

## **INPUT COMMERCIALIZATION, FARM YIELD AND INCOME OF POOR AND NON-POOR LYCHEE FARMERS IN LUC NGAN DISTRICT, BAC GIANG PROVINCE, VIETNAM**

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### **ABSTRACT**

The study analyzed the extent of input commercialization among poor and non-poor lychee farmers in Luc Ngan District, Bac Giang province, Vietnam in 2013. Primary data were gathered from a sample of 31 poor and 134 non-poor lychee farmers using structured questionnaires. Descriptive statistics were employed to compare the primary data collected and assess the degree of lychee input market participation of the two farmer groups. OLS regression analysis was used to analyze factors affecting degree of input commercialization among poor and non-poor farmers. Results showed that both poor and non-poor farmers participated in the input market. However, poor households have lower degree of input commercialization than non-poor households, with commercialization index of 25.4% and 46.4%, respectively. Farm size has positive influence on the degree of input commercialization whereas family labor has a negative effect. Non-poor farmers have higher crop yield than poor farmers, with 11,205 kg/ha and 9,352 kg/ha, respectively. Their farm profit is also higher than that of poor farmers. The study recommends that poor farmers should be assisted in term of credit services, extension services, and improved input distribution system.

**Key words:** OLS regression, market participation, smallholders

### **INTRODUCTION**

World production of lychee is estimated at around 2.11 million metric tons (MT), with more than 95% of the area and production contributed by Asia. Lychee is widely distributed throughout the world's sub-tropical and tropical regions. Major centers of production are China, India, Taiwan, Vietnam, Thailand, Madagascar, Nepal, Bangladesh, and South Africa. Small production centers include Australia, South Africa, Israel, Mexico, Brazil and USA (Evans et al., 2004). China is the leading country in terms of production volume followed by India, Taiwan, Thailand, and Vietnam with volume of 1,000,000 MT, 430,000 MT, 110,000 MT, 85,000 MT and 40,000 MT, respectively (FAO, 2002).

Fruit production is an important part of Vietnam's agriculture. The Ministry of Agriculture and Rural Development (MARD) reported that fruit production in 2005 is close to 6.5 million MT. Lychee has contributed significantly to rural and agricultural development. With production approaching 156,000 MT, Vietnam is the third largest lychee producer in the world (Institute of

Agricultural Science for Southern Vietnam, 2014). Lychee is considered a high value commodity and is mainly grown in the northern part of Vietnam. According to Vu and Nguyen (2002), Bac Giang province has the biggest lychee-planted area and volume of production in Vietnam with shares to national area and production of 57% and 40%, respectively. Luc Ngan, on the other hand, is considered the largest lychee producing district of the province as well as nationwide. Its lychee production contributed up to 55% of the provincial production with 72,000 MT in 2013 (Department of Industry and Trade Bac Giang, 2013).

In Vietnam, majority of the poor live in rural and mountainous areas, where conditions are very difficult to improve their income. Bac Giang province is one such region located in the north of Vietnam with 19.6% of total households considered poor and 8.8% classified as near poor in 2010 (Vietnam's Minister of Labour, 2011). According to Decision No. 9/2011/QĐ-TTg released by Vietnam's Prime Minister, the poverty line applicable for the period 2011- 2015, for farmers who live in mountainous, rural areas, lowlands and islands, income is below 4,800,000 VND per year (or 231.24 USD) (Vietnam's Prime Minister, 2011).

Agricultural sector in general and fruit production in particular has a big role to increase farmers' income and contribute to poverty reduction. There is a strong correlation relationship between high agricultural productivity and poverty reduction (Minten and Barrett, 2008). The use of inputs such as fertilizer, pesticide and labor is seen as an important way to improve agricultural output and productivity and therefore incomes of rural households, especially the poor. "Greater dependence of the producers on the input market as the source of production inputs has been associated with increased productivity" (Okoboi, 2011). The contribution of fertilizer to increased yield is perhaps the greatest among the purchased inputs (Couston and Aspiras, 1979). Similarly, Okoboi (2011) indicated that expenditure on fertilizer, fungicides, herbicides and hired labor is significantly associated with an increase in maize yield. Do (2003) also found that an increase in amount of labor and fertilizer could lead to an increase in lychee yield.

Besides increase in crop production, the use of inputs can ensure a higher quality of crop. Fertilizer is one component of producing a crop with higher quality. However, applying more fertilizer than is recommended or needed by the crop entails additional costs and may reduce fruit and vegetable quality (Kessel, 2012). Pesticides are very important as they improve the quality and yield of agricultural produce (Markets and Markets, 2013). Pesticides allow consumers to consume high-quality product that is free of insect blemishes and insect contamination (CropLifeAmerica).

Although the use of inputs in production is desirable, the input market participation of poor farmers in Luc Ngan district, Bac Giang province may still be limited compared to middle-income and rich farmers. In general, poor farmers in developing countries are constrained by many problems including inadequate market information, lack of extension service, poor access to credit, limited infrastructure, and difficult access to technology. The farmers' limited knowledge of input markets and access to technology and other facilities are reflected in low productivity which in turn results in lower income. In all these studies cited, however, none appears to have simultaneously considered the relationship of input commercialization, farm yield and income of poor and non-poor farmers.

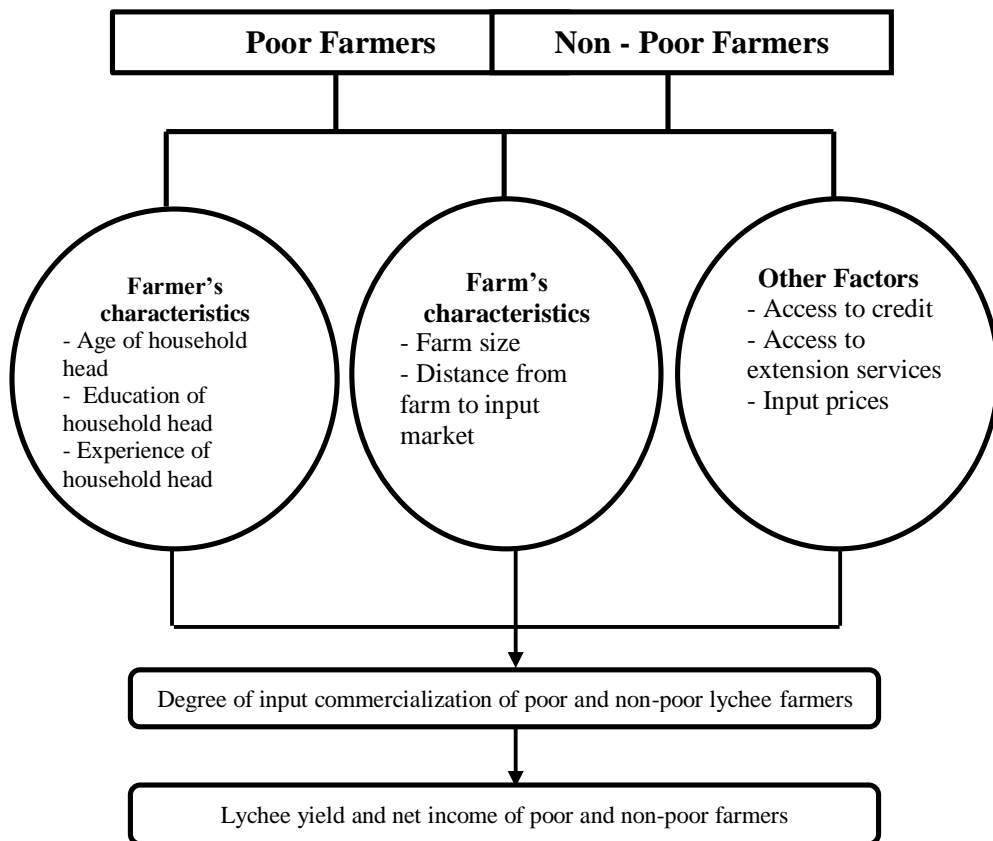
Therefore, this paper discusses (1) the extent of input commercialization among poor and non-poor lychee farmers in Luc Ngan district, Bac Giang province, Vietnam; (2) the factors affecting degree of input commercialization among poor and non-poor lychee farmers; and (3) the yield and income performance of poor and non-poor lychee farmers in the study area.

## METHODOLOGY

### Conceptual Framework

Three groups of factors are hypothesized to be affecting the degree of input commercialization between poor and non-poor farmers. These include farmer's characteristics, farm's characteristic and other factors (Figure 1).

Farmer's characteristics refer to individual characteristics of farmers such as age, sex, experience and educational level of household head. Farm characteristics consist of farm size, number of lychee trees, and distance between farm and input market. Access to credit, extension services, market information, input prices, and source of input are categorized as other factors.



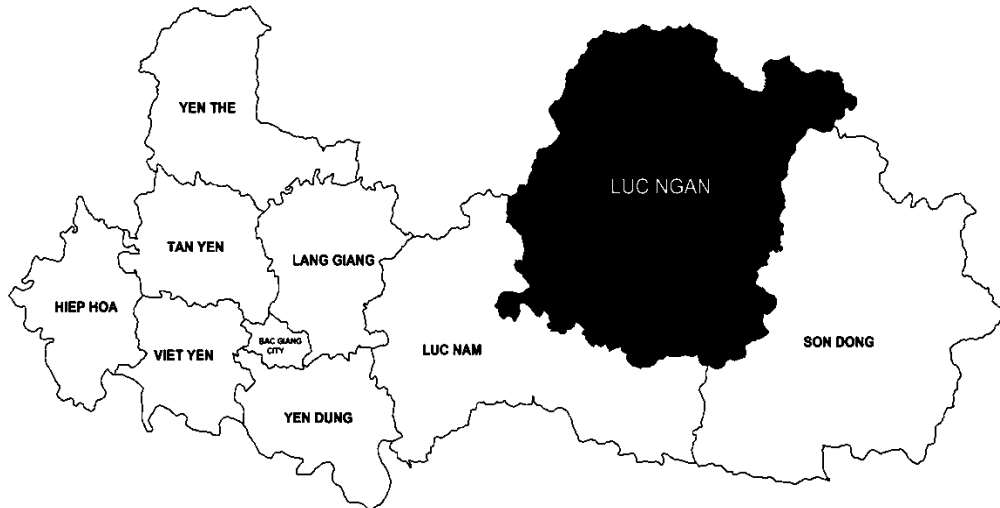
**Fig. 1.** A conceptual framework of input commercialization among poor and non-poor lychee farmers

### Analytical Methods

#### *Study area and data collection*

This study was conducted in Luc Ngan district. Luc Ngan is bounded on the northwest and northeast by districts of Lang Son province, on the southwest by Luc Nam district and on the southeast by Son Dong district (Figure 2). Topography of Luc Ngan is divided into two zones. The

first zone is a high mountainous terrain, making up nearly 60 % of the natural area of the district. It includes 12 communes. This area is largely sloping with more than 25° and average elevation of 300 - 400 meters (m) above sea level. Land in this area has potential in developing forest plantation, raising livestock and planting fruit trees. The second zone is low hilly terrain including 17 communes and 1 town. This area accounts for over 40% of the total area of the district. It has lower slope and average altitude of 80-120 m above sea level. Land in this area is suitable for the cultivation of fruit trees especially lychee.



Source: bacgiang.gov.vn

**Fig. 2.** Map of Bac Giang district showing the study area (Luc Ngan district, Bac Giang province, Vietnam)

Thirty-one randomly selected poor lychee farmers and 134 non-poor lychee farmers from the three communes (My An, Quy Son and Tan Lap) in Luc Ngan district, Bac Giang province served as respondents for this study. The farmer-respondents were personally interviewed using structured questionnaires. The study sites represent the highest volume of lychee production in the district and have lychee farmers who are considered poor.

The poor lychee farmers were determined by local officials based on the poverty line of Vietnam. Based on the total number of lychee households of each commune, the number of respondent-farmers of each commune was determined. The numbers of households engaged in lychee farming in My An, Quy Son and Tan Lap commune were 1,525, 4,215 and 1,806 households, respectively. With total of 165 selected farmers, there were 34, 92 and 39 respondents from My An, Quy Son and Tan Lap commune, respectively.

Lychee poor farmers were selected based on the poverty rate of each commune. The rates of poverty in My An, Quy Son and Tan Lap were 8.9%, 5.2% and 44%, respectively. Therefore, the number of lychee poor farmers selected from each commune was 4, 6 and 21, respectively.

### ***Degree of input commercialization***

Input commercialization index of households is commonly determined as the proportion of the value of purchased inputs to total value of crop production. On the other hand, household participation in input market is determined as the ratio of value of purchased crop inputs to the total

value of crop inputs used (Gebremedhin and Jaleta, 2010). In this study, lychee input market participation (LIMP) index is given as:

$$LIMP_k = \frac{\sum_{n=1}^N \overline{P}_i X_{kn}^p}{\sum_{n=1}^N \overline{P}_i X_{kn}^T} \quad (\text{Eqn 1})$$

Where:

- $X_{kn}^p$  is the amount of input n purchased by the poor or non-poor farmer k.
- $\overline{P}_i$  is average actual price paid by poor or non-poor farmer for inputs.
- $X_{kn}^T$  is the total amount of input n used in the lychee production.

The value is zero if the farmer does not buy any input in the market and one if the farmer buys all inputs in the market (Gebremedhin and Jaleta, 2010). In the empirical analysis for this study, LIMP is referred to as lychee input commercialization index or LICI. If the index is multiplied by 100, then the value ranges from zero to 100%.

### **OLS model**

The OLS regression model was employed to determine the factors affecting the degree of input commercialization among poor and non-poor lychee farmers in the study area. The empirical model is expressed as:

$$Y_i = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Sex} + \beta_3 \text{Lab} + \beta_4 \text{Educ} + \beta_5 \text{Exp} + \beta_6 \text{Fsize} + \beta_7 \text{Credit} + \beta_8 \text{Ext} + \beta_9 \text{cfp} + \beta_{10} \text{Idismkt} + u_i \quad (\text{Eqn. 2})$$

Separate analyses were done for the poor and non-poor farmer groups. A combined analysis of two farmer groups was also estimated using OLS regression model. The specific OLS regression model for analyzing the determinants of lychee commercialization of 165 farmers in the input market is stated as follows:

$$Y_i = \alpha_0 + \alpha_1 \text{Age} + \alpha_2 \text{Sex} + \alpha_3 \text{Lab} + \alpha_4 \text{Educ} + \alpha_5 \text{Exp} + \alpha_6 \text{Fsize} + \alpha_7 \text{Credit} + \alpha_8 \text{Ext} + \alpha_9 \text{Cfp} + \alpha_{10} \text{Idismkt} + \alpha_{11} \text{HHtype} + u_i \quad (\text{Eqn. 3})$$

Where:

- i represents the number of respondents,  $i = 1, 2, \dots, n$ .
- $Y_i$  represents the dependent variable “degree of commercialization” of farmer i measured as LICI.
- $\beta_0, \alpha_0$  is intercept of the model.
- $\beta_j$  (j = 1 to 10) and  $\alpha_j$  (j=1 to 11) are coefficients of independent variables in the OLS model.
- $u_i$  is the error term of the model.

Coefficients of the OLS model were estimated using the STATA 10 software. Table 1 shows a description of independent variables of the empirical OLS model. Chemical fertilizer included nitrogen, phosphorous and potassium in Table 1. The average price of chemical fertilizer paid by farmers is calculated by weighted average method.

T-test was conducted to determine and compare whether there is a significant difference between poor and non-poor farmers in terms of the socio – economic, farm and other characteristics as well as farm yield and profit.

**Table 1.** Description of the explanatory variables and expected signs in the input commercialization model

<b>Variable</b>	<b>Description</b>	<b>Measurement</b>	<b>Expected sign</b>
Age (Age)	Age of household head	Years	+
Sex (Sex)	Sex of household head	D = 1 if male; 0 = otherwise	+
Family labor (Lab)	Labor of household members employed in lychee farming	Number of mandays contributed by family members	-
Education (Educ)	Number of years of formal education of household head	Years	+
Experience (Exp)	Farming experience of household head	Years	+
Farm size (Fsize)	Size of area cultivated for lychee	Hectares	+
Credit access (Credit)	Lychee farmer has access to credit	D =1 if yes; 0 = otherwise	+
Extension access (Ext)	Lychee farmer has access to extension services	D =1 if yes; 0 = otherwise	+
Chemical fertilizer price (Cfp)	Average price of chemical fertilizer paid by farmers	Thousand VND per kilogram	-
Input market distance (Idismkt)	Distance between the residence of household and the nearest input market	Kilometer (Km)	-
Household type (Hhtype)	Type of household	D =1 if household type is non-poor; 0 = otherwise	+

## RESULTS AND DISCUSSION

### Socio-economic characteristics of respondents

Majority of the household heads of poor (58%) and (94%) non-poor farmers were male. The gender of household head captures the differences in market orientation between male and female. Males are expected to have a higher propensity to participate in markets than females (Martey et al., 2012).

Access to credit will provide more financial support for farmers to enable them to participate in input market. The proportion of poor farmers with access to credit was about 55% which is higher than that of non-poor farmers (47%). In general, poor farmers are constrained by many problems. One big problem is inadequate capital to buy inputs. Therefore, access to credit will help them to participate in input market.

Access to extension services will provide new methods to increase the yield of lychee and in turn, increase marketable surplus. However, only 29% and 77% of poor and non-poor respondents, respectively, participated in lychee training that were organized in the last three or four years in Luc Ngan.

**Table 2.** Characteristics of poor and non-poor lychee farmers, (categorical variables), Luc Ngan district, Bac Giang province, Vietnam, 2013.

Variable	Item	Poor farmers		Non-poor farmers		Total	
		n	%	n	%	N	%
Number of respondents		31	18.79	134	81.21	165	100.00
Sex	Female	13	41.94	8	5.97	21	12.73
	Male	18	58.06	126	94.03	144	87.27
Credit access	Yes	17	54.84	10	7.46	27	16.36
	No	14	45.16	124	92.54	138	83.64
Extension access	Yes	9	29.03	103	76.87	112	67.88
	No	22	70.97	31	23.13	53	32.12

Source: Survey result, 2014

Table 3 shows that poor farmers have mean age of 49 years, while non-poor farmers were about 46 years old. The difference in ages between the two groups was significant at 5% probability level. The youngest farmer was 21 years old to oldest was 72 years old. The age of household head is a proxy measure of experience and availability of resources. It is possible that older and more experienced heads are able to make better production decisions, such as adoption of new agricultural technologies and using improved inputs (Enete and Igboke (2009) as cited by Martey 2012).

Results show that 16 % of the poor farmers reported they did not attend formal schooling, while only 1% of non-poor farmers did not spend time in school. The mean years of education shows that the non-poor farmers spent 2.4 more years in school than poor farmers. Education allows the farmer to improve his knowledge, make independent decision, and increase the ability to use farm resources efficiently. Moreover, it will endow farmers with better production and managerial skills (Martey, 2012). They are not only able to complete operations in a timely manner, organize production processes, choose the technology best suited for a particular situation but they also possess marketing and financial management skills (Boehlje et al, 2001).

The differences in the average number of family labor engaged in lychee-related activities, farm size, and farm experience between poor and non-poor household groups are significant at 1% and 5% probability level. Among poor farmers, the mean distance to input market was about 2.39 km, which is higher than that of non-poor farmers (1.61 km), which is not statistically significant. Nevertheless, according to Woldesenbet (2013), the closer the market to the farm, the lesser would be the transportation charges. Data show that all input supply agents are located in the village. Thus, farmers and producers do not have to spend much time and cost on transportation and purchase of production inputs.

**Table 3.** Characteristics of poor and non-poor lychee farmers, (continuous variables), Luc Ngan district, Bac Giang province, Vietnam, 2013.

Variable	Poor farmers (a)	Non-poor farmers (b)	All	Difference (a-b)
Number of respondents	31	134	165	-
Age of household head (years)	49.74	46.34	48.04	3.4**
Experience of household head (years)	28.00	25.99	27.00	2.01**
Education of household head (years)	4.84	7.23	6.03	-2.39***
Family labor in lychee farming (persons)	2.29	3.16	2.73	-0.87***
Farm size (hectares)	0.35	0.85	0.58	-0.5***
Input market distance (km)	2.39	1.61	2.00	0.78 <sup>NS</sup>

Note: \*\*\* and \*\* are statistically significant at 1% and 5% probability level, respectively. T-test.

NS is not significant at 10% probability level.

Source: Survey result, 2014

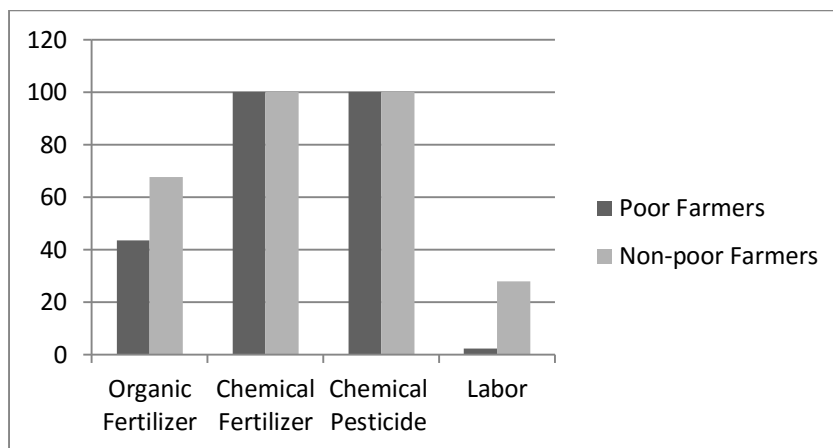
### **Extent of input commercialization among poor and non – poor lychee farmers**

The input distribution network in this district does not operate effectively. All of the lychee farmers had transactions in the input market for fertilizers, pesticides and labor, although the degree of commercialization varied between the poor and non-poor farmers. Figure 3 shows that both farmer groups purchased all the chemical fertilizers and pesticides used, that is, 100% commercialization. Most of inputs (chemical fertilizers and pesticides) for lychee production are distributed by private enterprise systems. Therefore, counterfeits and poor quality of chemical fertilizers and pesticides are still sold to farmers at a high price (Do and Cong, 2015). Farmers could not distinguish between poor and good quality fertilizer, thus affecting their lychee yield and profit.

The participation of poor and non-poor farmers in labor market is low, at 2.3% and 27.92%, respectively. This indicates that family labor was still the main resource in lychee farming operations, especially among the poor farmers. The degree of organic fertilizer commercialization of non-poor farmers is 67.7% which is higher than that of poor lychee farmers (43.6%). The difference is due to the higher value of homemade organic fertilizer for non-poor farmers.

Overall, the degree of input commercialization of the non-poor farmers as measured by LICI was 46.4% while that of the poor farmers was only 25.4%. These ratios indicate that input commercialization among the non-poor farmers is higher than among the poor farmers in the study area, with a significant difference at 1% probability level.

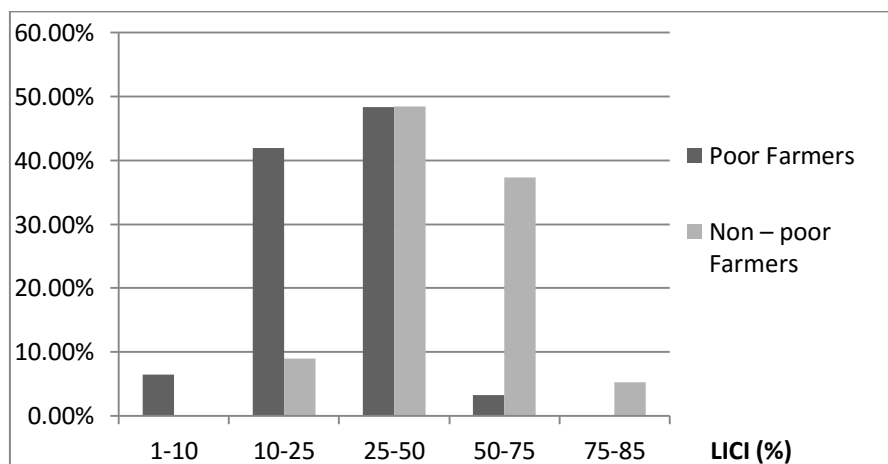




Source: Survey results 2014

**Fig. 3.** Proportion (%) of commercialization among poor and non-poor farmers by type of input

The distribution of the extent of lychee input commercialization among the poor and non – poor lychee farmers in the study area is presented in Figure 4. The result shows that among all farmers surveyed, none attained a ratio above 85%. The highest lychee input commercialization index (LICI) was 75% - 85%. However, this was only among non-poor farmers comprising 5.2% of total respondents. The lowest was 6.4% which was among poor farmers only.



Source: Survey results, 2014

**Fig. 4.** Proportion (%) of farmers by input commercialization index, poor and non – poor lychee farmers, Luc Ngan district, Bac Giang province, Vietnam, 2013.

The findings also indicated that a higher proportion (37.31%) of non-poor farmers in the study area participated in the input market at 50-75% input commercialization index compared to only 3.23% among poor farmers. Non-poor farmers bought a larger proportion of inputs they used than poor farmers. This is attributed to their advantages in capital and knowledge in lychee cultivation.

**Factors affecting extent of input commercialization among poor and non – poor lychee farmers**

OLS regression models were used to identify factors affecting degree of lychee input commercialization among the poor and non-poor farmers. The STATA 10 program was used to estimate coefficients of OLS models. The results of OLS regression models are presented in Table 5.

The adjusted R<sup>2</sup> value was 0.6784 and 0.5616 for OLS regression of poor and non-poor farmers, respectively. These values indicate that 67.84% and 56.16% of total variation in input commercialization index can be explained by the variables included in the model (Table 5). Among the explanatory variables considered, gender of household head, farm size, and credit access have positive influence on the degree of input lychee commercialization among the poor farmers. On the other hand, price of chemical fertilizer (Cfp) and family labor have negative effect. For non-poor farmers, age of household head, education attainment, farming experience, farm size, and access to extension services have positive and significant influence on the degree of lychee input commercialization. Family labor has negative significant influence (Table 5).

**Table 5.** OLS regression results for determinants of degree of lychee input commercialization among poor and non-poor farmers in Luc Ngan district, Bac Giang province, Vietnam, 2013.

Variable	Poor farmers (n = 31)			Non-poor farmers (n =134)			All farmers (n=165)		
	Coefficient	Std. Error	T- value	Coefficient	Std. Error	T- value	Coefficient	Std. Error	T- value
Intercept	27.5124 <sup>NS</sup>	22.4040	1.23	8.5302 <sup>NS</sup>	10.8214	0.79	-23.0947 <sup>***</sup>	7.9486	-2.91
Age	0.2135 <sup>NS</sup>	0.3599	0.59	0.8691 <sup>***</sup>	0.1183	7.34	0.9056 <sup>***</sup>	0.1038	8.73
Sex	6.4815 <sup>**</sup>	3.0840	2.10	1.5807 <sup>NS</sup>	2.2492	0.70	3.6268 <sup>**</sup>	1.8278	1.98
Labor	-3.0909 <sup>**</sup>	1.3876	-2.23	-3.8637 <sup>***</sup>	0.9712	-3.98	-2.6923 <sup>***</sup>	0.6557	-4.11
Education	0.7342 <sup>NS</sup>	0.5317	1.38	0.7107 <sup>***</sup>	0.2642	2.69	0.8765 <sup>***</sup>	0.2265	3.87
Experience	0.0823 <sup>NS</sup>	0.3235	0.25	0.2878 <sup>*</sup>	0.1497	1.92	0.3472 <sup>***</sup>	0.1324	2.62
Farm size	21.7416 <sup>*</sup>	11.5265	1.89	3.2972 <sup>**</sup>	1.5989	2.06	4.1249 <sup>***</sup>	1.6496	2.50
Credit	6.8240 <sup>*</sup>	3.8967	1.75	-2.0022 <sup>NS</sup>	1.8428	-1.09	0.7417 <sup>NS</sup>	1.6370	0.45
Extension services	0.3576 <sup>NS</sup>	3.8112	0.09	3.6592 <sup>***</sup>	1.3754	2.66	3.0904 <sup>***</sup>	1.2721	2.43
Cfp	-4.0311 <sup>*</sup>	2.3259	-1.73	-1.3662 <sup>NS</sup>	0.8333	-1.64	-1.1654 <sup>NS</sup>	0.7659	-1.52
Idismkt	0.3294 <sup>NS</sup>	0.4974	0.66	-0.0942 <sup>NS</sup>	0.2966	-0.32	0.0318 <sup>NS</sup>	0.2532	0.13
HH type							19.4577 <sup>***</sup>	2.2293	8.73
R <sup>2</sup>		0.7856		R <sup>2</sup>		0.5945	R <sup>2</sup>		0.7368
Adjusted R <sup>2</sup>		0.6784		Adjusted R <sup>2</sup>		0.5616	Adjusted R <sup>2</sup>		0.7179
F (10, 20)		7.33		F (10, 123)		18.04	F (11, 153)		38.94
Prob > F		0.0001		Prob > F		0.0000	Prob > F		0.0000

Note: \*\*\*, \*\* and \* are significant at 1%, 5% and 10% probability level, respectively. NS is not significant at 10% probability level.

The gender of the head of poor households was found to have a positive and significant influence at 5% probability level on the degree of input commercialization. Poor farmers are more likely to participate in the input market if he is male household head. The higher probability of poor male household head participating in the lychee input market than female household head may be related to economic status, level of information and extension access. In Vietnam, the female usually stays at home while the male makes important decisions on farm production, which in this case is the respondent's main source of income. However, the effect of sex of non-poor household head on the input commercialization was negligible. It could be due to that fact that there was little variation in sex data of non-poor farmers with 94% of them being male. In addition, both of male and female household heads of non-poor group spent more years in school and have access to extension services. Therefore, there was not difference in decision to participate in the inputs market between male and female household heads of non-poor group.

Family labor has a negative significant influence on input commercialization of poor and non-poor farmers. This indicates that households who had more family labor are less likely to hire labor for lychee production as well as participate in the input (labor) market. With highly available family labor, they do not need to hire more labor in farming operations (Table 5).

Price of chemical fertilizer also has significant and negative effect on the level of input commercialization of poor farmers. It means that the poor farmers are less likely to increase degree of input commercialization if price of chemical fertilizer is high. They have less capital resource, which limits their participation in the input market. On the contrary, non-poor farmers have more financial resources, thus, their level of input commercialization is not likely to be much influenced by the price of chemical fertilizer.

Farm size has positive significant influence on input commercialization of the poor and non-poor farmers. The poor farmers who have bigger farms are likely to buy more inputs for producing the crop. It is because larger size of area cultivated with lychee will require farmers to add more inputs such as labor, fertilizer and chemical pesticide.

Access to credit of the poor farmers has a positive and significant effect on input commercialization. This suggests that poor farmers who have access to credit were more likely to increase the level of input commercialization. Access to credit will provide more financing for the farmer to purchase the inputs, thereby increasing lychee production. However, the effect of credit access of non-poor farmers on the input commercialization was negligible and not clear. It could be noted that a high proportion of non-poor farmers (92.5%) indicated they had enough capital for lychee production, hence, they did not have to access to credit.

Age and farming experience of non-poor household head have positive and significant influence on the degree of input commercialization. Older household heads are more likely to increase participation in the input market. For farming experience, if the number of years of household head experience increased by one year, then the proportion of lychee input commercialization could increase by 0.28%.

Consistently, the educational level and access to extension services of non-poor households have a positive and significant impact on the degree of input commercialization at 1% probability significant level. Households who have access to extension services and are literate are more likely to participate in the input market. This is because access to extension services will provide new farming methods to increase the yield of lychee. Thus, farmers may need to buy more inputs. In addition, higher educational level corresponds to better technology adoption and participation in the input market. However, the effect of these factors on the degree of input commercialization of the poor farmers is not significant as most of them have similar educational attainment and did not have access to extension services.

### *Input commercialization, farm yield and income of poor and non-poor lychee farmers.....*

A combined analysis of two farmer groups was also estimated using OLS regression model. The results for determinants of degree of lychee input commercialization for all farmers in Luc Ngan district are also presented in Table 5.

Based on the results of the multiple regression analysis involving 165 sample grower-respondents in Luc Ngan, about 72% of the total variation in input commercialization could be explained by the 11 explanatory variables included in the model. This model was significant at 1% probability level. The extent of input commercialization is significantly influenced by age of household head, sex of household head, family labor, education attainment, farming experience, size of area cultivated with lychee, extension services access, and type of household. The greater number of significant variables could be due to a bigger sample size when all farmers were considered in the model.

For the type of household (HH type), the positive and significant coefficient at 1% probability level suggests that degree of input commercialization of the non-poor lychee farmers was greater than that of the poor lychee farmers. This could be attributed to the difference in farm investments between the two farmer groups. The value of coefficient of household type was 19.4577 which means that the degree of input commercialization among non-poor households is higher by 19.4% than among poor households.

### **Yield performance of poor and non-poor lychee farmers**

Results of this study show that non-poor farmers who have higher degree of input commercialization obtained higher lychee yields than the poor farmers. The yield difference between the two farmer groups is statistically significant at 1% probability level on per hectare basis and at 5% probability level on per tree basis. The difference in yields between the groups could be attributed to difference in the level of input application. Use of inputs which include hired labor, fertilizer and chemical pesticide was higher among non-poor farmers than poor farmers as shown earlier. Moreover, non-poor farmers have higher educational level and have more access to updated extension services and information

**Table 6.** Yield performance of poor and non-poor lychee farmers, Luc Ngan district, Bac Giang province, Vietnam, 2013.

Item	Production (kg/farm)	Area planted (ha/farm)	Number of bearing (trees/farm)	Yield	
				kg/ha	kg/tree
Poor farmers	3,273	0.35	98	9,352	33.31
Non-poor farmers	9,524	0.85	246	11,205	38.74
Difference	6,251***	0.50***	148***	1,853***	5.43**

Note: \*\*\* and \*\* are statistically significant at 1% and 5% probability level, T-test.

Source: Survey result, 2014

### **Profit performance of poor and non-poor lychee farmers**

Profit is computed as the difference between the total revenue and total cost expended on producing the crop. Therefore, profit is determined by farm yield, price of lychee and total cost in this study. If farmers have good quality of lychee, they will be able to sell their product at higher price.

Non-poor farmers participated more in input market compared to poor farmers. They also got greater yield of lychee. Therefore, their net income or profit is bigger than poor farmers' profit even though they incurred higher total cost (Table 7).

The profit per ha and per farm of the non-poor farmers was also higher than that of the poor lychee farmers. The difference in profit between the groups is about 41,086 thousand VND on per hectare basis and 63,707 thousand VND on per farm basis. This is significant at 1% probability level.

**Table 7.** Profit performance of poor and non-poor lychee farmers, Luc Ngan district, Bac Giang province, Vietnam, 2013.

Item	Poor Farmers (n=31)		Non – poor farmers (n=134)		Difference	
	1000 VND/ha (a)	1000 VND/farm (b)	1000 VND/ha (c)	1000 VND/farm (d)	(a-c)	(b-d)
Minimum	7,875	2,707	19,113	11,596	-	-
Maximum	107,144	46,435	152,599	226,678	-	-
Average	47,991	14,134	89,077	77,841	41,086***	63,707***

Note: \*\*\* is statistically significant at 1% probability level. T-test.

Source: Survey result, 2014

## CONCLUSION AND RECOMMENDATIONS

Poor households have lower degree of input commercialization than non-poor households, with commercialization index of 25.42% and 46.39%, respectively. The degree of input commercialization of poor farmers was influenced by sex of household head, family labor, farm size, credit access, and price of chemical fertilizer. Non-poor farmers have higher crop yield than poor farmers, with 11,205 kg/ha and 9,352 kg/ha, respectively. Their farm profit is also higher than that of poor farmers.

The following are the recommendations to increase the poor farmers' participation in input market. Firstly, to improve credit access has a positive and significant influence on the degree of poor farmers' input commercialization. However, for most small farmers, access to credit amount is limited and the bank procedures are complicated. To meet their capital requirement for lychee production, the government as well as credit agencies should consider improving the support given to poor farmers. A more simplified approach of accessing credit and bigger credit amount could allow farmers to purchase more inputs. Secondly, poor farmers have limited access to extension services. Many of the poor farmers did not know and participate in lychee training courses. Therefore, the Provincial and District Centers for Agriculture Extension should provide extensive training courses for farmers, especially the poor. And lastly, the government should improve the input distribution network to ensure that farmers are able to use quality inputs at lower prices. The input distribution system in Bac Giang is still not adequate (Le, 2012). Prices of inputs such as fertilizers, pesticide, and chemicals are still high. In addition, the farmers are not sure about the quality of inputs.

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