

## Drivers of Farmers' Relationship Choice in Commodity Supply Chains: The Case of Soybean in Northern Ghana

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### ABSTRACT

*To ensure an efficient marketing with attractive profit margins in supply chains, factors influencing relationship choice between farmers and buyers require critical assessment. Choice of marketing relationship is the bane of most agricultural commodity supply chains in Northern Ghana. The type of relationship agreed between farmers and buyers determines the form of delivery of a commodity. Buyers identified included retailers, itinerant traders and wholesalers. Identified marketing relationship was either on contract or spot buying with access to credit, membership to farmer association, experience and price as drivers of marketing relationship. In terms of marketing relationships, 57% of the farmers' commodities are based on agreed contract while 43% commodities are without any binding contract. Age, price, access to credit, membership of farmer association, education and farmers' experience are the factors influencing contracting or otherwise in established commodity supply chain in Northern Ghana. Soybean production and utilization has the potential to draw the youth into agriculture and government and private partners should intervene with the commercialization supply chains with strong contract relationships in the supply chain.*

### INTRODUCTION

Agricultural production in Ghana is generally subsistence in nature and partially linked to markets usually through a diversification of commodities produced. Producers are also often constrained with what they can produce and the way commodities can be transformed thus limiting marketing opportunities. These constraints have led to the involvement of various supply chains based on demand from end users of agricultural commodities. These established chains lead to efficiency in

production and hence an increase in profits due to an efficient use of scarce resources. In Ghana, established supply chains are associated with high value and industrial commodities such as soybean, cocoa and cotton. This classification is based on the contribution of these commodities to the GDP of Ghana (ISSER, 2016). Soybean in particular identified as a cash crop in Ghana due to its diverse importance has seen the creation of various supply chains. The emergence of ethanol and biodiesel as

alternative source of fuel since the Renewable Energy Mandate in 2006, and the shift from cereal and grains to meat and dairy products resulting in high demand for livestock feed has raised global demand for soybean (Heady and Fan, 2008; Wright, 2011; Dillion and Barret, 2015). This increased the demand for soybean especially in Sub-Saharan African countries like Ghana where futures contract between farmers and buyers is adopted. In most instances, future contract is based on supply chains built on trust emanating from the relationship built among actors. This has the tendency of solving agricultural marketing challenges in terms of regular supplies and prompt payment of goods (Eaton and Shepherd, 2001). The case of the soybean supply chain in Ghana is not different from other supply chains since the relationship between the producers and buyers tends to last only for the current transaction and nothing more. This has resulted in poor bargaining at the producer level as customers buy at low farm-gate prices leaving the producer at a loss. The situation also results in waste of produce largely due to poor storage methods with associated operational cost increment; long supply chains characterised by mistrust and low profit sharing based on the strength of the actors in the chain. This can be attributed to the choice of relationship between the various actors in supply chains. To marketing and agro-industrial firms, the soybean supply chain in Northern Ghana is unattractive because every actor will hold onto the produce until prices are high and thus disrupting planning processes at every stage of the chain.

Generally, the success of every commodity supply chain depends on the relationship between the various actors. The choice of relationship between smallholder farmers and the other actors is influenced by a number of factors such as price, access to credit and experience of the farmer (Chalwe, 2011; Kihoro *et al.*, 2016). There is paucity of knowledge trying to assess the role and drivers of a marketing relationship in agricultural commodity chains in Northern Ghana. This relationship offers solutions by providing market guarantees to the farmers and assuring regular and effective supply to buyers (Al-Hassan *et al.*, 2006). Farmers will not cultivate unless they know they can sell their farm

produce, and traders or processors will not invest in ventures unless they are assured that the required commodities can be consistently produced. This further determines the relationship choice such as contracting, that links farmers and other actors and thus offers a potential solution to this situation by providing market guarantees to the farmers and assuring supply to the purchasers (Clottey *et al.*, 2007; FAO, 2004).

The strength of relationships in various supply chains increases as parties engage in contracting arrangements and contracts occupy an intermediate position in this spectrum of possible relationships (Pleatsikas and Teece, 2001). Sexton, (2012) argues that there are various models of relationship choice that exist in theory and in practice which is either on contract or spot marketing. Kirsten and Sarterious (2002) revealed that contracts are relationship choice based on agreed terms with farmers providing land, labour and tools with the client providing credit, technical knowledge as well as advice. Contract mode is classified according to what is involved in the contract: produce price specification, supply volumes, credit supply and access to markets. This also forms a market specification contract, which is the simplest form of agricultural contract (Al-Hassan, 2006). In the case of a documented relationship between smallholder farmers and other actors, it is a way to raise small-farm income by delivering technology and market information to farmers, integrating them into remunerative new markets (Miyata *et al.*, 2009). Based on reviewed literature, not much work has been conducted on the factors influencing the choice of relationship between farmers and other actors in supply chains using binary choice models especially in sub-Saharan Africa, as such, the need for this analysis. Most of the studies tend to dwell more on the types of contracting among buyers and farmers.

## **MATERIALS AND METHODS**

### **Types and Sources of Data Collection**

Both primary and secondary data was collected. The primary data was collected from selected respondents (farmers), retailers/itinerant traders; the secondary data was collected from produce buyers

like the Savannah Farmers Marketing Company (SFMC) and Gundaa Produce Marketing Company.

### Sampling Procedure

The procedure of sampling began with the determination of sample size.

Following Calderon (2003) the sample size (n) used in the study was determined using the formula:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Where n = sample size, N = total population of farmers in the 4 communities of Northern Ghana, e = desired margin of error.

Farmers list was obtained from the district offices of the Ministry of Food and Agriculture (MoFA). These farmers are into the production of various crops such as soybean, sorghum, groundnuts and maize and this formed the basis for the selection of the sample size. Using an error margin (e) of 0.05 % with a total population of (N) of one thousand, two hundred (1,200) farmers from Lassie Toulou in the Upper West, Yendi in the Northern Region, Sandema in the Upper East Region and Kadelso in the Brong Ahafo Region.

Purposive sampling was used to select the four communities as well as the agro-processing firms. A simple random sampling was then employed to select actual respondents. The respondents were first selected by the method of listing. The collection of qualitative and quantitative data was by means of key informant interviews, target questionnaires as well as focus group discussions. The target questionnaire interviews were used for farmers, retailers, itinerant traders, and agro-processing firms. First the Snowball method of sampling was employed to trace the actors in the supply chain. For farmers, data on the price and quantity of processed soybean was collected.

Farmers provided information on the buyers of their produce, price at which they sell the produce, yield

$$\Pr(y_i = 1 | x_i) = F(x_i) = E(y_i | x_i) \quad (2)$$

$$y_i^* = x_i' \beta + \varepsilon_i$$

Here,  $Y^*$  is considered as an underlying propensity for the dummy variable to take the value of 1 and is a discrete variable so that

per acreage. Key informant interviews were conducted with market queens who provided information on the retailers of soybean in the various markets.

### Theoretical Framework

The choice of relationship between farmers and the respective buyers in a supply chain is either based on contract or otherwise. According to Gujarati (2004), this takes a dichotomous or binary form where a response variable or regress and takes only two values, that is, 1 or 0 otherwise. Relationship was measured as a dummy (Contract=1 or otherwise=0). Based on the type of relationship, primary data was collected from 300 soybean farmers on whether a contract as a form of relationship exists between farmers and buyers; and if yes, what factors influence an agreed contract. Agreed future contract between actors depends on the quality and sophistication of the final product. The Probit model was used to estimate the factors influencing relationship choice (contract or spot buying) in the supply chain in Northern Ghana. The choice of relationship in the supply chain is influenced by a number of factors such as price, variety of soybean, quality, association, age of farmer, experience of farmer, as well as access to credit. The dependent variable (contract=1 or 0=otherwise) was captured as a dummy. Since the dependent variable is a dummy, an OLS regression is not appropriate. An OLS regression could yield incongruous predictions greater than 1 or less than 0. Also, the regression would violate the assumption of no heteroscedasticity because of the discrete nature of the dependent variable. In line with any adoption model for choice purposes similar to Simmons *et al.* (2005), Miyata *et al.* (2009) and Greene (1996), the Probit model is expressed as:

$$y_i^* = \begin{cases} 1 & y_i^* > 0 \Rightarrow x_i' \beta - \varepsilon_i > 0 \Leftrightarrow x_i' \beta > \varepsilon_i \Leftrightarrow \Pr(y_i = 1 | x_i) = F(x_i' \beta) \\ 0 & y_i^* \leq 0 \Rightarrow x_i' \beta - \varepsilon_i \leq 0 \Leftrightarrow x_i' \beta \leq \varepsilon_i \Leftrightarrow \Pr(y_i = 0 | x_i) = 1 - F(x_i' \beta) \end{cases} \quad (3)$$

Thus, if a farmer chooses contract as a form of relationship,  $y=1$ , otherwise,  $y=0$ . The likelihood function is:

$$L = \prod_{y_i=0} F(-\beta'X_i) \prod_{y_i=1} [1 - F(-\beta'X_i)] \quad (4)$$

so, the functional form of F for a Probit model is stated as:

$$F(-\beta'X_i) = \int_{-\infty}^{-\beta'X_i/\delta} \frac{1}{(2\pi)^{\frac{1}{2}}} \exp\left(-\frac{t^2}{2}\right) dt \quad (5)$$

Where t is standard normal distributed, that is, t~N(0,1).

The qualitative response nature of the choice of relationship between farmer *i* as well as factors influencing the choice are often known as probability models. This choice is either on contract (1) or otherwise (0).

The Maximum Likelihood Estimation (MLE) was used to estimate the coefficient of the various factors.

### Empirical Specification of Model

#### *Relationship Choice Between Farmers and the Other Actors Towards Efficiency*

From the theory of the Probit model explained above, a number of factors influence the choice of a relationship between a farmer and a preceding actor

in a supply chain. This relationship is either on contract or otherwise. The decision to choose contracting or otherwise is influenced by factors such as price, output, quality, association to farmer organization, age, market location, experience of the farmer as well as access to credit. The dependent variable (contract=1 or 0=otherwise) was recorded as a dummy in line with dichotomous models. The Maximum Likelihood Estimation (MLE) is used to estimate the coefficients ( $\beta_i$ ) of the various factors. Relationship choice (contract=1 or 0=otherwise) = f [Price (Px), Gender (Ge), Access to Market (Ma), Association (As), Age (A), Experience of farmer (E), Market Location (ML), Access to Credit (Cr)]. Mathematically:

$$\Pr(y=1/x) = \beta_0 + \beta_1 Px + \beta_2 Ge + \beta_3 Ma + \beta_4 As + \beta_5 A + \beta_6 Exp + \beta_7 MLoc + \beta_8 Cr + \mu \quad (6)$$

Where:

$\Pr(y=1/x) = 1$  = Probability of a farmer entering into a contract as a choice of relationship with other actors.

$\Pr(y=1/x) = 0$  = Probability of a farmer not choosing contracting as choice of relationship with other actors,

$\beta_i$  = Parameter estimates,  $\mu$  = error term.

Table 1 below indicates the dependent and independent variables, means of measurement and the *a priori* expectations. The t-test was used to test the level of significance between the choice relationship and the factors that influence a chosen relationship.

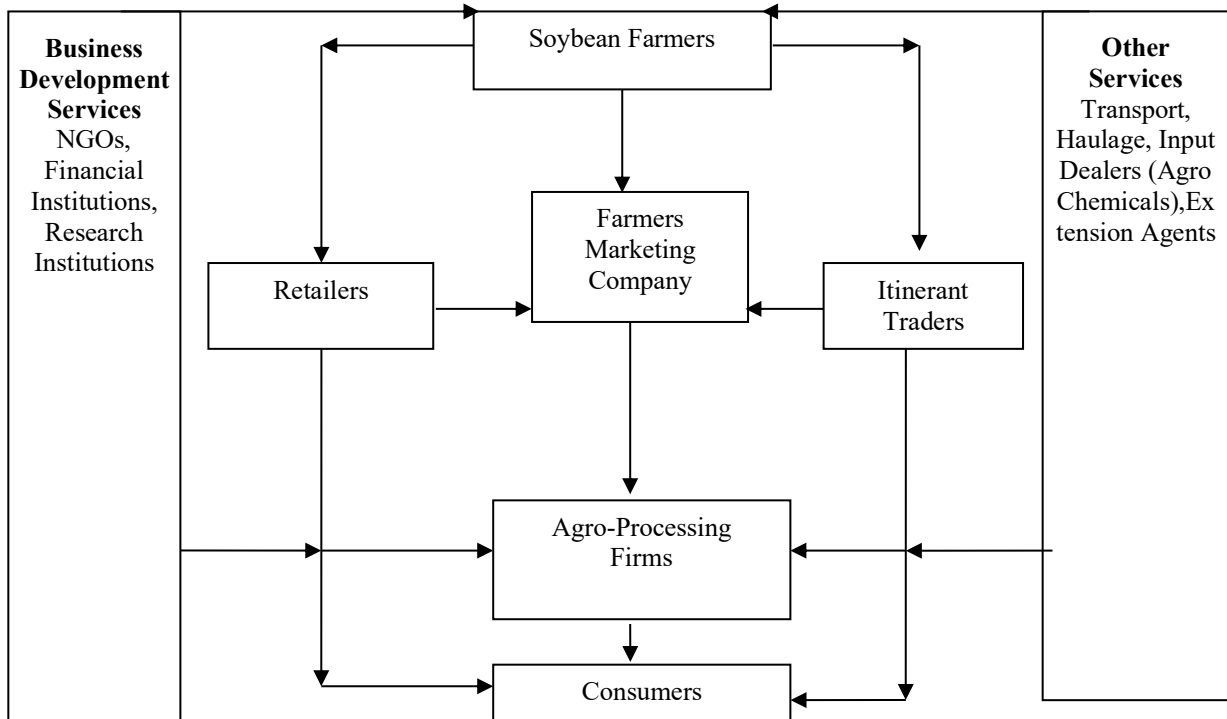
**Table 1: Description of Dependent and Independent Variables with *a priori* Expectation**

Dependent Variable	Independent Variables	Means of Measurement	<i>A priori</i> Expectation
Choice of Relationship (Contract=1 or 0=Otherwise)	Access to Credit (Cr)	Dummy (1=Access, 0=Otherwise)	+/-
	Age (A)	Years	+/-
	Farmer Association (Ass)	Dummy (1= Member of Farmer Association, 0=Otherwise)	+
	Education (Edu)	Years of Formal schooling	+
	Experience (Exp)	Years engaged in soybean farming	+/-
	Gender (Ge)	Dummy (1= Male, 0=Otherwise)	+/-
	Market Location (MLoc)	Dummy	+
	Price of Soybean (Px)	GH¢	+

## RESULTS AND DISCUSSIONS

### Actors in the Soybean Supply Chain

Results from the study showed that soybean farmers sell their farm produce to various customers ranging from itinerant traders to agro-processing firms at various locations. Sixty-three (63) respondents representing 21 % usually sell their produce to retailers in the market, 70 respondents representing 23.3 % sell their soybean to itinerant traders at the farm-gate level. Figure 1 presents a flow chart on the soybean supply chain in Northern Ghana.

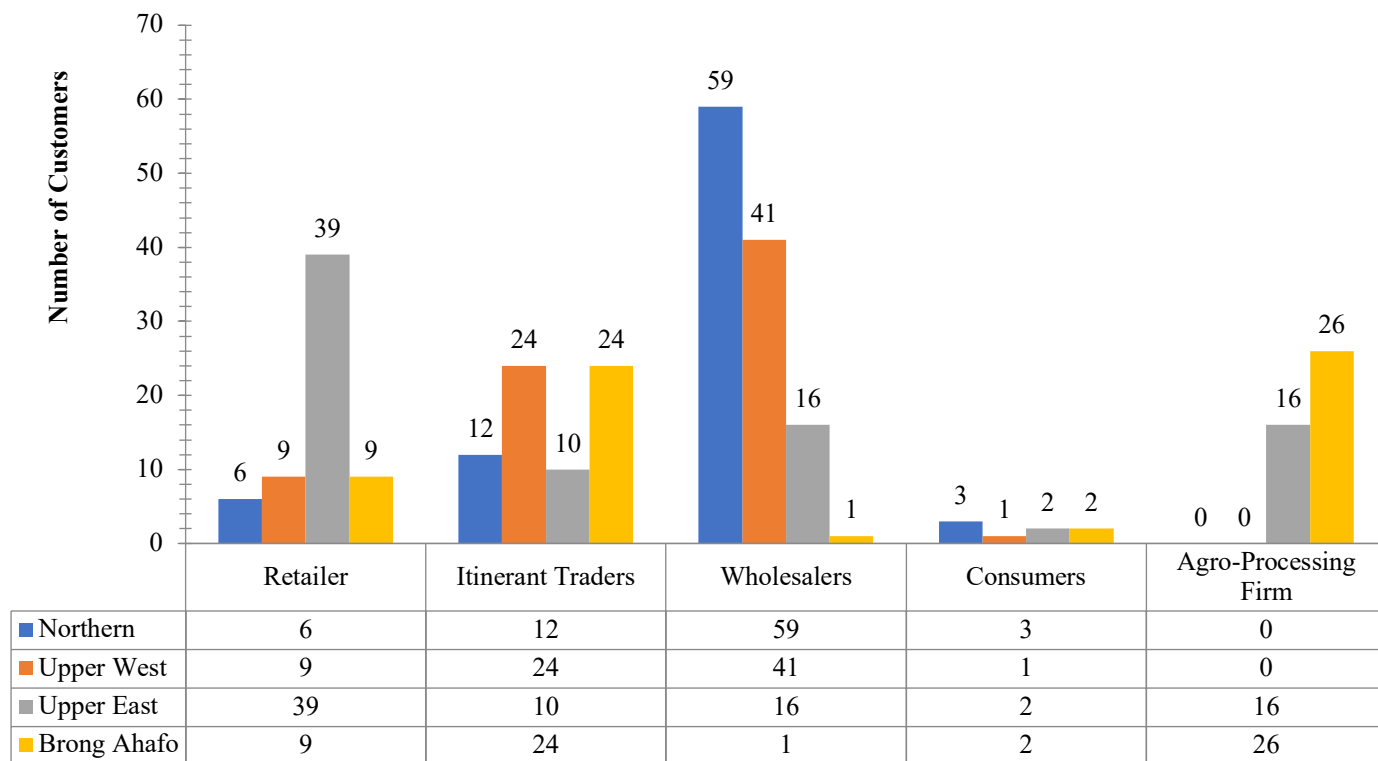


**Figure 1: A Flow Chart Showing the Soybean Supply Chain in Northern Ghana**

The study also showed that majority of the respondents (117) representing 39 % sell their commodities to wholesalers'/marketing companies. 8 respondents sold their commodities directly to agro-processing companies. Respondents assigned their decision to sell to a specific buyer based on a number of factors; the price a buyer offers, prompt payment for commodities sold and also fulfilling pre-financing production agreements.

### Agricultural Commodity Supply Chain Actor Relationship

129 respondents representing 43 % adopted contract as a form of relationship with buyers whilst 171 respondents representing 57 % did not adopt contract farming as a form of marketing relation in various commodity supply chains. Adoption of contracting was attributed to the provision of credit in the form of seed and tractor services. This is confirmed by Abdulai and Al-Hassan (2016) that farmers who adopt contracting enhances access to credit.



Types of Customers

**Figure 2: Customers of Soybean Farmers in Northern Ghana**

**Drivers of Farmers’ Relationship Choice in Agricultural Commodity Supply Chain in Northern Ghana**

Findings from the study identified eight (8) factors which drives a farmer’s decision to participate in a contract as a marketing relationship. Age of farmer, number of years of farming, membership to farmer association, level of education, gender, market location and price of a commodity were factors identified as influencing a farmer’s decision to enter into a contract or not. This was similar to findings by Kutawa (2016) and; Vavra( 2009). Table 2 presents a cross-tabulation of factors influencing contract decision or not with corresponding number of respondents for each factor.

**Table 2: Cross Tabulation between Explanatory Variables and Contract, Non-Farmers**

**Contract**

Explanatory Variables	Categories	Type of Contract Relationship		Total
		Non-Contract	Contract	
Access Credit	No	98	39	137
	Yes	73	90	163
Total		171	129	300
Age Group	18-25	31	24	55
	26-33	46	43	89
	34-41	45	40	85
	42-49	36	15	51
	50-57	13	7	20
Total		171	129	300
Farmer Association	Non Member	111	59	170
	Member	60	88	130
Total		171	129	300
Education	Primary	22	13	35
	J.H.S	15	10	25
	S.H.S	34	24	58
	Middle school	6	15	21
	Tertiary	7	8	15
	Non formal	9	1	10
	O Level	7	7	14
	Post-Secondary	4	7	11
	None	67	44	111
Total		171	129	300
Experience (Years)	1-3	101	95	196
	4-6	59	29	88
	7-9	7	5	12
	10-12	4	0	4
Total		171	129	300
Gender	Female	81	54	135
	Male	90	75	165
Total		171	129	300
Market Location	At the Market	58	41	117
	Farm-gate	74	71	145
	Buyer's End	8	5	13
	At home	22	3	25
Total		171	129	300
Price (GHS)	0.21 - 0.26	1	0	1
	0.27 - 0.32	12	9	21
	0.33 - 0.38	97	83	180
	0.39 +	70	28	98
Total		171	129	300

Table 3 shows results of Probit analysis of contract adoption as a choice of relationship by farmers in the soybean supply chain. The Maximum Likelihood Estimate gives an indication of the relationship between the soybean farmers and the other actors in the supply chain. It was estimated using E-views 9.0 software. Out of the 8 parameters estimated, 4 were statistically significant at 1 % and 10 %. The variables access to credit, membership of farmer association, experience of the farmers, and price per kilo of the soybeans were significant at 10 %, 1 %, 1 % and 1 % respectively. These parameters also met the *a priori* expectation except for price and age of respondent. The coefficient of access to credit was positive and statistically significant at 10 percent level implying that the availability and access to credit both in cash and in-kind will lead to a 12.5 % probability that a farmer will agree to a contract relation with a particular buyer. This was confirmed by Abdulai and Birachi, 2009 who also found access to credit to be significant at 10 % in their study on the Choice of Coordination Mechanism in the Kenyan Fresh Milk Supply chain.

Findings from their study indicated that the marginal effects for the length of credit period indicate that the shorter the length of credit period, the higher the likelihood of spot market contract being used. This credit is used in acquiring simple farm inputs like improved seeds, weedicide and tarpaulins for threshing as well as hiring of labour for agronomic and post-harvest activities. However, observations from the field indicate that only 7 respondents out of 129 adopters of contracting as a marketing relationship in the supply chain were in the age bracket of 50-57. This demonstrates that farmers in this age group usually produce to feed their households.

Membership to a farmer association had a coefficient estimated to be positive as expected and statistically significant at 1 percent, indicating that the probability that a farmer will adopt contracting as a form of marketing relation in the supply chain increases by 19.5 %. This is because produce marketing companies as well as agro-processing companies prefer to contract farmers who are into organized associations. (Abdul-Rahman and Donkoh, 2015 reported that

these associations are committed to supplying quality soybeans based on the contract agreement Farmers believe that with a strong and dynamic leadership in place they can better negotiate for better prices with buyers.

Education had a negative coefficient and hence did not meet the *a priori* expectation and not statistically significant. Results further showed respondents with higher education do not undertake farming as a major occupation. This is confirmed by McLarty (2005) who found that higher education especially university graduates do not get actively involved in agriculture. D'Silva (2009), Hassan *et al.* (2009) and Hayrol *et al.* (2009), observed that agriculture is among the choice for those with lower education group. This is reflected in the lower adoption of contract farming as a choice of relationship among educated farmers.

Number of years of farmers measured in years met the *a priori* expectation and was statistically significant at 1 %. The results showed that an annual increase in soybean production will lead to a 3.8 % increase in a farmers' decision to adopt contracting as a form of relation with other actors in the soybean supply chain; farmers with more years of experience are better negotiators for improved prices than farmers with less years of experience. This is in line with Fischer and Qaim, (2012) who found farming experience significant and thus influence membership to farmer association and hence desire to produce on contract.

Location of produce market met the *a priori* expectation but not statistically significant. Farmers did not place emphasis on location of sale due to the contract specification in which produce will be mobilized at farm-gate level. This finding was ascertained by Abdulai *et al.* (2008) who found that market location does not influence contractual choice in the Nyandarua district in Kenya. The soybean supply chain has agreed collection points where produce is picked and hence market location does not influence a farmer's decision to choose a specific marketing relationship. Finally, coefficient price was negative as such did not meet the *a priori* expectation, but statistically significant at 1 %. Farmers without prior market information on soybeans prices appear likely not to adopt contracting as a form of market relation with buyers. This is an indication of a lack of



prior negotiations between farmers and buyers as such no agreed prices for soybean. Non-negotiated future price of agricultural commodities is beneficial to producers during shortage of agricultural

commodities (Tomek and Kaiser, 2014). This is common with commodity marketing in Northern Ghana where farmers on the spot marketing is preferred to contracting.

**Table 3: Results of Determinants of Farmers Relationship Choice in a Soybean Supply chain**

Variable	Coefficient	Std. Error	z-Statistic	Marginal Effects
C	0.5367	0.5974	0.8984	
Credit Access	0.3201*	0.1788	1.7905	0.1249
Age	-0.0453	0.0680	-0.6661	0.0179
Farmer Association	0.4944***	0.1626	3.0407	0.1945
Education Level	-0.0175	0.0247	0.7075	0.0070
Experience	0.0952***	0.0364	2.6119	0.0377
Gender	-0.0471	0.1568	2.611	0.0187
Market Location	0.0117	0.0910	0.1289	0.0046
Price	-3.2081***	1.2314	2.6053	1.2705

**Note:** \*\*\*, \*\* and \* denotes 1 %, 5 % and 10 % significance level.

## CONCLUSION

Access to credit is currently a challenge to supply chain actors especially with smallholder farmers due to the risk involved in agriculture and as such, government and private partners should set up an agricultural fund for easy access to credit. Farmer associations should be strengthened to build an effective contract relationship with other actors. These associations can be transformed in to cooperatives with effective collective action backed by strong bargaining powers. Experienced farmers should be given the opportunity to lead farmer associations for mentoring purposes towards making good decisions during contract signing periods. Government should strengthen the bulk buying companies to provide a ready market for the produce. For soybean farmers, a supply chain looks promising due to progressive price increment since its introduction into Ghana. The price increment is as a result of the wide usage of the product as a good source of nutrient for human consumption. It has been realised that farmers who sell directly to the agro industries earn more income compared to farmers who sell to ‘middle men’. Contract relations with

these agro-industries will enhance profit margins of farmers but this will negatively affect when they cannot meet the quality requirements of these industries. These farmers relate to other actors in the supply chain through contract or on the ‘spot market’. Contracted farmers are offered high prices as an incentive relative to non-contracted farmers and have easier access to credit compared to non-contracted farmers. Soybean farmers need to form more groups in order to play effective roles during price fixing. The current system allows market ‘queens’ to dictate price of soybeans in the market. Farmers need to add value to their produce in order to sell directly to the agro-industries. This will reduce the number of ‘middle men’ in the soybean Supply chain. Storage facilities were the most limiting constraint due to abandonment of existing facilities in the areas. In most of the farming communities, storage facilities are infested with pest making it impossible to store produce.

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