require a large quantity. Hence, it is hypothesized to negatively influence farmers' decision to sell at the farm-gate. In terms of transaction costs variables, Osebeyo & Aye (2014), Fafchamps & Hill (2005) Key *et al*. (2000) and Sigei *et al* (2015), show a positive relationship between distance and probability of selling at farm-gate, while ownership of transport means had a negative influence on the probability of selling at the farm-gate. Similarly, an increase in information search duration has been associated with a decreased in the quantity of agricultural produce sold, whereas access to market information has been reported to reduce farm-gate sales (Woldie & Nuppenau, 2009; Osebeyo & Aye, 2014; Randela *et al*., 2008). Access to information enables farmers to make an informed decision on the choice of marketing outlet and quantity to supply to the market.

3.2 Study area and sampling design

Margibi County was purposively selected as it is the major area for rubber production in Liberia and it has the largest industrial natural rubber plantation (Firestone natural rubber company) in the world. The county has four districts, Kakata, Gibi, Firestone, and Mambah-kaba and has a total population of 209,923 (GoL, 2011). The climate is hot and humid with an annual temperature of 80°F and an average annual rainfall of 510cm. The soil is sandy clay loam and has a lot of nutrients. The main cash crops produced are natural rubber-52 percent, followed by plantain and banana 34 percent, sugarcane and pineapple 14 percent, palm nuts 14 percent and cacao 10 percent. The primary food crops produced are cassava-79 percent, followed by rice and maize 33 and 12 percent respectively. The primary livelihood activities in the county are natural rubber and charcoal production. The County has an approximated land area of 2866.67 square miles, and 6.4 percent is used by NR plantations (GoL, 2012; UNMIL, 2006) The total population is 88,704 in Kakata district and 14,250 in Gibi district (GoL, 2011).

A multi-stage random sampling procedure was used to sample smallholder natural rubber farmers in the districts of Kakata and Gibi. In the first stage, Kakata and Gibi districts were purposively selected because they have a large number of smallholder rubber farmers (GoL, 2011). In the second stage, out of 22 villages in Kakata District and 70 villages in Gibi District, 15 and 52 villages were purposively selected respectively. This was done in accordance with the number of registered farmers in the districts by the Ministry of Agriculture and the maturity of the farms for harvesting. In the final stage, a list comprising of 530 households in the selected villages were obtained from the office of the county agricultural coordinator. Using a table of random number, respondents were randomly selected for interviews.

The total respondents sampled and interviewed were 200. The sample size was distributed across the 2 districts using probability proportionate to size. Data on socioeconomic, institutional and transaction costs factors was collected. Six households were dropped during the analysis due to incomplete data, therefore, a total of 194 households were included in the analysis.

4. Results and discussion

4.1 Descriptive results and discussion

To compare the socioeconomic and institutional characteristics of the sample household by choice of selling outlet (sells at the farm-gate or alternative markets), the study employed a two-sample t-test to check for significant differences between farmers selling at farm-gate and alternative markets. The results in Table 2 show significant differences between the two groups of farmers.

Table 2: Socioeconomic and farm characteristics of sample household by choice of selling outlets

	Farm-gate sellers (n=64)	**Alternative markets (n=130)**		Significant Differences
Variables	**Means**		***t*-ratio**	**(P-value)**
Household size	7	8	2.18	0.03**
Monthly yield of natural rubber (Kg)[a]	425.47	647.96	3.45	0.00***
Transaction costs				
Distance to the nearest market (km)[b]	7.40	27.70	8.58	0.00***
socioeconomic and farm characteristics	Percentage of household		*z*-ratio	(P-value)
Gender of the household head (Male)	88	89	0.19	0.84
Group membership	45.31	52.31	0.92	0.36
Access to extension services (Yes)	10.94	1.54	-2.93	0.00**
Training in NR production and marketing (Yes)	7.8	16.90	1.72	0.08***
Farm size (1= 0-10 acres)	50	37.70	-1.63	0.10*
Transaction costs				
Access to market information (Yes)	46.88	57.69	1.42	0.15
Time taken to find buyer (1=<8 hours)	62.50	47.69	-1.94	0.05**
Ownership of transport means (Yes)	5	17	2.39	0.02***

Notes: ***, ** and * imply significance at 1%, 5 % and 10% respectively
[a] = kilogram (Kg)
[b] = kilometer (Km)
Source: Survey Data, (2018)

The average natural rubber yield of farmers selling at alternative markets was significantly greater than farm-gate sellers. This is attributed to the fact that alternative market sellers have bigger farms compared to their farm-gate counterparts. The average household size for farmers selling at alternative markets was more than farm-gate sellers suggesting less family labor available for farm-gate sellers to produce enough bulk quantities that can be sold in high price markets.

A higher proportion of households that sold natural rubber at alternative markets owned more transport means (bicycle, motorbike, and a vehicle) in comparison to their counterparts selling at the farm gate. Ownership of transport means increased access to distant markets and helps in the reduction of transportation costs. Alternative market sellers significantly have bigger farm sizes compared to farm-gate sellers. Contrary to expectation, the average distance to the market for alternative market sellers was significantly higher compared to the average distance of farmers selling

at the farm-gate. A likely explanation is that, most farm-gate sellers do not meet the minimum quantity required to sell to the market, hence they are constrained to sell to itinerant traders. For instance, the Firestone Natural Rubber Company requires a minimum of 500kg for purchase. Moreover, alternative market sellers owned more transport means that could have helped in accessing distant markets.

Farmers selling at alternative markets had more training in latex processing and marketing than farm-gate sellers. Training enables farmers to access high price markets like processors who demand specific rubber quality before purchasing. Unexpectedly, farm-gate sellers had more access to extension services compared to their alternative markets 'counterparts. Probably, the extension service provided is not oriented towards the marketing of natural rubber. On average, most of the farmers selling at the farm-gate took less than 8 hours to find a potential buyer compared to alternative market sellers.

4.2 **Empirical results and discussion**

The marginal effects of the binary logit model are presented in Table 3. The model fitted the data well since the $wald\ \ \chi^2\ (10) = 49.41$ and a $Prob > \chi^2 = 0.000$, meaning that all the independent variables taking together statistically and significantly explained the variation in the probability of smallholder natural rubber choice of selling outlets in Kakata and Gibi districts. The results indicate that the proxies for transaction costs variables (distance to the nearest market, ownership of transport means, time taking to find buyers, and access to market information) as well as some socioeconomic factors (household size and access to extension services) significantly influenced households' choice of selling outlets.

Table 3: Determinants of household choice of selling outlets using logit model

Dependent variable: Household choice of sell outlets (1= farm-gate , 0= alternative markets)	Coefficient	Robust Std. error	Marginal Effect (dy/dx)
Gender (1= male, 0= female)	0.485	0.088	0.063
Household size	-0.146	0.008	-0.019 **
Access to extension (1= yes, 0= no)	3.714	0.155	0.483***
Training in NR[a] production and marketing (1=yes, 0= no)	-0.935	0.083	-0.121
Group membership (1=yes, 0= no)	-0.156	0.063	-0.020
Farm size (1= 0-10 acres, 0=10> acres)	-0.351	0.054	-0.046
Transaction costs variables			
Access to market information (1=yes, 0=no)	-0.836	0.052	-0.109**
Time taken to find buyers(1= < 8 hours, 0=>8)	0.867	0.053	0.113**
Distance to the nearest market (km)	-0.084	0.001	- 0 .011***
Ownership of transport means	-1.516	0.104	-0.197 *
Log Likelihood = -78.82			
Pseudo R^2 = 0.36			
Prob >Chi^2 = 0.000			
LR Chi2(10) = 49.41			

Notes: ***, **,* Significance levels at 1, 5 and 10 percent respectively
[a] = Natural rubber (NR)
Source: Survey data, (2018)

In a typical agrarian setting, large households represent labor resources available to assist with farming activities. A unit increase in household size reduced the likelihood of selling at the farm-gate by 2 percent. In other words, an additional member of the household increased the likelihood of selling at alternative markets by 2 percent. A tenable explanation is that larger household size is an indication of more family labor available to produce bulk quantities of natural rubber to access distant markets with a high price. This result corroborates with the findings of Kadigi (2013) who found that an increase in household size reduced the probability of dairy farmers in Tanzania selling their milk at the farm-gate.

The likelihood of selling at the farm-gate increased by 48 percent as a household received extension services. The result is contrary to priori expectation. This is likely that the extension services provided in the study areas are mostly oriented towards other agricultural activities than marketing, hence, farmers received more information about increasing the yield of natural rubber than marketing it. Additional discussion with farmers revealed that the extension services provided are mainly oriented toward curbing of natural rubber disease and the tapping of latex. Similarly, Alemu *et al*. (2011) who studied determinants of vegetable marketing outlets in Ethiopia found that access to extension negatively influenced market participation.

Access to market information is a proxy for fixed transaction costs. The more information smallholder natural rubber farmers have on marketing the less transaction costs they incur for searching and waiting for potential buyers and storage. Access to market information reduced the probability of selling at farm-gate by 11 percent. This indicates that households receiving marketing information are more likely to access high value alternative markets compared to non-receivers. Access to market information enables farmers to analyze the market situation and information about prices and the proportion of natural rubber to supply to the market. Further, it reduces the risk of oversupplying commodity to the market that results in the acceptance of a lower price. The result concurs with Osebeyo & Aye (2014) who found that access to market information increased smallholder farmers' market participation in Nigeria.

Time taken to find buyers is another proxy for fixed transaction costs. Taking less than 8 hours to find a buyer for NR increased the probability of selling at farm-gate by 11 percent. This is probably ascribed to the non-food nature of the crop and quantity produced. Farmers may be in need of urgent cash for the daily sustenance of the family, leading to farmers opting to sell at the farm-gate or contacting traders via mobile phone to come at the farm-gate to get direct payments.

The distance to the nearest local market is a proxy for variable transaction costs. Contrary to priori expectation, a kilometer increase in the distance from the local market to the household reduced the probability of selling at the farm-gate by 11 percent. This means that a household closer to the market is more likely to sell at farm-gate compared to households distant from the market. A reasonable explanation is that farm-gate sellers have lower yields that restrict them from accessing the nearest local market. Further, natural rubber is not sometimes charged per distance traveled, but the weight of the natural rubber. Also, there are less quality restrictions in selling at farm-gate than to alternative markets to processors who require a specific natural rubber quality. Randela *et al*. (2008) reported that a unit increased with the distance increased the market participation of cotton farmers in South Africa.

Owning transport means is another proxy for fixed transaction costs. Ownership of any transport means reduced the probability of a household selling at the farm-gate by 20 percent. This implies that households that owned a bicycle, motorbike and vehicle are more likely to sell at alternative markets. Ownership of transport means helps lower transaction costs in accessing markets and increases the quantity of NR traded on the market. Additionally, it provides greater insight for the marketing choices made by farmers in selling natural rubber. The result is in line with Sigei *et al* (2015)who find that in Kenya, ownership of transport means increased small-scale farmers' market participation. Similarly, Key *et al* (2000), find that ownership of transport means positively increased farmers' likelihood of participating in spot markets.

5. Conclusion and policy recommendations

This study used household survey data collected from smallholder natural rubber farmers in Gibi and Kakata districts in Liberia to analyze the effect of transaction costs on smallholders' choice of selling outlets. The effect of transaction costs on smallholder rubber farmers' choice of selling outlets was estimated using a binary Logistic regression model. This helps to estimate the significant factors influencing smallholder natural rubber farmers' decision to sell at the farm-gate or alternative markets. The results support the hypothesis that transaction costs are the main determinants of smallholder rubber farmers' choice of selling outlets. The results show that variable transaction costs related to market access such as the distance to the nearest market had a negative and significant

influence on the farmer's decision to sell produce at the farm-gate. Similarly, fixed transaction costs such as time taken to find potential buyers had a positive and significant influence on farm-gate sales, while ownership of transport means and access to market information reduced the likelihood of making farm-gate sales. Variables such as access to extension services had a positive and significant influence on farm-gate sales and household size had a negative and significant influence on farm-gate sales.

The study recommends the establishment of market support services by the government of Liberia in the form market information system, accessible markets and transportation means. This will provide up to date and reliable information on potential trading partners and prices, which will reduce the transaction costs of accessing information. The positive influence of access to extension services on the decision to sell at farm-gate calls for extension officers to be more versatile in the services provided. Extension agents could provide training in marketing and help farmers choose marketing outlets that offer higher prices. This can be done through a village-based field trip, social learning, organizing a weekly radio talk show about the marketing of natural rubber that farmers can listen to or use information communication technology to disseminate marketing information.

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