GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

GlobalFood
www.uni-goettingen.de/globalfood

RTG 1666 GlobalFood

Transformation of Global Agri-Food Systems:
Trends, Driving Forces, and Implications for Developing Countries

University of Goettingen

GlobalFood Discussion Papers

No. 105

Determinants of Specialty Rice Adoption by Smallholder Farmers in the Red River Delta of Vietnam

Thai Thuy Pham
The Anh Dao
Ludwig Theuvsen

August 2017

RTG 1666 GlobalFood · Heinrich Düker Weg 12 · 37073 Göttingen · Germany
www.uni-goettingen.de/globalfood

ISSN (2192-3248)

Suggested Citation:

Pham, T.T., T.A. Dao, L. Theuvsen. (2017). Determinants of Specialty Rice Adoption by Smallholder Farmers in the Red River Delta of Vietnam. GlobalFood Discussion Paper 105, University of Goettingen. http://www.uni-goettingen.de/de/213486.html.

Determinants of Specialty Rice Adoption by Smallholder Farmers in the Red River Delta of Vietnam

THAI THUY PHAM [1*], THE ANH DAO [2], LUDWIG THEUVSEN [3],

[1] *GlobalFood Research Training Group (RTG 166), Georg-August-University of Goettingen, Germany;*
Faculty of Economics and Business Administration, Hung Vuong University, Phu Tho, Vietnam
[2] *Center for Agrarian systems research and development, Field Crops Research Institute, Hanoi, Vietnam*
[3] *Department of Agricultural Economics and Rural Development, Georg-August-University of Goettingen, Germany.*

**Corresponding author:*
Address: Nong Trang, Viet Tri, Phu Tho, Vietnam; E-mail: phamthaithuy2013@gmail.com

Abstract

This study addresses factors influencing the adoption of specialty rice variety among smallholder farmers in Vietnam. We used a sample of 336 farmers from the Red River Delta who were interviewed between October and December 2014. We follow the adoption behavior model based on the utility maximization criterion and adopt a two-step approach, starting with a Probit model for determinants of specialty rice adoption before analyzing the intensity of adoption using a Tobit model. Overall, 50% of the probability of specialty rice adoption is explained by the selected independent variables such as: cultivated land, experience in growing rice, and network size. Tobit model estimates show that group membership (such as in agricultural cooperatives, farmer's union, etc.) and possession of a two-wheel-tractor increase the share of land allocation to specialty rice production by 3.4% and 7.8% respectively. Based on the findings manifold social and political implications will be derived.

Keywords: Specialty Rice; Adoption; Smallholder Farmers; Network Size; Red River Delta
JEL classification: O30, Q16, R20

Acknowledgement

The financial support to this research received from the German Research Foundation (DFG) through the GlobalFood Research Training Group (RTG 1666), the Stiftung Fiat Panis, the Göttingen Graduate School of Social Sciences (GGG). Thai Thuy Pham also acknowledges

the financial support received from the Vietnamese Government for his doctoral studies. The authors are also grateful to the Center for Agrarian Systems Research and Development (CASRAD), the Rural Development Center (RUDEC/IPSARD), and the Hung Vuong University (HVU) for their support in fieldwork coordination. The authors take full responsibility for all remaining errors.

A shorter version of this paper has been published in the conference proceedings - *The Agrarian Perspectives XXV – "Global and European Challenges for Food Production, Agribusiness and the Rural Economy"*, Prague, Czech Republic, September 14-16, 2016, pp. 259-67

1. Introduction

Rice production plays a key role in the agricultural development of many developing countries, especially in the rice economies of the Association of Southeast Asian Nations (ASEAN) (ADB, 2012; IRRI, 2003). Billions of people around the world rely on rice as a staple food (Coxhead et al., 2012; Giraud, 2013; Muthayya et al., 2014); as a result, focusing on rice production helps to improve food security issues and stabilize economies (Minot and Goletti, 2000). Furthermore, rice production is a crucial source of export earnings for rice economies like Vietnam and Thailand.

Due to increasing consumer wealth coupled with economic growth, demands for rice in terms of food quality and safety is now a global issue (Chaudhary, 2003; Giraud, 2013). Smallholder farmers could raise their incomes by producing specialty rice varieties that are unique in terms of quality and increase their potential for selling to high-value markets. Globally, aromatic rice- one of the most important SR varieties which accounts for 10-15% of world trade, sells at 50% higher price than common rice (Chaudhary, 2003). Producing SR varieties, thus, might be a good tool for reducing poverty and improving livelihoods, and has indeed made great contributions to these ends in many developing countries, such as India, Pakistan, Thailand, the Philippines, and Vietnam (Chaudhary, 2003; Giraud, 2013; Jaenicke et al., 2010; Moustier et al., 2010). As a result, more attention should be paid to the adoption of SR varieties (FAO, 2001).

In addition to the well-known SR varieties such as Jasmine and Basmati rice, less known ones are traditionally grown and harvested in specific geographic regions (Chaudhary, 2003; Giraud, 2009; Ngokkuen and Grote, 2012). These varieties are reviewed alongside special, high-quality rice and marketed under their own brand names. Geographical Indication (GI) label, collective trademarks, and local food systems are now promoted and developed in many developing countries in order to add more value to specialty products (Anh and Sautier, 2011; Coley et al., 2009; Giraud, 2009; Ngokkuen and Grote, 2012). Therefore, there are increasing opportunities for local varieties to reach specialized and high-value markets.

The growth of high-value agricultural and specialty markets presents both opportunities and challenges for small farmers in many developing countries (Gulati et al., 2005). On the one hand, this trend creates opportunities for small farmers to raise their income (Gulati et al., 2005; Jaenicke et al., 2010). Wollni and Zeller (2007), for example, find that farmers who participate in specialty coffee markets achieve higher prices than farmers delivering to traditional markets. On the other hand, such markets are often associated with higher costs of participation and stricter requirements concerning food safety and quality control than are

traditional ones. In many cases, high-value markets do not necessarily refer to international or export markets, as domestic or regional markets still offer potential for specialty agricultural products. For instance, glutinous (sticky) rice, for instance, is most consumed by Laotians, whereas other Asian countries prefer Jasmine rice (Chaudhary, 2003; Jamora and Cramon-Taubadel, 2012). Moreover, consumers in each country are also interested in some varieties that are particular to certain areas. In this respect, SR fulfils the needs of local end-consumers for such high-quality products.

With a significant increase in GDP per capita by an annual 12.73%[1] from 2010-2013, the demand for SR varieties in Vietnam has risen over time (Diaz et al., 2009). In accordance, the government has implemented ambitious programs to protect and develop the many kinds of specialty agricultural products with intellectual property rights such as geographical indication (GI) label and collective trademarks. SR is, thus, a relevant case study for adoption of high-quality agricultural product in developing countries.

Currently, the market for SR in Vietnam is underdeveloped and a lack of transparency in the traditional market means that low-quality rice is often mixed with, and passed off as, SR. Traders and sellers often have more knowledge of product quality than consumers. Rice consumers are increasingly confused and unable to make informed decisions on their SR purchases; thus, they are not willing to pay higher prices for this SR. Nonetheless, there is a raising demand for SR within specialized marketing chains in Vietnam (Moustier et al., 2010). This is a positive development, as this is a good way to stabilize the country's SR market.

With respect to the production aspect of SR varieties, many varieties were replaced by high-yielding rice, due to initial high yields, lower costs of external inputs, and short crop rotation, especially after the "Doi moi[2]" reforms in the late 1980s. As we observed in the RRD region, a large share of rice farmers has given up SR varieties in favor of ordinary ones or other cash crops. Urbanization and industrialization, crop diversifying strategy, small and fragmented land, climate change, and degrading quality of seeds are the main constraints facing the production of SR (Frédéric and Dao, 2005; Jaenicke et al., 2010).

A specialty product usually means superior quality attributes; Basmati and Jasmine rice, for example, are globally recognized as SR and sold on international markets. However, there are hundreds of underdeveloped, under-marketed varieties (FAO, 2001) specific to particular countries or regions but with very high potential for development. As the production of SR is

[1] Calculation from the World Bank data (http://data.worldbank.org/indicator/NY.GDP.PCAP.CD).

[2] "Renovation" is the name of the economic reforms initiated in Vietnam in 1986.

generally tied to traditional culture and knowledge, it is interesting to look at such varieties and examine whether and or why they have been re-adopted recently in developing countries.

From the current body of literature we know that farmers participating in specialty markets are more likely to get higher prices (Brown et al., 2013; Cazzuffi and McKay, 2012; Chaudhary, 2003; Giraud, 2013). Most studies, thus, focus on the adoption of high-value agricultural products related to export markets or hybrid varieties. Nevertheless, there is still insufficient research on specialty markets and how they work for smallholder farmers in developing countries at regional and domestic levels. In such countries, urban consumers are raising the demand for specialty products as their income increase. We fill this gap by introducing a conceptual framework and an ongoing empirical research on the adoption of specialty agricultural production related to social networks. We are not aware of any studies that have analyzed the adoption of specialty products in regional markets characterized by specific preferences. Therefore, this paper addresses an important research gap for the first time in the international literature.

Additionally, the study of social networks has been given more attention in the line of technology adoption in agriculture. Social networks play an important role in adoption decisions of new technologies (Bandiera and Rasul, 2006; Matuschke and Qaim, 2009) whereas its role for farmers' participation in, for instance, modern food supply chains has only rarely been addressed (Herforth, 2015). This paper also analyzes whether a rice farmer's decision to adopt SR depends on his social network. We hypothesize that farmers are more likely to adopt SR when other farmers in their network have adopted SR through sharing experiences and knowledge. To estimate the effect of social networks on individual adoption decision of SR production we use the network size as the main measurement at the village level. Network size is measured by; how many close farmers a household can rely upon should it face financial problems or other hardship.

The aim of this paper is to analyze determinants and intensity of SR adoption in Vietnam. To this end, the paper is organized as follows: the next section is a brief review of the SR sector in the RRD region. Section 3 describes the conceptual framework with selected variable description. Section 4 shows the methodology and estimation strategy. Section 5 provides the results from probit and tobit models. Section 6 presents the discussion. The final section presents conclusions and recommendations for relevant policies.

2. Specialty Rice Production in the Red River Delta

The term "specialty rice" in the international market is currently used to refer to Jasmine rice from Thailand and Basmati rice from either India or Pakistan. Chaudhary (2003) defines varieties of specialty rice as: "… those which are not common". SR is unique in terms of aroma, kernel color, or chemical composition, of which aroma is the most important criterion in classing rice grain quality. Jamora and Cramon-Taubadel (2012) categorize aromatic and glutinous rice as specialty items in particular regions (India and Pakistan, Southeast Asia). The higher SR price is another indicator with which to compare it with normal rice (Moustier et al., 2010; Ngokkuen and Grote, 2012).

Following Chaudhary (2003), the major groups of SR varieties worldwide are: aromatic rice, color rice, red rice, black rice, soft rice, glutinous or waxy rice, nutritional quality rice, and organic rice. Glutinous rice is defined by the International Organization of Standardization as special varieties of rice (Oryza sativa L. glutinosa) the kernels of which have a white and opaque appearance. The starch of glutinous rice consists almost entirely of amylopectin. It has a tendency to stick together after cooking (ISO, 2011).

In our paper, we use the term "specialty rice" to refer to glutinous varieties, sometimes also called "sticky," "sweet," or "waxy" rice (Chaudhary, 2003), which grow mainly in Southeast and East Asia, e.g., in Laos, Thailand, and Vietnam. In our study, SR primarily focuses on national and regional markets in order to meet local consumers' demands and preferences. In essence, glutinous rice is a traditional variety that has been upgraded in terms of seed quality due to development programs in recent years (Jaenicke et al., 2010). For this study, any farmer that does not cultivate SR seed variety was not considered as an adopter of SR production.

Vietnam is the second largest rice exporting country in the world behind Thailand (FAO, 2006). The vast majority of rice exported is low and medium quality, making the Vietnamese rice cheaper than that of rivals (Jamora and Cramon-Taubadel, 2012; Nguyen and Baldeo, 2006; Nielsen, 2003). The percentage of glutinous rice in total export volume in 2011 was approximately 3% (Giraud, 2013); to be competitive in the rice market, the country must focus on the development of high-quality and specialty rice (Nguyen and Baldeo, 2006).

The harvested rice area, production, export volume, and yield per hectare in Vietnam (1986-2013) are shown in Figure 1.

The harvested area and rice yield had increased gradually during the period of 1986-2013. This is also due to the process of renovation or "Doi moi" that was implemented in the late 1980s. In 2013, 7.9 mil. ha were harvested with an average yield of 5.57 tons/ha, producing

approximately 44 mil. tons of rice (FAOSTAT, 2015; GSO, 2014). Vietnam is currently projected to export around 6.5 million tons per year by 2015.

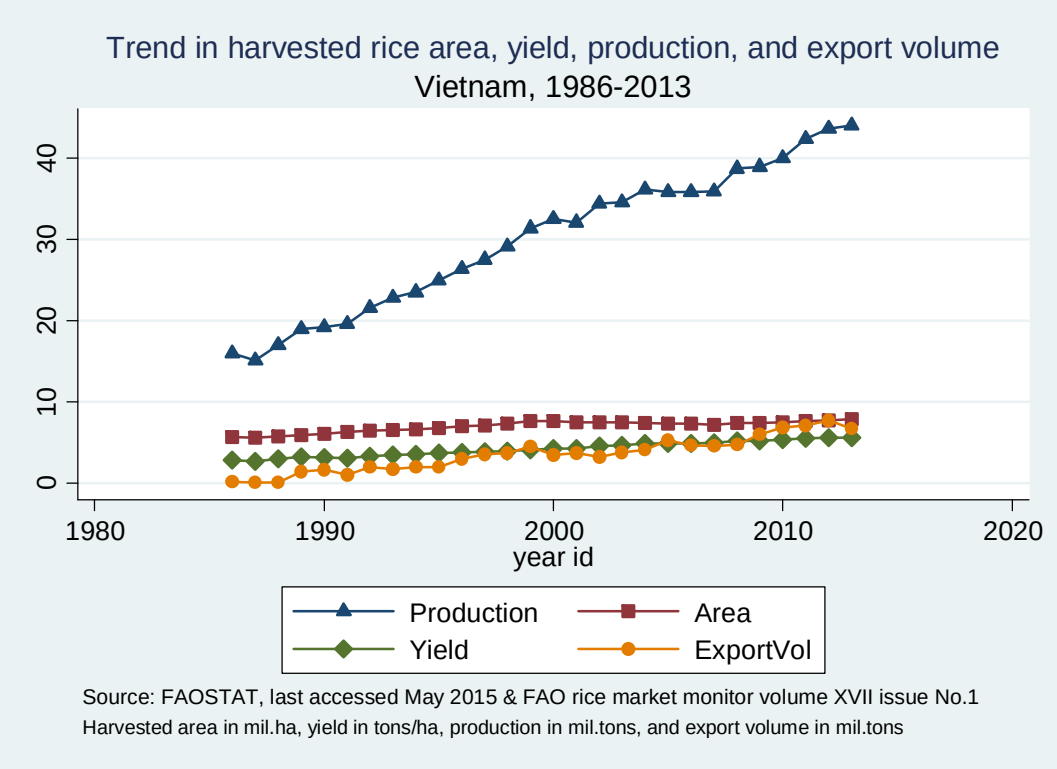


Figure 1. Harvested rice area, yield, production, and export quantity

To foster high-quality rice varieties and commercialize SR production for domestic and export markets, several policies have already been implemented in support of small farmers, such as the branding of Vietnamese rice, the reduction of pre- and post-harvest losses, the attention to climate change (e.g. climate change adaptation and low carbon emission measures in rice production), and improvement of soil fertility (Nielsen, 2003).

Income growth, urbanization, and other socioeconomic transformations have affected the consumption of and preferences for foodstuffs, including rice. Overall, rice consumption per capita in Vietnam has been on a downward trend since 2000 (see Appendix 1). Consumers are buying less of it while simultaneously demanding higher quality products. This trend leads farmers to produce more high-quality rice for urban consumers. Indeed, the majority of Vietnamese people do not use glutinous rice as a main food, but they often use it for special occasions, such as making cakes or ceremonial dishes, or as a valuable gift that farmers give to their relatives. SR has thus essentially become a very important source of cash income for rice farmers.

The Red River Delta (RRD) has a long history of rice production, and, as one of two main rice production regions in Vietnam, most of its agricultural land is allocated to rice

cultivation. The region has numerous rice varieties, many of which are protected by the Vietnamese government under a collective mark, certified mark, and or a geographical indication (see Appendix 2).

Among the SR varieties, Hoa vang glutinous rice is most popular for its quality. Grown mainly in Northern Vietnam (e.g., Hai Duong, Quang Ninh, Thai Binh, and Bac Ninh provinces), it is a long-term variety with a growing time of around 145-150 days. Farmers sell the majority of their surplus rice to the domestic traditional markets in Hanoi, Hai Phong, and Quang Ninh, the RRD's three largest cities.

Some previous research (Jaenicke et al., 2010; Moustier et al., 2010) has noted the area of SR production has decreased in recent years due to the impacts of industrialization and urbanization. The Hoa vang glutinous rice in particular must compete with ordinary varieties in the region. Jaenicke et al. (2010) find that the area of SR before 1986 was much higher than at present. To meet the consumers' current demands, the government has tried to expand the SR area by investing more in infrastructure, improvement of traditional seeds and new cultivation practices.

3. Conceptual Framework

In the conceptual framework, we follow the model of adoption behavior put forth by Rahm and Huffman (1984). In their model, farmers' adoption decisions are assumed to be based on the objective of utility maximization. In our case, the decision by small farmers to adopt SR is covered by the household adoption model; their goal is to maximize the utility (U), which is obtained from the SR adoption but depends on both vector R_i of farm and farmer characteristics, and vector A_i of the attributes associated with SR adoption. The utility function will be described in the following section.

This conceptual framework is well-known in the existing literature (Feder et al., 1982) and has been applied in recent adoption studies (Adedeji et al., 2013; Kijima and Sserunkuuma, 2013; Ngokkuen and Grote, 2012; Wollni and Zeller, 2007). For instance, Adedeji et al. (2013) and Kijima et al. (2008) look at the adoption of new rice varieties in Nigeria and Uganda, respectively. In addition, the conceptual framework refers to the diversification strategy of small farms in developing countries where, due to land constraints, farmers attempt to diversify their activities in order to improve their standard of living.

In previous studies, the adoption of rice varieties has been analyzed via a focus on high-yielding varieties (HYV) and new technologies in rice sector. In recent decades, many kinds of traditional varieties have been replaced by hybrid ones in order to ensure food security and caloric intake (IRRI, 2003; Mottaleb et al., 2015; Nguyen and Baldeo, 2006). Lin (1991)

found that education has a positive effect on the F1 hybrid rice varieties in China. In the case of Bangladesh, Mottaleb et al. (2015) noted that a number of factors (e.g., loan facilities, road access, irrigation facilities, and seed dealers) have significant influence on the adoption of hybrid varieties.

The conceptual framework and literature review suggest that a number of institutional and circumstantial factors significantly influence the adoption process, including farm experience (Kijima and Sserunkuuma, 2013), access to extension services (Moser and Barrett, 2006; Ngokkuen and Grote, 2012), capital resources (Feder et al., 1982), and the social network (Matuschke and Qaim, 2009; Moser and Barrett, 2006).

For our study, we divided the analysis of SR adoption into two separate parts. The first part is the decision to adopt SR, which may be influenced by individual or household specific factors such as risks, profitability, social networks, and farmer/farm characteristics (see Figure 2). In the second part, rice farmers decide how much cultivated land they allocate to SR production, a decision that also depends on their attitude towards their diversification strategy and those factors mentioned above.

In addition, individual factors that influence SR production are divided into two main groups. Following these chosen variables, we analyze those factors with a positive and negative impact on the participation of small farmers in the production of SR.

SR may have dramatically higher price and returns but may also be more sensitive to flooding and diseases. Market price fluctuation is another common source of uncertainty, though the relationship between domestic price and farm gate price. Many rice farmers prefer approaches with lower average returns but more reliability to approaches with higher returns, and more risks. Adoption of SR varieties may be seen as risky, as they are long-term varieties. In RRD region, SR is considered as a cash crop, so in this case farm gate price in the long-term can be one factor that influences SR adoption.

Adoption of any agricultural innovation such as technology adoption or improved varieties adoption depends on the profitability. Profitability of SR production is influenced by economic and social factors, for instance farm gate price, production costs, productivity, farm characteristics, social network, and farm characteristics. Previous studies highlights the profitability of any production systems is much more a function of farm management skills than lower input costs (Batie and Taylor, 1989).

Measuring network size

An analysis of social network and social capital has been widely applied in agricultural innovation studies (Hoang et al., 2006; Maertens and Barrett, 2013; Marsden, 1990;

Matuschke and Qaim, 2009; Wossen et al., 2015). Smallholder farmers often use social networks to obtain information, solve problems, exchange knowledge, and gain social support. Matuschke and Qaim (2009) found that social networks play a crucial role in the decision to adopt innovation as well as the adoption intensity of hybrid seed in India. Recently, Wossen et al. (2015) highlighted that social capital significantly influences technology adoption.

There are many aspects with which to measure social networks, including network size, network density, centrality and centralization, tie strength, and network range (Marsden, 1990). In this paper, we use "network size" as the primary measurement of a social network and as such assume that farmers rely on their network to exchange social and economic information. Social interaction may influence rice farmers' decision to produce SR, as Moser and Barrett (2006) found that learning in social networks significantly influences the system of rice intensification adoption in Madagascar. In the same vein, Hoang et al. (2006) found that neighborhood networks significantly influenced the adoption of innovation in Northern Vietnam.

We applied the following method in order to analyze network size (Wellman, 1979): first, respondents were asked about the number of farmers they regularly talk to and share information with in the village about SR production. Second, we asked two hypothetical questions regarding financial and social support in the case of a lack of money or a suddenly occurring hardship in order to clarify how many people in their network. For each question, we asked respondents how many farmers in the village are willing to support them or offer immediate help. Those questions helped to determine the network size of the small rice farmers' interviewed. We assume that the larger network a rice farmer has, the higher the probability of SR adoption.

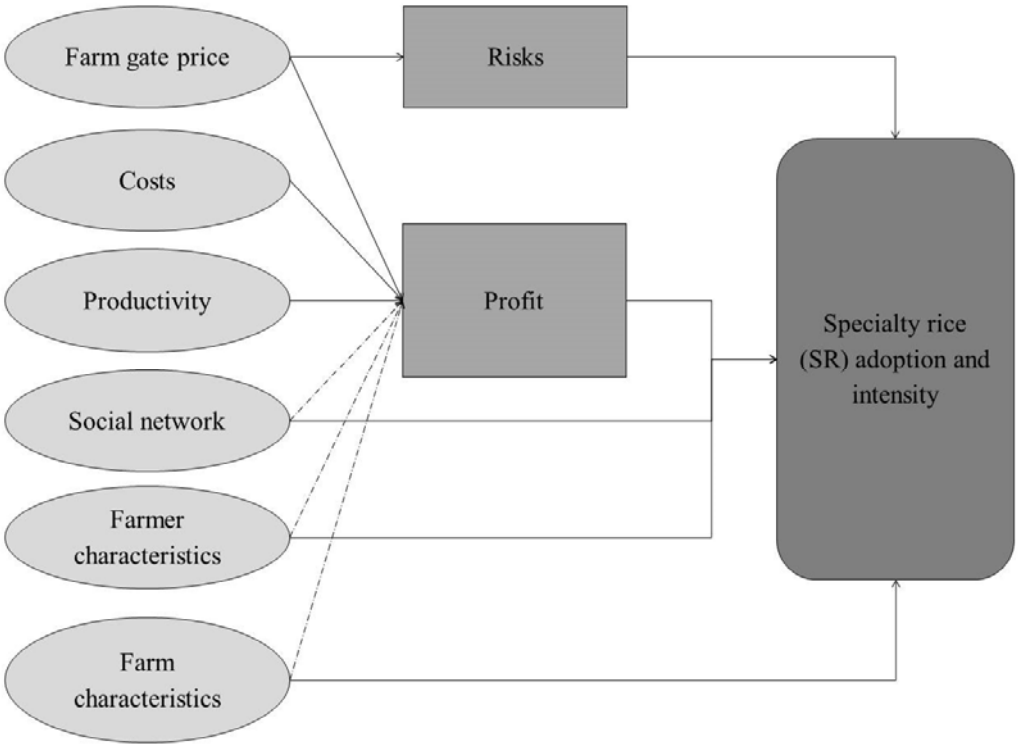


Figure 2. Conceptual Framework of SR Adoption

(Source: Own illustration)

Demographic characteristics:

The age of the household head may have an impact on farmers' decision to produce SR. Adedeji et al. (2013) found that in Nigeria, a younger male household head is more likely to adopt an improved rice variety than an older one. Older farmers, however, have a higher probability of continuing to produce SR, as their particular variety is related to traditional techniques since they have more experience in growing rice than younger farmers do.

Gender of the household head is included as a dummy variable to account for possible gender effects on SR adoption. Ngokkuen and Grote (2012) find that male farmers are more likely to adopt GI certification than females in Thailand. Males are expected to be more likely to adopt and expand their share of SR compared to female headed households; presumably, they have a better understanding of how to produce SR relative to females or they have less risk aversion.

The number of individuals aged 16 to 60 in the household plays an important role in the decision to adopt SR, as the higher the number of productive laborers, the more likely they are to adopt SR (Kijima et al., 2008; Kijima and Sserunkuuma, 2013). However, households with

many members may prefer diversifying non-farm activities in order to generate higher incomes and grow other rice varieties or crops.

Off-farm: This variable explains whether the head of the household worked outside agriculture. On the one hand, doing so helps the household by providing additional source of income that can be used to invest in SR production; on the other hand, it might increase the opportunity cost of family labor, especially during the harvesting season (as we observed, SR production is more labor-intensive than are ordinary varieties).

Cultivated land represents the total agricultural land cultivated in one year period as measured by various formal or informal land transactions. Farmers who have more land are more likely to adopt improved varieties than are small-scale rice farmers. A growing body of literature on the impact land size has on improved technology has found significant positive correlation between land and the decision to adopt (Adedeji et al., 2013; Moser and Barrett, 2006; Ngokkuen and Grote, 2012).

Owned land is a continuous variable used as a proxy to indicate a household's wealth. Feder et al. (1982) found that larger and wealthier farmers are more likely to adopt innovation and do so earlier than others.

Participation in groups is measured by how many farmer groups at the commune level that household participated in (e.g., agricultural cooperative, farmer union, women union, youth union, etc.). Being a member in farmer groups is expected to have a positive influence on SR production as such farmers raise their awareness of SR and come into contact with other group members knowledgeable of SR. By participating, farmers can easily gain access to extension or credit services and can adopt improved technology; Ngokkuen and Grote (2012), for example, found that being a cooperative member had a significant positive impact on GI adoption in the case of Jasmine rice in Thailand. We assume the more groups farmers are involved in, the more likely they are to adopt SR.

Other factors: The distance to the nearest local market may be one factor that has a negative impact on SR adoption. It is assumed that the further the household's proximity to the market, the higher are transportation costs and the lower is access to market information (Kijima and Sserunkuuma, 2013), and so less likely to adopt.

Another factor that may have an impact on farmers' decision is the occurrence of external catastrophes such as disasters, floods, storms, and droughts, as SR production always takes on some external environment-based risk (Feder et al., 1982). Because SR is a long-term variety, there are often more risks in production in comparison with ordinary or normal rice varieties in the same region. The expected signs of mentioned variables appear in appendix 3.

4. Methodology and Estimation Strategy

4.1. Household survey

This survey was conducted in Hai Duong and Quang Ninh provinces, a famous area in the RRD region for SR production (see map). In Hai Duong, the proportion of the population living in rural areas was 77.90% in 2013; the proportion of the labor force aged 15 or older in the rural area was 79.20%, 39.5% of which were involved in agriculture. The gross domestic product per capita[3] was 34,560,000VND (1,645 USD). For this study, we selected Kinh Mon district, since it is famous for Hoa vang glutinous rice production. Generally, the district only accounts for 10% of total planted area of paddy in Hai Duong province (HSO, 2013), but has the largest SR area in Hai Duong province. The improved seeds were first time introduced in 2006 under the government's support.

In Quang Ninh, the proportion of the population living in rural areas was 38.30% in 2013, while the proportion of the labor force aged 15 or older accounted for 76.90% of the total rural population. The gross domestic product per capita was 58,674,000VND (2,789 USD). We selected Dong Trieu district for this study, as it is the second largest district in terms of planted paddy area with the highest paddy productivity (approximately 5.8 ton per ha) from 2005-2013 (QSO, 2013). We found it is interesting to focus on these two provinces in terms of difference in their rural populations' structure (77.90% and 38.30% in Hai Duong and Quang Ninh respectively). Furthermore, the two provinces are different in term of potential urban markets.

From the two selected districts, we randomly chose four communes in each, then selected two villages in each commune, including SR and non-SR production. There were totally 16 villages in our sample. All data were achieved during the 2013/2014 crop year which included the winter of 2013 and the summer of 2014. Our survey was conducted between October and December 2014; here, we randomly chose rice farmers on the village level who do and do not produce SR based on the list of villagers received from the local authorities.

We carried out the survey by using a structured questionnaire, including different modules (e.g., on household characteristics, tenure and farm production, non-farm income, social networks, consumption and expenditure) and conducted direct interviews with individual farmers. The total number of observations is 336 households. Consequently, we used all interviewed households in the analysis and classification of their characteristics in order to determine the factors influencing their decision to adopt SR production.

[3] Vietnam currency, at current prices in 2013;and exchange rate: 1 USD = 21,009 VND

The sample is divided into two categories: farmers who produce SR (N1=276) as treatment group and farmers who do not produce SR (N2=60) as control group. In both groups, male head household dominated (more than 60%). Since we particularly focused on SR production, the treatment group is over represented.

Table 1

Sample Procedure by Specialty Rice Adoption

		Total	By gender of the household head	
			Male	Female
Specialty rice adoption	Yes	276	183	93
	No	60	42	18

Source: Household survey data, 2014

4.2. Focus group discussion

Focus group is now applied widely to identify farmers' preferences and needs that will assist in the long-term development in the rural areas. Ideally, the focus group method is based on participants' opinion expression (Brent et al., 1991; Johnston et al., 1995). The method was used as an explanatory tool to discover farmers' opinion about SR varieties and main reasons to non-adopt SR.

Focus group discussion was applied shortly after the household survey. We invited a small number of 15 participants from the non-adopter group. The selection of group participants was typically purposive based more on convenience. Data were collected from the interaction between members of the group. They discussed main reasons to not produce SR in the villages and ranked the reasons in order of importance. This method traced more carefully the cognitive and social processes that influenced respondents' comprehension of survey questions and their subsequent responses. Each participant freely gave his or her opinion and exchanged the information with other participants. All in all, the method helped to illustrate survey findings and clarify survey results.

4.3. Estimation strategy

Rice farmer's utility function (U): $U_{ji} = \alpha_j F_i(R_i, A_i) + \varepsilon_{ji}$ (1), where j = 0, 1 and 1; i = 1, 2, …., n

Rice farmers are assumed to choose the variety that gives them the largest utility; in other words, U_{1i} must be greater than U_{oi} when the i^{th} rice farmer chooses to adopt an SR variety over ordinary rice.

$$D_i = \begin{cases} 1 \; if \; U_{1i} > U_{0i} \; SR \; is \; adopted \\ 0 \; if \; U_{1i} < U_{0i} \; normal \; rice \; is \; adopted \; and \; replaces \; SR \end{cases}$$

The probability of the adoption decision(D_i=1) can be expressed as below:

$$P_i = P_r(D_i = 1) = P_r(U_{1i} > U_{01}) = P_r[\alpha_1 F_i(R_i, A_i) + \varepsilon_{1i} > \alpha_0 F_i(R_i, A_i) + \varepsilon_{0i}]$$
$$= P_r[\varepsilon_{1i} - \varepsilon_{0i} > F_i(R_i, A_i)(\alpha_1 - \alpha_0)] = P_r(\mu_i > -F_i(R_i, A_i)\beta = F_i(X_i\beta) \text{ (2)},$$

where X_i is a vector of farm and farmer characteristics.

Modelling specialty rice adoption

Firstly, rice farmers decided whether or not to produce SR. Using a simple probit model, we divided the sample into two groups (that do and do not produce SR), based on the assumption that other conditions remain the same.

Secondly, we examined the intensity of use (i.e., how much cultivated land is planted for SR) based on a tobit model.

Probit model: decision to produce specialty rice (adoption decision)

$$y_{1i}^* = X_{1i}'\beta_1 + \beta_2 * network\ size + v_i \text{ (3)},$$

Tobit model: how much land is planted for SR (intensity of use)

$$y_{2i}^* = X_{2i}'\beta_2 + \mu_i \text{ (4)},$$

$$y_{2i} = \begin{cases} y_{2i}^*, if\ X_{2i}'\beta_2 + \mu_i > 0 \\ 0, other\ wise \end{cases}$$

Where the SR adopter is a dummy variable indicating whether the farmer adopted SR, and X_i is a vector of explanatory variables expected to affect the adoption decision.

In the tobit model, we used both outcome variables (y_{2i}^*), that is, the share of the SR area adopted in the total cultivated rice area (%) and the total planted SR area (m^2) during the winter season of 2013. X_{1i} is the vector of explanatory variables for the adoption of specialty rice; while $X_{2i}$is the vector of illustrative variables for the level of SR adoption in the region.

The two error terms v_i and μ_i are expected to be independent and normal distributed with $v_i \approx N(0,1)$; $\mu_i \approx N(0,\sigma^2)$.

5. Results

5.1. Descriptive statistic: SR adopters versus non-adopters

We divided the sample into two groups, adopters and non-adopters of SR production. The main characteristics of rice households are given in Table 2, where the value of owned livestock and a two-wheel tractor are a proxy for wealth. Overall, SR adopters seem to be richer (with a higher gross income and income per capita) than non-adopters.

Table 2

Descriptive Statistics by Specialty Rice Adoption

Variable description	Adopters ($N_1 = 276$)	non-Adopters ($N_2 = 60$)	Differences
Household characteristics			
Age of household head (in years)	53.192	47.083	6.109***
Age of household head squared	2921.141	2294.983	626.158***
Female household head (dummy)	0.337	0.300	0.037
Household size	3.801	3.917	-0.116
Productive labors (number)	3.080	3.167	-0.087
Household head worked off-farm (dummy)	0.467	0.567	-0.099
Household head had a high school degree (dummy)	0.304	0.433	-0.129*
Social capital & network			
Access to extension (dummy)	0.732	0.567	0.165**
Access to credit (dummy)	0.438	0.617	-0.178**
Years growing rice (in years)	29.507	8.367	21.141***
Network size	7.391	3.067	4.325***
Number of local organizations involved	3.014	2.583	0.431**
Farm characteristics			
Number of plots	5.580	4.050	1.530***
Owned land (m^2)	2255.830	1626.060	629.770***
Owned land 5 years ago (m^2)	2411.452	1831.740	579.712***
Cultivated land 2013-2014 (m^2)	2952.404	1730.460	1221.944***
Total planted SR (m^2)	1202.622	0.000	1202.622***
Farm wealth			
Value of livestock ('000 VND)	10136.493	6875.533	3260.959
Two wheel-tractor owned (dummy)	0.572	0.400	0.172**
Information			
Distance to the nearest local market (km)	1.130	1.267	-0.136
Farm performance			
Total of paddy produced 2013-2014 (kg)	2617.496	1595.550	1021.946***
Total SR paddy produced 2013-2014 (kg)	450.036	-	-
Gross household income ('000VND)	119655.850	88059.916	31595.935***
Gross household income per capita ('000VND)	31752.864	22686.987	9065.877***
Food expenditure per month ('000VND)	2897.053	2582.557	314.496**
N	336		

Significant at * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Productive labors were calculated as household members who are over 16 and less than 60 years old.

SR adopters tended to have older household heads; in our study, the SR farmers were on average 53 years old and had extensive experience in growing rice. On average, their mean years of growing rice amount to 29.5 as compared to 8.4 years in the non-adopter group. However, SR farmers are significantly less educated as their counterparts. For instance, about 30% of household heads of adopter group had a high school degree as opposed to 43.3% of non-adopter farmers. Farmers who adopted SR had better access to extension (73.2%) in comparison with farmers producing ordinary rice varieties (56.7%). Another significant

difference relates to the access to credit. Among adopter group, about 44% of households obtained financial services as compared to roughly 62% in the non-adopter group.

Regarding the agricultural area, the first important finding is that the farm size of farm-household in our sample is dominated by small farms. More than 90% of the respondents cultivate rice on 0.5ha or less. There is a difference in average owned land and cultivated land between the two groups. SR adopters also had more land area and a higher number of plots than did non-adopters. As we observed, rice farmers preferred to diversify of varieties in order to produce for many purposes (e.g. own consumption, providing for their relatives in urban areas, or earning cash).

However, we did not find any significant difference between the two groups in terms of household size, number of productive laborers, female head, and whether the household head had worked off-farm.

The descriptive results from Table 3 show that SR farmers have a larger network size (about 7.4) than do other rice farmers (3.0). The number of farmers who are able to provide financial and social support is significantly different.

Table 3

Number of Network Members Reported by Rice Farmers

	Adopters	Non-adopters	Difference
Number of close farmers currently in the village	8.072	5.650	2.42***
- Number of farmers able to provide financial support	4.754	2.767	1.99***
- Number of farmers able to provide social support	7.391	3.067	4.32***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We are interested in understanding farmers' perceptions of producing SR. For those who adopted SR, we asked about their motivation in terms of farm gate prices, production costs, productivity, market opportunities, traditional culture, and knowledge. The descriptive results are summarized in Table 4.

Table 4

Reason for deciding to plant SR by District (in %), 2014

	Hai Duong (152)			Quang Ninh (124)		
	Yes	No	Do not know	Yes	No	Do not know
It can be sold at a higher price than normal rice	99.34	0.66	0.00	100.00	0.00	0.00
It helps save on production costs	37.50	59.21	3.29	31.25	67.19	1.56
It has stable productivity	57.24	41.45	1.32	71.88	26.56	1.56
It is easy to sell	84.87	13.82	1.32	85.94	13.28	0.78
It contributes to regional traditional culture	87.50	3.95	8.55	89.06	3.91	7.03
To gain knowledge of SR through training and extension activities	76.97	15.79	7.24	78.13	20.31	1.56

Note: The percentage was calculated by number of agreed respondents per total sample in each district

In the two districts, it is not surprising that nearly 100% of the rice farmers sold SR for a higher price than normal, short-time varieties. However, more than half the respondents said that producing SR did not help them save on production costs. In Quang Ninh province, nearly 67% of rice farmers produced SR varieties with higher production costs than other varieties, meanwhile approximately 60% in Hai Duong. More than 40% of SR farmers in Hai Duong responded that the productivity of rice was not stable as SR's long-term growing development (30-45 days more than normal varieties) meant additional risks. However, only 27% of the interviewed farmer complained about SR productivity instability in Quang Ninh.

Regarding the SR market, almost 85% farmers believed that the SR market still contains untapped potential and, as a result, they do not worry about selling their product. Moreover, farmers were concerned about where they should sell their output, be it through an SR farmer association or traditional marketing chains. In addition, more SR farmers continue to develop rice because their traditional culture and they could gain more knowledge. Therefore approximately 88% of SR farmers said they were proud of their production because it helps to preserve the local culture. At the same time, 77% of the respondents could gain knowledge by getting involved in training and extension activities during the process of producing and marketing SR. The government should give credit to marketing and commercialization of SR.

We also asked the farmers who did not adopt SR what reasons they had for their decision through a group discussion with a total of 15 participants. First, a lack of knowledge about production techniques is the most important reason for 80% of the participants. Rice farmers belong to this group as mentioned in Table 2 had not extensive experience growing rice. Second, the fact that it is a long-term variety is the second most important reason that

influences the decision to not adopt SR. Third, an unstable productivity is another influencing factor of the non-adopter group's decision. It is important to note that during the discussion, participants were asked to list three reasons why they chose to not adopt SR. Detailed information is shown in Figure 3.

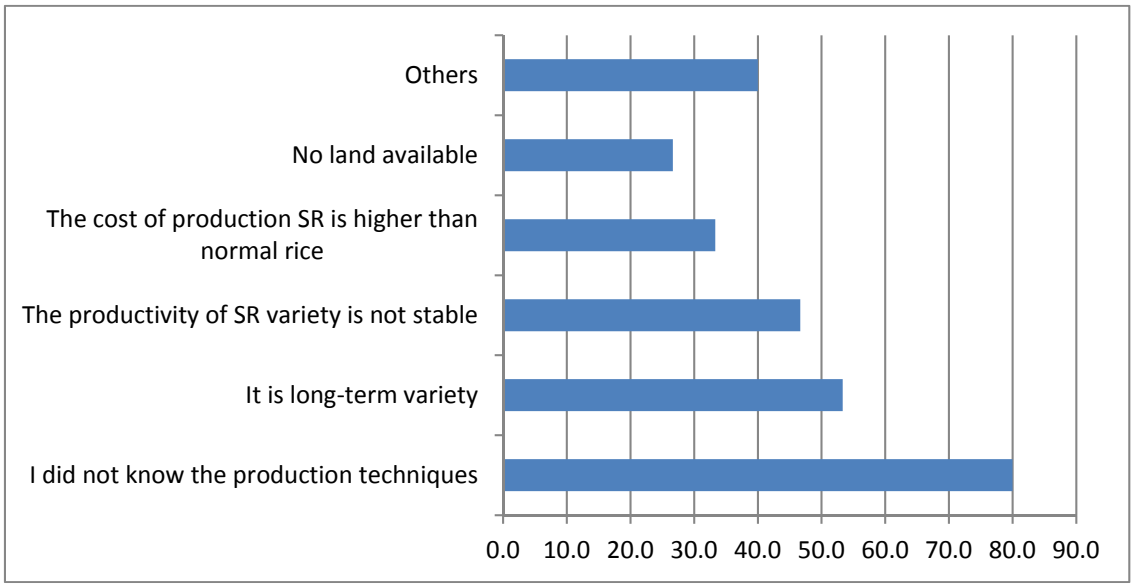


Figure 3: Main Reasons for Non-adoption of SR

Source: Focus group discussion, 2014

5.2. Regression models

a) Specialty rice adoption model

The empirical results of SR adoption are presented in Table 5. Model 1 gives the outcomes of a probit model that we estimated without including network size- which is the main variable of interest in our study. There are several explanatory variables that are expected to have an effect on rice farmers' decisions for or against to SR adoption. We also calculated the average marginal effects (AME) of each model that may help to understand the magnitude of the effects of each explanatory variable on the SR adoption decision.

Many of the explanatory variables are statistically significant. The regression results show that cultivated land, experience of growing rice, and possession of a two-wheel tractor have a significant positive influence on SR adoption. However, the number of productive laborers and the distance to the nearest local market has significant negative effects on SR adoption. Other factors such as age and gender of household head, access to credit are insignificant, and groups' participation is contrary to our expectations.

Cultivated land has a significant and positive influence on the likelihood of producing SR at the 1% level. Due to urbanization trend in the two provinces, more young farmers get out of agriculture to create their own businesses or work in the industry sector, leaving their land to relatives or neighbors for cultivation. On average, if the cultivated land increases by one square meter, the probability of the household's adoption of SR increases by 0.014% equivalent to a 5% rise in probability per additional local unit of land. (*1sao =360 square meters*). If farmer households possess a two-wheel tractor, their probability to adopt SR increases by 7.7%.

Table 5

Determinants of SR Adoption in the RRD region

	Model 1		Model 2	
Variable description	Coef.	AME	Coef.	AME
Age of household head (in year)	0.00981	.0018806	0.00717	.0009816
	(0.01793)	(.003452)	(0.02241)	(.0031037)
Female household head (dummy)	0.24522	.0470146	0.22185	.0303543
	(0.21052)	(.0403748)	(0.22636)	(.0317554)
Productive laborers (number)	-0.20249**	-.0388212**	-0.23646*	-.0323541*
	(0.09357)	(.0174539)	(0.13438)	(.0165626)
Experience growing rice (years)	0.02808*	.0053836*	0.03652*	.0049974*
	(0.01677)	(.0031386)	(0.02202)	(.0027884)
Cultivated land (m^2)	0.00072***	.0001377***	0.00066***	.0000901***
	(0.00015)	(.0000261)	(0.00023)	(.0000255)
Network size			0.38516***	.0526995***
			(0.07204)	(.0054914)
Number of group the household involved (number)	0.00414	.0007938	-0.07326	-.0100243
	(0.09167)	(.0175772)	(0.11763)	(.0157523)
Access to credit (dummy)	-0.21251	-.0407433	-0.28269	-.0386797
	(0.19312)	(.0372405)	(0.23927)	(.034362)
Distance to the nearest market (km)	-0.28306***	-.0542681***	-0.24043*	-.0328968*
	(0.10471)	(.0192525)	(0.13916)	(.0177005)
Two wheel-tractor owned (dummy)	0.40289**	.0772418**	0.24571	.0328968
	(0.19035)	(.0347947)	(0.22449)	(.0290792)
Constant	-1.16474*		-2.58229***	
	(0.70618)		(0.82337)	
Observations	336		336	
Wald statistic	51.87		67.40	
Prob > chi2	0.0000		0.0000	
Pseudo R-squared	0.2659		0.4909	

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the model 2, we add the network size in the adoption model. Our main variable of interest increases the probability of SR adoption by 5.3% if rice farmers have one more person in their

network. The more close neighbors a rice farmer has, the more likely it is that a farmer adopts SR. Based on social network relations; farmers can learn from others and influence each other by collective decision.

The number of productive laborers in the family has a negative and significant effect on SR adoption, a result which supports the trend of increasing opportunities for finding off-farm income in the region. Households with more laborers are more likely to leave agriculture to find a job in the industry sector in order to diversify and raise their income.

b) Intensity of SR adoption

After analyzing the factors that influence the decision to adopt, we explore the factors that affect the intensity of use. To do so, we use two dependent variables: the share of SR area adopted in the total cultivated rice area (%) and the planted SR area (m^2). These variables were captured in the winter paddy season 2014. The distribution of share of SR area adopted in total cultivated rice area is presented in appendix 4.

Table 6

Intensity of SR Production by Tobit model

Variable	Share of SR planted area (%)	Area planted to SR (m^2)
Age of member	0.00277	7.19800
	(0.00398)	(12.26758)
Female household head (dummy)	0.04550	103.68253
	(0.03785)	(116.98061)
Number of productive labors in household	-0.03675**	-92.35597*
	(0.01558)	(48.17506)
Experience growing rice (years)	0.00303	1.71666
	(0.00367)	(11.31195)
Total cultivated area (m^2)	0.00003**	0.40791***
	(0.00001)	(0.03100)
Number of groups the household is involved in (number)	0.03418**	139.56671***
	(0.01497)	(46.20060)
Whether household has access to credit service (dummy)	-0.05240	-109.13915
	(0.03531)	(109.20200)
Distance to the nearest market (km)	-0.02448	-32.46927
	(0.02136)	(65.71153)
Two-wheel-tractor owned (dummy)	0.07811**	232.32657**
	(0.03513)	(108.76310)
Constant	0.03001	-875.79790*
	(0.14617)	(452.66687)
Observations	336	336
LR chi2 (10)	44.39***	162.20***
Pseudo R-squared	0.1477	0.0339

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results are displayed in Table 6. The number of groups that rice farmers are involved in and whether they have a two-wheel tractor have a significant influence on the area allocated to SR. The number of groups a household is involved in has a positive effect on the intensity of SR adoption. Every additional group a rice farmer is a member of increases the planted SR area by $139m^2$. The coefficient of the total cultivated area also shows a significantly positive influence on the intensity of SR, indicating that if rice farmers expand their agricultural land use, they are more likely to increase the SR planted area.

The Likelihood Ratio (LR) Chi-Square tests demonstrate that the tobit model is appropriate (Wooldridge, 2010). In comparison with the results from the probit regression, experience in growing rice and the distance to the nearest local market are not statistically different from zero, indicating they do not appear to influence the intensity of SR.

6. Discussion

Our main finding is various factors have influence on farmers' decision to adopt SR production and the intensity of adoption. It was also found that social networks have a close relationship with SR production that is, a farmer's individual decision to produce SR is also influenced by his/her neighbors in the village. This is in line with findings from previous studies showing that social networks has been played a significant role in technology adoption (Bandiera and Rasul, 2006; Maertens and Barrett, 2013; Matuschke and Qaim, 2009). In the context of Vietnam, this finding is really important in order to protect and to develop SR varieties under commercialization and industrialization in rural areas.

The number of farmer groups the household is involved in has a positive influence on the intensity of the SR area adopted. That is, the more group participation helps to expand their SR area. This is relevant in the case of Vietnam where most of households participated in at least one farmer group. Being member in farmer groups, household is provided with agricultural training, extension services, market information, and other subsidies (Kijima and Sserunkuuma, 2013; Moustier et al., 2010).

In addition to the regression results, the descriptive statistics show that wealthier rice farmers with more land and possession of a two-wheel tractor tend to be more likely to adopt SR. These findings resonate with past studies that found significant difference between cultivated land in the adoption of improved technology (Adedeji et al., 2013). It means that farmers that operate on relatively lager scale level are discovered to have higher adoption level. It should be kept in mind that almost all farmers in our sample are small-scale. Limited availability of suitable cultivated land may be a potential constraint to SR adoption.

The regression results also corroborate what was observed earlier in the summary statistics that gender of household head does not have a significant effect on the probability of adopting SR. Other explanatory variables such as age of household head, access to extension service, and access to credit were found significant different in the descriptive statistic. However, we could not find any effect of those variables on SR adoption decision in the regression model.

All in all, the case of SR adoption in the RRD region contributed new insights into our understanding of adoption decisions, especially the role of social network and group membership in the rural areas.

7. Concluding Remarks

All in all, the case of SR adoption in the RRD region contributed new insights into our understanding of adoption decisions, especially the role of social network and group membership in rural areas. We find that cultivated area and network size have a positive and significant influence on households' likelihood to produce SR. Additional experience tends to increase adoption SR varieties, and long distance to the nearest local market tends to reduce it. However, some basic farmers' characteristics did not have a significant effect on the probability and intensity of adoption SR. The findings of this study have several important implications for policy making. As expected, in order to expand the area of SR, authorities need to invest more in helping small farmers to build their networks through training activities. Promoting SR production must address the specialized markets where the product is given particular consideration in terms of quality, origin, and quality control.

The findings of this study have several important implications for policy making. As expected, in order to expand the area of SR, authorities need to invest more in helping small farmers to build their networks through training activities. Promoting SR production must address the specialized markets where the product is given particular consideration in terms of quality, origin, and quality control. Thus, policy-makers should focus more on addressing and strengthening new marketing chains for specialty products by providing credit or loan to SR farmer associations.

Social network has a positive influence on SR adoption because of it makes knowledge exchange and collective decision-making possible. Based on the findings, this study will help foster the production of SR among smallholder farmers by building up individuals' network size. More importantly, SR farmers should be involved in activities such as: interactions, meetings, events, and other common projects. In addition, a land reform policy will help to increase SR production in the RRD region, for instance implementing of land consolidation

program and creating land market. Therefore, it contributes to the overall policy regarding the development of specialty agricultural products in Vietnam's rural areas.

Further research should aim at a more through measurement of the determinants of SR adoption. In measuring social network, for instance, we did not capture how rice farmers use their networks to exchange information such as frequency and importance of the exchanged information about specialty rice production and detailed marketing strategies. Further studies should focus more on social networks in the context of SR production in order to really understand their role in expanding SR area in the region.

Future research should also focus on examining the impact of SR production on household income, the role of SR farmer associations in improving household income (Moustier et al., 2010) and the food consumption of their members. Total household income consists of farm income (livestock and crops), off-farm income and other subsidies or support from relatives, friends, and the government. Propensity score matching (PSM) could be a way to estimate the causal effect of treatment group and to sort out causation from correlation. In addition, the participation in farmer association is not randomly assign leading to biased and inconsistent coefficients. In this case, the instrument variable regression approach could be improved. It is also important to analyze the impact of farmer organizations on rice productivity and efficiency, especially for organization participants in comparison with other rice farmers in the region.

References

ADB, 2012. ASEAN and Global Rice Situation and Outlook. ADB. http://www.adb.org/publications/asean-and-global-rice-situation-and-outlook.

Adedeji, T.O., Nosiru, M.O., Akinsulu, A.A., Ewebiyi, I.O., Abiona B. G., Jimoh T.S., 2013. Adoption of New Rice for Africa (NERICA) technology in Ogun State, Nigeria. *J. Dev. Agric. Econ. 5* (9), 365–371.

Anh, D.T., Sautier, D., 2011. Local Food Systems in Vietnam: Strengths and Opportunities. http://www.fftc.agnet.org/library.php?func=view&style=type&id=20131024113041.

Bandiera, O., Rasul, I., 2006. Social Networks and Technology Adoption in Northern Mozambique. *Economic Journal 116* (514), 869–902.

Batie, S.S., Taylor, D.B., 1989. Widespread adoption of non-conventional agriculture: Profitability and impacts. am j alt ag 4 (3-4).

Brent, W., Knodel, J.E., Sittitrai, W., 1991. Focus Groups and Surveys as Complementary Research Methods: Examples from a Study of the Consequences of Family Size in Thailand. University of Michigan; PSC Research Report No. 91-213.

Brown, C., Waldron, S., Longworth, J., 2013. Specialty products, rural livelihoods and agricultural marketing reforms in China. Emerald Group Publishing Limited. http://www.emeraldinsight.com/doi/full/10.1108/17561371111131335.

Cazzuffi, C., McKay, A., 2012. Rice market participation and channels of sale in rural Vietnam. *The International Association of Agricultural Economists*. http://ageconsearch.umn.edu/handle/126566.

Chaudhary, R., 2003. Speciality rices of the world: Effect of WTO and IPR on its production trend and marketing | WFL Publisher. http://world-food.net/speciality-rices-of-the-world-effect-of-wto-and-ipr-on-its-production-trend-and-marketing/.

Coley, D., Howard, M., Winter, M., 2009. Local food, food miles and carbon emissions: A comparison of farm shop and mass distribution approaches. *Food Policy 34* (2), 150–155.

Coxhead, I., Linh, V.H., Le Tam, D., 2012. Global market shocks and poverty in Vietnam: The case of rice. *Agricultural Economics 43* (5), 575–592.

Diaz, V., Wang Huaiyu, Moustier, P., Nguyen, N.L., 2009. Consumers' demand for sticky rice in Hanoi. CIRAD. www.malica-asia.com.

FAO, 2001. Speciality rices of the world. Breeding, production and marketing. http://www.fao.org/ag/magazine/0207sp1.htm.

FAO, 2006. International commodity profile. https://scholar.google.de/scholar (accessed 25 May 2015).

FAOSTAT, 2015. FAOSTAT3. http://faostat3.fao.org/download/Q/QC/E (accessed May 2015).

Feder, G., Just, R.E., Zilberman, D., 1982. Adoption of agricultural innovation in developing countries: A survey / Gershon Feder, Richard E. Just, David Zilberman. World Bank, Washington, D.C.

Frédéric, T., Dao, T.A., 2005. Community biodiversity management 207-212: Promoting resilience and the conservation of plant genetic resources / edited by Walter Simon de Boef, Nivaldo Peroni, Abishkar Subedi, Marja Helen Thijssen, and Elizabeth O'Keeffe.

Giraud, G., 2009. Range and Limit of Geographical Indication Scheme: The Case of Basmati Rice from Punjab, Pakistan. *International Food and Agribusiness Management Review*>Volume 11, Issue 1, 2008.

Giraud, G., 2013. The World Market of Fragrant Rice, Main Issues and Perspectives. *International Food and Agribusiness Management Review*>Volume 16, Issue 2, 2013.

GSO, 2014. Statistical handbook of Vietnam 2014.

Gulati, A., Minot, N., Delgado, C., Bora, S., 2005. Growth in high-value agriculture in Asia and the emergence of vertical links with farmers. World Bank. http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Standards/paper_minot.pdf. Accessed 8 September 2015.

Herforth, N., 2015. Modern supply chains, social networks, and income effects among blackberry farmers in the Ecuadorian Andes. Dissertation, Goettingen.

Hoang, L.A., Castella, J.-C., Novosad, P., 2006. Social networks and information access: Implications for agricultural extension in a rice farming community in northern Vietnam. *Agric Hum Values* 23 (4), 513–527.

HSO, 2013. Haiduong Statistical Yearbook 2013. *Statistical publishing house*.

IRRI, 2003. Hybrid rice for food security, poverty alleviation, and environmental protection. IRRI, Metro Manila Philippines, viii, 407.

ISO, 2011. ISO 7301:2011 - Rice -- Specification. http://www.iso.org/iso/catalogue_detail.htm?csnumber=50935 (accessed 25 May 2015).

Jaenicke, Hannah, Anh, The, D., Nghiep, Cong P, 2010. Harnessing local underused crops to improve household nutrition and income opportunities in Vietnam: case of Hoa vang sticky rice in Red river delta. *European Association of Agricultural Economists.* http://econpapers.repec.org/paper/agseaa116/95038.htm (accessed 20 May 2015).

Jamora, N., Cramon-Taubadel, S.v., 2012. What world price?: Georg-August-Universität Göttingen - GlobalFood Discussion Paper Series No.17. https://www.uni-goettingen.de/en/213486.html (accessed 20 May 2015).

Johnston, R.J., Weaver, T.F., Smith, L.A., Swallow, 1995. Contingent Valuation Focus Groups: Insights From Ethnographic Interview Techniques. *Agricultural and Resource Economics Review>Volume 24, Number 1*, April 1995.

Kijima, Y., Otsuka, K., Sserunkuuma, D., 2008. Assessing the impact of NERICA on income and poverty in central and western Uganda. *Agricultural Economics 38* (3), 327–337.

Kijima, Y., Sserunkuuma, D., 2013. The adoption of NERICA rice varieties at the initial stage of the diffusion process in Uganda. *African Journal of Agricultural and Resource Economics Volume 8 Number 1* pages 45 - 56.

Lin, J.Y., 1991. Education and Innovation Adoption in Agriculture: Evidence from Hybrid Rice in China. *American Journal of Agricultural Economics* 73 (3).

Maertens, A., Barrett, C.B., 2013. Measuring Social Networks' Effects on Agricultural Technology Adoption. *American Journal of Agricultural Economics* 95 (2), 353–359.

Marsden, P.V., 1990. Network Data and Measurement. Annu. Rev. Sociol. 16 (1), 435–463.

Matuschke, I., Qaim, M., 2009. The impact of social networks on hybrid seed adoption in India. *Agricultural Economics* 40.

Minot, N., Goletti, F., 2000. Rice market liberalization and poverty in Viet Nam. International Food Policy Research Institute, Washington, D.C., xiii, 113.

Moser, C.M., Barrett, C.B., 2006. The complex dynamics of smallholder technology adoption: the case of SRI in Madagascar. *Agricultural Economics* 35 (3), 373–388.

Mottaleb, K.A., Mohanty, S., Nelson, A., 2015. Factors influencing hybrid rice adoption: A Bangladesh case. *Aust J Agric Resour Econ* 59 (2), 258–274.

Moustier, P., Tam, P.T.G., Anh, D.T., Binh, V.T., Loc, N.T.T., 2010. The role of farmer organizations in supplying supermarkets with quality food in Vietnam. *Food Policy* 35 (1), 69–78.

Muthayya, S., Sugimoto, J.D., Montgomery, S., Maberly, G.F., 2014. An overview of global rice production, supply, trade, and consumption. *Annals of the New York Academy of Sciences* 1324 (1), 7–14.

Ngokkuen, C., Grote, U., 2012. Geographical Indication for Jasmine Rice: Applying a Logit Model to Predict Adoption Behavior of Thai Farm Households. *Quarterly Journal of International Agriculture*.

Nguyen, C.T., Baldeo, S., 2006. Trend in rice production and export in Vietnam - Google Search. https://www.google.de/#q=Trend+in+rice+production+and+export+in+Vietnam. Accessed 18 May 2015.

Nielsen, C.P., 2003. Vietnam's Rice Policy: Recent Reforms and Future Opportunities. *Asian Econ J* 17 (1), 1–26.

QSO, 2013. Quangninh Statistical Yearbook 2013. *Statistical publishing house*.

Rahm, M.R., Huffman, W.E., 1984. The Adoption of Reduced Tillage: The Role of Human Capital and Other Variables. *American Journal of Agricultural Economics 66* (4).

Wellman, B., 1979. The Community Question: The Intimate Networks of East Yorkers. *American Journal of Sociology* 84 (5), 1201–1231.

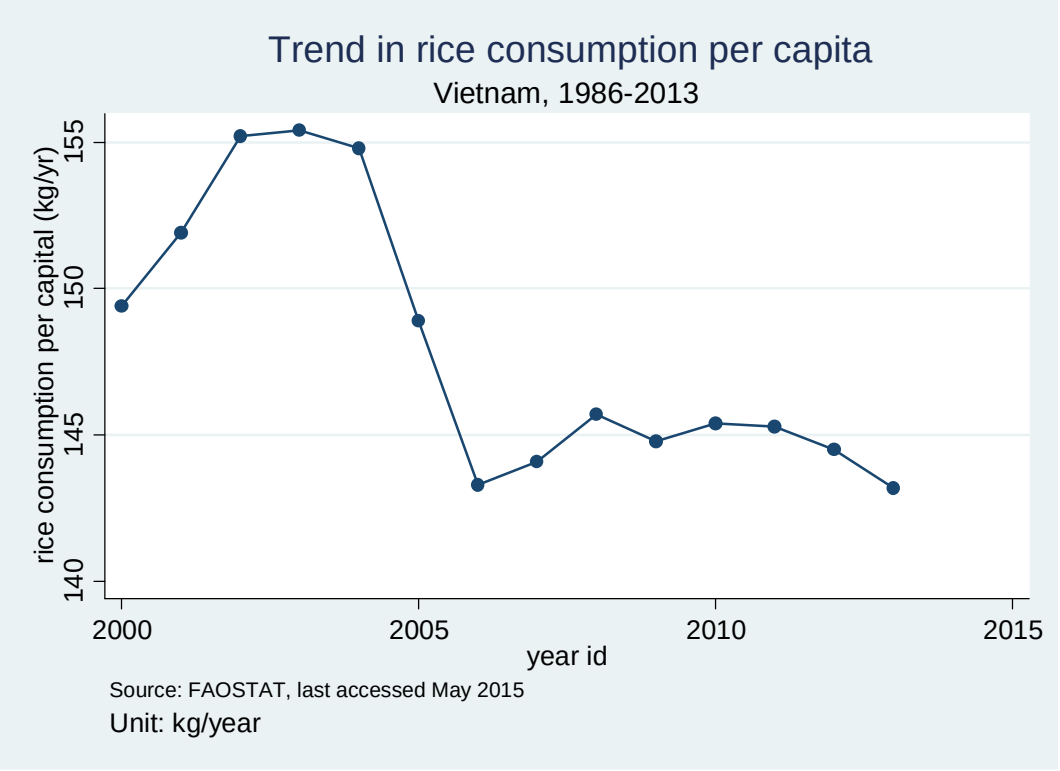
Wollni, M., Zeller, M., 2007. Do farmers benefit from participating in specialty markets and cooperatives?: The case of coffee marketing in Costa Rica1. *Agricultural Economics* 37 (2-3), 243–248.

Wooldridge, J.M., 2010. Econometric analysis of cross section and panel data, 2nd ed. MIT, Cambridge, Mass., London.

Wossen, T., Berger, T., Di Falco, S., 2015. Social capital, risk preference and adoption of improved farm land management practices in Ethiopia. *Agricultural Economics* 46 (1), 81–97.

Appendices

Appendix 1: Trend in rice production per capita in Vietnam



Appendix 2: List of certified rice varieties in Vietnam (*up to date 31.05.2013*)

Geographical indication (04)	Certification mark (03)	Collective trademark (21)
Fragrant rice (Hai Hau, Nam Dinh); Bay Nui rice (An Giang); Dien Bien rice (Dien Bien); Hong Dan rice (Bac Lieu)	G HB Huong Binh rice (Ninh Binh); HDPC high quality rice (Ha Noi); ST fragrant rice (Soc Trang)	High quality rice and fragrant sticky rice (Bac Quang, Ha Giang); fragrant rice (Long An); Bo Nau rice (Ha Noi); Quang Dien red rice (in Hue); hoa vang sticky rice (Quang Ninh); glutinous rice (An Giang); fragrant rice (An Giang); Phu Tan sticky rice (An Giang); Tu Le sticky rice (Yen Bai); high quality rice with GlobalGAP (Tien Giang); GDH Bao Thai (Tuyen Quang); Long Trifragrant rice (Vinh Phuc); sticky rice (Bac Giang); HG2 specialty paddy (Hau Giang); Cat Tien rice (Lam Dong); My Lung sticky rice (Phu Tho); Yen Dung fragrant rice (Bac Giang); Cho Don rice (Bac Kan); VM rice (An Giang); Kinh Mon sticky rice (Hai Duong); Thau Dau sticky rice (Thai Nguyen);

Source: National Office of Intellectual Property of Vietnam, 2013

Appendix 3: Definition of variables used in the regression models

Variable	Description	Measurement	Expected sign
Household characteristics			
Age	Age of household head	years	+
Age2	Age of household head squared		
Female	Female household head	1= female 0=male	-
HH_size	Household size	Number	+
Productive_labor	Productive laborers	Number of people over 16 and under 60	+
Off_farm	Household head worked off-farm	1=yes 0=no	-
Social capital			
Network_size	Network size	Number	+
credit	Access to credit	1=yes 0=no	±
Groups' participation	Number of local organizations involved	Number	+
Farm characteristics			
Total_cultivatedland	Cultivated land area	m^2	+
N_plot	Number of plots	Number	+
Farm wealth			
Livestock_value	Value of owned livestock	'000VND	-
Two-wheel tractor	Own two-wheel tractor	1=yes 0=no	+
Information			
Distance_k	Distance to the nearest local market	km	-
Distance_FA	Distance to SR farmer association's headquarter	km	-
No_source_D	Number of sources of market information	1=if more than 1 0=1	+
Exten	Access to extension	1=yes 0=no	+
Experience	Rice growing experience	Years	+

Source: Own illustration

Appendix 4: Distribution of share of SR area adopted in total cultivated rice area