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Factors influencing farmers' decision to convert to organic tea cultivation in the mountainous areas of northern Vietnam

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Abstract Using a logistic regression model, this study examines those factors affecting the decision made by farmers to convert from conventional to organic tea production activities in the mountainous areas of northern Vietnam. Data were collected from a household survey conducted among 181 organic and 195 conventional tea-producing households in the provinces of Thai Nguyen and Ha Giang. The results of this survey reveal that farm size, participation in training programs, access to credit, access to extension services, technology support, and market access had a positive impact on the adoption of organic farming methods. For the novice organic tea farmers living in this relatively undeveloped region, one with high poverty levels, economic motives played an important role in the decision to convert to organic practices. Although the tea farmers had a good awareness of the health and environmental benefits brought by organic farming practices, this had so far not led to conversion on a large scale. Therefore, in order to expand organic tea production activities in northern Vietnam, it will be necessary to improve tea farmers' knowledge of organic farming, and also show them the potential economic benefits to be brought by organic farming over the longer term. Besides, the Vietnamese government should create the conditions and policy environment needed to promote the expansion of organic tea production activities.

Keywords Organic farming · Adoption · Tea production · Logistic regression · Farm households

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Introduction

The intensive use of agrochemicals under conventional agricultural management systems has had a negative impact on the natural resource base, and also on human health globally. Therefore, drastic changes in the global agricultural food system are needed to achieve a more sustainable form of agriculture, one that can provide healthy food for consumers while at the same time protect the environment and safeguard animal welfare. It has been suggested that organic agriculture can make a significant contribution to sustainable food production systems (Azadi et al. 2011; Läpple and Kelley 2013; Thamaga-Chitja and Hendriks 2008), and such agriculture has expanded rapidly due to increasing consumer demand for organic products. From 1999 to 2016, the land area under organic agricultural management increased over fifth-fold, from 11.0 million hectares (ha) to 57.8 million ha (FiBL and IFOAM 2018). Organic agriculture in developing countries has so far been carried out mainly for the export market; however, there has been a domestic increase in demand for organic foods in these countries in recent years, due to increasing consumer concerns over food safety (FiBL and IFOAM 2015).

Over the past few years, Vietnam has experienced a rapid growth in the amount of land under organic agriculture, and is currently among the top six countries in Asia in that category. In 2016, 53,348 ha of land under organic farming was reported, compared with just 12,622 ha in 2008. However, the area under organic management still remains relatively small, accounting for only 0.5% of the country's agricultural land, and with only 8365 organic producers reported in 2016 (FiBL and IFOAM 2018). Despite the early emergence of organic agriculture in Vietnam in the late 1990s, this sector has only started to receive attention in recent years, mainly due to an increase in consumer awareness regarding food safety issues (Faltmann 2019). At the moment, Vietnam lacks the legislative framework needed to support organic farming. The country has national organic standards, as issued by the Ministry of Agricultural and Rural Development in 2006, but there have been no national guidelines developed or published on how to grant domestic organic certification, and there is no supervision of the quality of organic produce.

Vietnam is the fifth largest tea exporter in the world after Kenya, China, Sri Lanka, and India (FAO 2015). Tea is grown in 39 provinces, though tea-growing areas are mainly concentrated in Lam Dong province and in the northern midland and mountainous regions, covering a total area of 129,300 ha in 2017 (GSO 2018). Tea production has become a key part of the socio-economic development strategies in these regions. Vietnamese tea exports were valued at more than US$235 million in 2014, accounting for 4.73% of the total value of agricultural exports from the country (UNCOMTRADE 2016). However, Vietnamese tea is mainly exported as a raw product, and its prices fluctuate. Also, international health and safety requirements create barriers to entry, and these hamper the export of Vietnamese tea to developed countries, due to its high levels of pesticide residue. Organic production could, therefore, provide a promising way to increase tea exports from Vietnam.

Although the northern midland and mountainous region has natural conditions which favor the growing of organic tea, such as a tropical climate and suitable soil, and organic tea production is supported by the Vietnamese government as well as by international and national organizations, a large number of tea farmers hesitate to adopt organic production methods, that is, they are reluctant to abandon their reliance on chemical pesticides and fertilizers and adopt safer but lower yield practices as they have been using such chemicals for a long time. Some of those farmers who previously adopted organic tea farming have even returned to conventional production methods after a few years, despite improved producer and customer awareness of the adverse environmental and health impacts of using agrochemicals in recent years. Therefore, it is essential to understand what motivates tea farmers in Vietnam and the key factors influencing their adoption or otherwise of organic farming practices, including the barriers or challenges they face in relation to their conversion.

Numerous empirical studies have been carried out into organic farming practices and those factors affecting farmers' conversion to them (Cranfield et al. 2010; Koesling et al. 2008; Läpple and Kelley 2013; Ramesh et al. 2005). However, according to Thamaga-Chitja and Hendriks (2008), factors such as the policy environment, farmers' financial resources, subsidies for farmers, access to markets, access to extension services, and consumer demand play different roles in facilitating farmers' conversion to organic production in developed and developing countries. These factors also vary across countries and regions depending on socio-economic, cultural, political, and environmental conditions. Some authors have even produced contradictory results regarding the role these factors play in farmers' decisions to switch to organic farming (as stated in Cranfield et al. 2010). Some of these previous studies have only focused on motivational factors related to farmers' levels of awareness and views on organic farming, while others have used qualitative analysis, principal component analysis (PCA) or discriminant analysis (Cranfield et al. 2010; Karki et al. 2011) to understand why farmers adopt organic farming. These methods have partly identified those factors affecting conversion, but have not statistically identified and quantified the relationship between them and the conversion itself. Using a logistic regression model, this study aims to shed light on those key factors affecting farmers' decision to convert to organic tea production in the mountainous areas of northern Vietnam, incorporating factors such as the tea farmers' perceptions. Understanding the tea farmers' adoption behavior and those factors that drive their adoption may help create the conditions and policy environment needed to facilitate the expansion of organic tea production in Vietnam.

Literature review

Organic agriculture is a complex innovation which requires significant change to occur on the part of the farmer (Padel 2001). Farmers convert to organic production not only for farming related and personal motives but also to achieve a mixture of financial and non-financial goals. While early organic farmers were more strongly motivated by husbandry problems and religious concerns, more recent entrants have tended to be more concerned about the environment (Läpple and Rensburg 2011) and gaining economic benefits (Flaten et al. 2005), and so consider organic agriculture to be a professional challenge (Padel 2001). Most studies conducted in developed countries show that farmers' decisions to convert to organic production are motivated by economic factors such as subsidies (Daugbjerg et al. 2011; Flaten et al. 2005; Padel 2001; Pietola and Lansink 2001; Uematsu and Mishra 2012), market access and consumer demand (Lamine and Bellon 2009; Seppänen and Helenius 2004), the higher profit levels associated with organic farming practices (Rigby et al. 2001), and non-economic factors such as land stewardship, environmental attitudes (Läpple and Rensburg 2011; Mzoughi 2011), and social acceptance (Läpple and Kelley 2013). Koesling et al. (2008) also proved that non-economic factors can play an important role in a farmer's conversion to organic farming. One study conducted in Canada by Cranfield et al. reported health concerns and environmental issues as the predominant motives for conversion to organic farming methods, while economic motives were found to be of lesser importance.

Some authors have found that organic farmers typically run smaller farms (Chouichom and Yamao 2010; Padel 2001; Rigby et al. 2001), are younger and better educated, but also have less farming experience than their conventional counterparts (Koesling et al. 2008). Studies in Nepal, Uganda, and Bangladesh have shown that organic farms are larger than conventional ones, as the adoption of new production methods requires significant capital investment, and only larger scale farmers can afford to pay for such production costs, as well as for the relevant organic certification (Bolwig et al. 2009; Karki et al. 2011; Sarker and Itohara 2008). The roles of access to extension services and membership of producer associations were also discussed by Karki et al. (2011), who examined the motivation behind farmers' conversion to organic farming. As Karki et al. (2011) concluded that in developed countries, subsidies for farmers and market access are important incentives to convert to organic agriculture.

These conditions and motivations are different in developing countries. Wollni and Andersson (2014) showed that social conformity concerns, information availability, and productivity spillovers play an important role in the adoption decisions of Honduran farmers. Pornpratansombat et al. (2011) revealed the crucial position of production and consumption conditions such as water accessibility and farm gate price, and also attitudes toward conventional production problems, among Thai organic farmers in deciding whether or not to convert. Critical factors favoring the growth of organic production are often absent in developing countries, such as in Africa where Thamaga-Chitja and Hendriks (2008) found there to be a lack of policy and marketing channels, and in Nepal according to a study by Karki et al. (2011), who found there to be a lack of support for farmers' institutions.

In summary, the decision to convert to organic farming is a complex one, and is affected by personal motivations as well as external factors. In fact, those factors prompting farmers' conversion to organic farming can be divided into five groups: (i) households' demographic and socio-economic characteristics, (ii) environmental and health/safety concerns, (iii) awareness of the economic benefits, (iv) factors related to beliefs, and (v) policy factors. In developed countries, perceptions related to health and the environment are likely to be more important, while economic-related factors play a more important role in developing countries.

Materials and methods

Data collection

Primary data were collected by a household survey conducted in 2016. The household survey covered 181 organic and 195 conventional tea-producing households in Thai Nguyen and Ha Giang, the two largest provinces in terms of tea production and output in northern Vietnam. The total tea-producing area of Thai Nguyen province was 22,027 ha with the fresh tea output of 230,903 tons (Thai Nguyen Statistics Office 2019), while those figures of Ha Giang province were 20,810 ha and 71,780 tons, respectively (Ha Giang Statistics Office 2019). The area of land under certified organic

management in Thai Nguyen province was over 2000 ha and was 7153 ha for Ha Giang province. To ensure the credibility and representativeness, in each province, two largest districts in terms of tea-producing area were selected as the study area and then in each district, two communes with largest number of tea-producing households were selected. In each commune, 40–50 tea-producing households were randomly selected. In the questionnaire, we designed questions to capture the households' demographic characteristics, assets, perceptions, and government supports. To assess the householders' perceptions on health, the environment and the economic benefits of organic production, we used a set of 12 questions with five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5) constructed from the existing literature. A five-point Likert scale (very bad = 1, bad = 2, medium = 3, good = 4, very good = 5) was also used to assess the householders' views on the support given by the government, and their level of access to credit and the market. Besides, large and heterogeneous group discussions were conducted to gain a deeper insight into the motives behind and problems faced when converting to organic production.

Model

In order to quantify those factors affecting the farmers' decisions to switch from conventional to organic tea production, we employed a logistic regression approach which has been used in some empirical studies to address the similar problems (Noorhosseini-Niyaki and Allahyari 2012; Thapa and Rattanasuteerakul 2011). To do this, the dependent variable was set as the conversion to organic tea production, as follows: the dependent variable y_1 was dichotomized with a value of 1 if a household had adopted organic production and 0 if it had not. Therefore, the expected value of y would be as follows:

$$p = P(y_i = 1|x_i) \tag{1}$$

where p is the probability that a household will adopt organic production activities given the independent variables (x_{1i}, x_{2i}, …, x_{ni}). For the logit model, the probability that a household would adopt organic production ($y_i = 1$) was set as follows:

$$p_i = \frac{e^{(\alpha+\beta x_i)}}{e^{(\alpha+\beta x_i)}+1} = \frac{1}{e^{-(\alpha+\beta x_i)}+1} \tag{2}$$

The probability that a household would not adopt organic production($y_i = 0$) was as follow:

$$1-p_i = \frac{e^{-(\alpha+\beta x_i)}}{e^{-(\alpha+\beta x_i)}+1} = \frac{1}{e^{(\alpha+\beta x_i)}+1} \tag{3}$$

where β is the parameter to be estimated. Therefore, one could write the following:

$$\frac{p_i}{1-p_i} = \frac{1+e^{(\alpha+\beta x_i)}}{1+e^{-(\alpha+\beta x_i)}} \tag{4}$$

For the purpose of estimation, the logistic regression model was transformed, leading to the following equation:

$$L_i = \ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta x_i \tag{5}$$

The independent variables were grouped into two categories, these being (i) the demographic and socio-economic characteristics of the households, and (ii) their perceptions of organic production. The demographic and socio-economic characteristics of the households were comprised of the land area set aside for tea cultivation, the number of working adults, the gender, age, and education level of the household head, participation in training programs, ethnicity and tea farming experience. The households' perceptions of organic production consisted of financial support, technological support, extension service support, and market access.

Before using the maximum livelihood estimation (MLE) to estimate the model, we employed exploratory factor analysis (EFA) with a varimax rotation to pool and reduce the number of variables to a smaller number of factors, those which would determine the tea farmers' perceptions related to organic tea production (Hair et al. 2010).

Results and discussions

Characteristics of the conventional and organic tea-producing households

The characteristics of the studied organic and conventional tea-producing households are shown in Table 1. The mean scores and standard deviations for the two

groups are reported, along with the results of the *t* tests carried out. In the mountainous areas of northern Vietnam, most tea is grown by small-scale farmers who sell directly at the market or sell to a tea processing company. For these farmers, tea cultivation is the main source of income. Farmers also cultivate crops such as rice, and fruit and vegetables, plus raise animals. However, these latter activities contribute only a small amount to their total incomes. In the study area, both the conventional and organic farmer groups were populated by smallholders with an average tea cultivating area of only 0.27 ha and 0.89 ha respectively, meaning that the average amount of land given over to conventional tea cultivation was around a third of that used by the organic farmers. The average age of the farmers who undertook conventional farming was 45, whereas the organic farmers were significantly younger. Compared with other regions of the country, members of both household groups had a low level of education (8 years in education for the conventional farming households and 6 years the organic farming households). The ratio of organic households which participated in organic agriculture training programs was 0.90, while for the conventional farming households it was 0.57. This ratio was high for both groups because famers in the region had equal right to participate in the training programs. Both the conventional and organic farming households had average experience of more than 18 years growing tea.

Furthermore, the descriptive results in Table 1 show that more than 81% of conventional farming households belonged to the Kinh ethnic group, the majority group in Vietnam, whereas only 35% of organic farming households were Kinh. Access to credit, technology support, extension services, and market access were shown to be statistically different at a 1% level between the conventional and organic farming groups. This finding is consistent with previous studies into the adoption of organic production methods (Koesling et al. 2008; Wollni and Andersson 2014).

It should be noted that organic farming had a positive relationship with livestock production volumes, as shown by the finding that the average number of farm animals owned by the organic farming households was 3.79 tropical livestock units (TLUs), while the number owned by the conventional farming households was lower at 2.85 TLUs. During the group discussions and the individual interviews, farmers indicated that converting to organic farming encouraged households to expand their livestock rearing activities, because livestock manure was used as a key source of nutrients for the tea plants. However, we did not find any significant differences in household size, farm labor numbers, genders of the household head or tea farming experience between the conventional and organic tea farming households.

Tea-producing households' perceptions on organic farming

The households' perceptions of the major environmental, health- and economic issues-related to organic farming are shown in Table 2. The results indicate that both groups were acutely aware of the health and environmental issues, as well as the export opportunities and economic benefits to flow from organic farming. The mean scores shown in the table for all the items were greater than 3.3, and in particular, those items related to health and environmental issues came out at 4.5 or more, though there were slight differences between the perceptions held by the two groups. However, the organic households could be seen to be more economically motivated, as they rated economic items significantly higher than the conventional farm households. These items include "greater export opportunities," "higher demand from developed countries," households can easily sign a contract with a tea company which commits to purchasing all their output', "higher prices" and "higher incomes."

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to test the partial correlation among perception items (perception variables), and Bartlett's sphericity test was used to test the null hypothesis; that the correlation matrix was an identity matrix. The KMO index result was 0.835 and Bartlett's sphericity test was found to be significant (p value = 0.000), indicating that exploratory factor analysis, or EFA, was suitable and that the 12 perception items could be factorized appropriately. The results of the EFA are shown in Table 3. As a number of factors are identified based on eigen values greater than one, we determined two factors. All the items under these factors had factor loadings greater than 0.6, except the last one "reduction in input costs." Factor 1, named "Perceptions of economic benefits and a positive market outlook from organic production," included the five items related to "export opportunities," "secure market," "sales contract," "higher prices," and "higher incomes." Factor 2, named "Perceptions of health and environmental

Table 1 Descriptive statistics for the sample of conventional and organic tea-producing households in northern Vietnam

Variable	Explanation	Conventional farming households	Organic farming households	Organic as % of conventional
Upland area used for tea cultivation	Hectares	0.267 (0.198)	0.894 (1.206)	234.8***
Household size	Persons	3.836 (1.060)	3.975 (1.064)	3.6
Farm labor supply	Number of working adults	2.795 (0.972)	2.900 (1.111)	3.8
Gender of household head	Male = 1; female = 0	0.875 (0.250)	0.884 (0.269)	1.0
Age of household head	Years	44.728 (9.806)	42.382 (10.923)	−5.2**
Education level of household head	Number of years of formal education	7.589 (2.250)	6.113 (4.021)	−19.4***
Participation in training programs	Dummy variable used to show whether the household head has participated in organic farming training programs (yes = 1; no = 0)	0.573 (0.391)	0.901 (0.327)	57.2***
Ethnicity	Dummy variable used to show whether the household head belongs to an ethnic minority group (Kinh group = 1; other ethnic minority group = 0)	0.814 (0.231)	0.345 (0.502)	−57.6***
Tea farming experience	Number of years spent cultivating tea	19.582 (9.068)	18.921 (11.327)	−3.3
Access to credit	Five-point scale	3.093 (0.931)	4.019 (0.886)	29.9***
Access to technological support	As above	3.535 (0.806)	3.865 (0.838)	9.3***
Access to extension service support	As above	3.597 (0.823)	3.918 (0.861)	8.9***
Market access	As above	3.323 (0.847)	4.141 (0.720)	24.6***
Farm animals (TLUs)	Tropical livestock units (TLUs) for East and South East Asia, as based on Chilonda and Otte (2006)	2.854 (5.546)	3.795 (3.972)	33.0**

Average over all households per category. Standard deviations in parentheses. Significance tests refer to a two-sample *t* test of the difference in means: $*P < 0.10$, $**P < 0.05$, $***P < 0.01$

concerns/benefits," consisted of six items associated with "health and environmental concerns" arising from the intensive use of agrochemicals, and the "health and environmental benefits" of carrying out organic production.

Factors affecting farmers' decision to convert to organic production

The logistic regression results for those factors affecting tea farmers' adoption of organic farming techniques are shown in Table 4. From the table, it can be seen that the Cox and Snell R^2 was 0.567, the Cragg and Uhler's R^2 was 0.764, and the Hosmer-Lemeshow test was insignificant ($\chi^2 = 2.98$; p value = 0.9354), indicating that the goodness-of-fit of the logistic regression model was acceptable. As the _hatsq of the Linktest was also not statistically significant (the z-test value was 0.81 with a probability of 0.420), we can say that the link function was properly specified. The values of variation inflation factor (VIF) were below 10 indicating no problem of multicollinearity.

The results revealed a significantly positive relationship between farm size and the adoption of organic production practices. Tea farmers with a larger area of land tended to adopt organic production, possibly

Table 2 Perceptions of the conventional and organic tea-producing households

	Conventional farming households	Organic farming households	Organic as % of conventional
Environmental concerns related to the use of chemicals and fertilizers	4.642 (0.516)	4.508 (0.582)	−2.9***
Producer health concerns related to the use of chemicals and fertilizers	4.721 (0.469)	4.649 (0.579)	−1.5
Consumer health concerns related to the use of chemicals and fertilizers	4.562 (0.548)	4.646 (0.591)	1.8*
Organic production is better for the tea producers' health	4.673 (0.480)	4.643 (0.512)	−0.6
Organic production helps reduce environmental problems	4.774 (3.399)	4.565 (0.636)	−4.4
Organic production is better for consumers' health	4.512 (0.567)	4.596 (0.552)	1.9
Greater export opportunities	3.960 (0.818)	4.304 (0.792)	8.7***
Higher demand from developed countries/More secure markets in developed countries	3.845 (0.873)	4.241 (0.851)	10.3***
Households can easily sign a contract with a tea company, one which commits to purchase all output	3.372 (0.977)	4.009 (1.032)	18.9***
Higher prices	3.686 (0.968)	4.257 (0.979)	15.5***
Higher incomes	3.478 (1.120)	4.273 (0.983)	22.9***
Reduction in input costs	3.420 (1.018)	3.335 (1.340)	−2.5

Average over all households per category. Standard deviations in parentheses. Significance tests refer to a two-sample t test of the difference in means: $*P < 0.10$, $**P < 0.05$, $***P < 0.01$

because such farmers were generally less resource constrained and could afford to dedicate part of their land toward trying new farming methods, while those with smaller amounts of land could not. This finding is supported by the adoption theory or innovation-decision paradigm, which states that farmers with better access to resources (such as capital, income, and land) are more likely to take risk of adopting new technologies (Mignouna et al. 2011). On the other hand, some studies have shown that smaller scale farmers tend to adopt land-saving technologies, so as to increase agricultural production (Mwangi and Kariuki 2015; Yaron et al. 1992). This indicates that farmers with less land have less incentive to adopt organic farming practices, which are considered more land-intensive than conventional methods.

Table 3 EFA results for the perception variables related to organic production

	Economic benefits and market outlook	Environment and health
Environmental concerns related to the use of chemicals and fertilizers	−0.0423	*0.7512*
Producer health concerns related to the use of chemicals and fertilizers	0.0012	*0.7072*
Consumer health concerns related to the use of chemicals and fertilizers	0.2271	*0.7575*
Organic production is better for family health	0.0666	*0.7416*
Organic production is better for consumer health	0.2462	*0.7105*
Organic production helps to reduce environmental problems	0.1972	*0.7586*
More export opportunities	*0.7542*	0.3322
Higher demand from developed countries/More secure markets in developed countries	*0.7817*	0.3106
Households can easily sign a contract with a tea company which commits to purchasing all their output	*0.6891*	−0.0961
Higher prices	*0.8012*	0.8012
Higher incomes	*0.8535*	0.1457
Reduction in input costs	0.4579	−0.0296
Percent of variance explained	***0.2827***	***0.2959***
Eigen value	***2.2471***	***4.6961***

Kaiser-Meyer-Olkin (KMO) index = 0.8351 Bartlett's sphericity test: $\chi^2 = 3136.543$; p value = 0.000. Factor loading > 0.6 is highlighted in italic

Table 4 Logistic results for those factors affecting farmers' conversion to tea organic production

Explanatory variable	Coefficients	Std. error	Z	P value
Upland area for tea cultivation	1.278	0.485	2.63	0.008
Farm labor supply	0.036	0.159	0.22	0.822
Gender of the household head	0.547	0.559	0.98	0.328
Age of the household head	− 0.048	0.024	− 2.04	0.041
Education level of the household head	− 0.189	0.071	− 2.67	0.008
Participation in training programs	0.966	0.403	2.40	0.016
Ethnicity	− 4.309	0.467	− 9.23	0.000
Tea farming experience	0.027	0.021	1.29	0.197
Credit access	0.487	0.209	2.33	0.020
Technology support	0.695	0.256	2.72	0.007
Access to extension services	0.563	0.238	2.37	0.018
Market access	1.322	0.233	5.69	0.000
Perceptions on the environment and health	− 0.035	0.172	− 0.21	0.837
Perceptions on economic benefits and market outlook	0.374	0.163	2.29	0.022
Constant	2.322	1.638	1.42	0.156
Number of observations	376			
Prob > χ^2	0.0000			
Predicted probability	58.53%			
Hosmer-Lemeshow test	$\chi^2 = 2.98$, p value = 0.9354			
Linktest (_hatsq)	$z = 0.81$, p value = 0.420			
Cox and Snell R^2 (maximum likelihood R^2)	0.567			
Cragg and Uhler's, R^2	0.764			
Minimum value of VIF	1.13			
Maximum value of VIF	2.75			

The results also suggest that age negatively affected the decision to convert, meaning younger tea farmers were more likely to adopt organic farming methods, as a form of innovation. According to the theory of diffusion of innovation, young farmers tend to be adopters, that is, they are more willing to take risks and try-out new technologies (Adesina and Zinnah 1993; Feder and Umali 1993).

Those tea farmers with better access to credit were more likely to convert to organic farming. Discussions with the conventional and organic tea farmers also suggested that a lack of financial capital was a constraint to conversion. Organic farmers are generally pointed to earn higher incomes than conventional farmers due to the higher prices they can charge for organic products, plus the potential export opportunities that arise (Thamaga-Chitja and Hendriks 2008). Nevertheless, for the first few years after converting, organic farmers' incomes may decrease due to the high production costs incurred and lower yields generated. Mwangi and Kariuki (2015), when analyzing those factors that determine the adoption of new technologies in developing countries also found that high costs are a constraint to the adoption of agricultural technology. Thus, financial support helps to overcome any financial constraints faced by the tea farmers during the first few years after conversion. Without such financial support, the tea farmers know they will face difficulties and so are reluctant to convert to organic farming.

Participation in training programs on organic agriculture helped tea-producing households gain the technical knowledge they need to cultivate the organic crop. Therefore, training programs, technology support and extension services all played an important role in the tea farmers' adoption of organic production practices. This can be attributed to the fact that those living in the northern upland areas of Vietnam are characterized by a low education level, so farmers are hesitant to adopt

new production methods without the necessary assistance being in place. As a result, training programs as well as extension services provided tea farmers with the knowledge, technical advice, and information they need to adopt organic practices. Nevertheless, as organic farming has only expanded in Vietnam over recent years, the local extension workers themselves often do not have the requisite knowledge and technical skills needed to assist the farmers. Hence, in the future, new extension and assistance programs from both international and national institutions will be needed, so as to encourage farmers to convert to organic agriculture. In addition, it should be noted that the ratio of households participating in organic agriculture training programs was high for both groups (Table 1), indicating that farmers' participation in training programs did not necessarily translate into their decision to convert to organic farming. This is probably because the effectiveness of training programs substantially depends on the attributes of farms and farmers. Besides, training programs in mountainous areas of Vietnam tend to focus on quantity of participants instead of quality of training. Therefore, improvement of quality of training programs to make them more effective is more essential than expansion of these programs.

Table 4 also shows that market access had a significant relationship with the decision to convert to organic production practices. As stated, in the study area, the tea farmers can sell their products directly to individual customers, or sell them to a processing factory, and the organic tea farmers usually sign a contract with a company for the sale of their produce. Therefore, they do not have to worry about how to sell their tea, and their price risk is reduced because contracts often specify the prices they will receive in advance. In the context of a poor infrastructure and the limited access to markets that exists in the region, this can be considered an advantage for the organic farmers, especially the larger ones.

The results show that ethnic minority farmers were more likely to adopt organic production methods than the Kinh farmers. Although the ethnic minority groups generally have long-standing traditional production methods and face problems adopting new technologies due to a lack of capital, low education level, and a lack of knowledge, they also tend to be less conservative in terms of adopting organic farming practices. This can be attributed to the fact that they have a strong sense of group solidarity which promotes adoption, as explored by Karki et al. (2011). The organic certification process is costly, especially if the tea cultivating households apply independently. As a result, the households tend to apply for certification in groups and the strong social cohesion that exists among the ethnic minority communities makes the process easier. Moreover, the ethnic minority farmers tend to be influenced by the herd mentality when making production decisions, meaning that if a farmer applies a new farming method, his neighbors will tend to copy him. This can be seen as a neighborhood effect in the conversion to organic farming. Meanwhile, the Kinh tended to be more cautious when making their production decisions.

According to Hall and Khan (2002), the decision to adopt a new technology is often the result of a comparison between uncertain benefits and uncertain adoption costs, meaning farmers decide to adopt only if they expect the new technology to bring-about a more profitable outcome than the existing situation. It is worth noting that both the conventional and organic tea farmers had a high level of awareness of the health, environmental, export market, and economic benefits of organic production (Table 2); however, based on our survey only direct economic benefits (such as higher prices, higher incomes, and greater market access) were significant determinants of the decision to convert from traditional to organic farming. High levels of awareness regarding environmental and health issues did not necessarily influence the decision to convert to organic farming; for example, awareness of the negative impacts of the intensive use of agrochemicals on the environment and health in isolation was not enough to trigger the decision to convert to organic practices. This is probably due to the fact that in such an undeveloped region, with high rate of poverty, people tended to focus on issues related directly to their living standards, such as household income levels or household welfare improvements, before becoming concerned about wider issues such as the environment and community health protection. Azadi et al. (2011) reported the positive contribution organic farming systems can make in terms of reducing soil degradation, increasing water efficiency and drought resilience, saving energy and increasing resistance to pests, all of which are extremely beneficial outcomes for farmers in developing countries. Therefore, it is very important to help farmers understand that the non-economic benefits of organic farming in terms of the environment can directly and

positively affect their livelihoods over the longer term.

From the group discussions held, we found that tea farmers' conversion to organic farming was also affected by spatial factors. Farmers of organic tea faced problems controlling diseases if the neighboring farms retained conventional practices, as their organic farms were prone to attack from pests which spread from such farms. This can be seen as another neighborhood effect in the decision to convert to organic farming in the region.

Conclusion and policy implications

The findings of this study show that the decision to convert to organic farming is a complex one for tea farmers in the mountainous areas of northern Vietnam, influenced as it is by household characteristics and by a mixture of both economic and non-economic motives. For the novice organic tea farmers in such an undeveloped region, one with high levels of poverty, economic motives played an important role in making such a decision to convert to organic practices, while non-economic factors such as awareness to environmental and health benefits were not directly linked to their decisions to convert. An improvement in tea farmers' level of knowledge of organic farming and their awareness of its long-term benefits is needed and may be carried out through the use of training courses, extension channels, and media communications. Also, as rural areas of Vietnam have strong social cohesion within their communities, farmers are good at sharing information and learning from each other. As a result, the oral transfer of information related to agricultural innovations is sometimes more reliable and effective than the formal channels put in place. For that reason, such informal channels should be taken into consideration when trying to improve tea farmers' knowledge and awareness of organic practices.

Financial support was a key factor underlying farmers' decision of adopting organic farming. However, it is important to mention that financial support alone is not sufficient to induce the conversion to organic farming, as experience from a number of previous innovation projects in the rural areas of Vietnam focused on financial support have shown that farmers generally stop applying new technologies or management practices once the initial project has ended. Therefore, as well as financial support, the government should formulate policies and measures aimed at creating conditions favorable to the expansion of organic production practices, including those related to the supply of inputs and production services, the introduction of appropriate technology and skills, and the provision of reasonable prices and of access to stable markets. Moreover, an efficient certification and control system for organic products is needed. Note that receiving a higher return has been reported as the predominant motivation behind the adoption of organic practices, but that consumers are only willing to pay higher prices if the organic products have been certified. In Vietnam, a certification and control system for organic products has not been developed and consumers; therefore, have difficulty identifying real organic products and distinguishing between organic products and so-called clean products. Hence, the role of the government in granting domestic organic certification and controlling quality of organic products is vital.

The results also reveal that farm size, and the education level, age, and ethnicity of household members, had a strong and significant influence on tea farmers' decision to adopt organic farming practices. Policymakers should, therefore, take into account these factors when designing policy instruments aimed at encouraging the expansion of organic farming. Especially due to the neighborhood effects identified in this study, the Vietnamese government should evaluate the feasibility of developing organic tea farming in each area, and then set up organic tea zones, instead of the current, spontaneous process, which leads to the formation of small holdings only.

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