Farmers' Adoption of Certified Aromatic Rice Seed in Mekong River Delta, Vietnam

การยอมรับข้าวหอมรับรองไปใช้ในเขตลุ่มน้ำโขง ประเทศเวียดนาม

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ABSTRACT

As the world rice demand has shifted towards higher value due to higher income, Vietnam's aromatic rice will need more input investments, especially by improving seed quality. The purposes of this study were to illustrate the farmers' attitude and expectations towards certified aromatic rice seed and identify factors influencing farmer's adoption of certified aromatic rice seed in Winter-Spring 2016/2017 in Mekong River Delta. Based on 203 rice farmers, it was found about 34% of rice farmer did not adopt certified aromatic rice seed. The results suggest that as perceived profitability advantages, reduced seed rate and more certified seed availability are key factors to create more incentives to adopt certified aromatic rice seed, policies such as promoting more supply and availability of certified rice seed at affordable price should be supported by the government.

บทคัดย่อ

เมื่ออุปสงค์ของข้าวมูลข้าวสูงในตลาดโลกเพิ่มขึ้นเนื่องจากรายได้ที่เพิ่มขึ้น ข้าวหอมของประเทศเวียดนามจึงมีความจำเป็นที่ต้องเพิ่มการพัฒนาของปัจจัยการผลิต โดยเฉพาะอย่างยิ่งโดยการเพิ่มคุณภาพของเมล็ดพันธุ์ ดังนั้นการศึกษานี้จึงมีวัตถุประสงค์ เพื่อแสดงให้เห็นถึงทรรศนคติ และความคาดหวังของชาวนาต่อการใช้เมล็ดพันธุ์รับของและเพื่อค้นหาปัจจัยที่มีอิทธิพลต่อการยอมรับเมล็ดพันธุ์ข้าวหอมรับรองในฤดูการผลิต Winter-Springปี 2559/2560 ในพื้นที่ลุ่มน้ำโขง จากการสำรวจชาวนา 203 รายพบว่าชาวนาประมาณร้อยละ 34 ไม่ยอมรับเมล็ดพันธุ์ข้าวรับรองผล การศึกษายังชี้ให้เห็นว่าชาวนาที่คาดว่าการใช้เมล็ดพันธุ์รับรองมีข้อได้เปรียบด้านกำไร มีอัตราการใช้เมล็ดพันธุต่ำและมีเมล็ดพันธุ์รับรองพร้อมให้ใช้ได้จะมีโอกาสยอมรับมากกว่ามาตรการสนับสนุนจากรัฐ เช่น การผลิตเมล็ดพันธุ์ข้าวรับรองและจำหน่ายในราคาที่ชาวนาสามารถเข้าถึงได้จะทำให้การยอมรับเมล็ดพันธุ์ข้าวรับรองมากขึ้น

Keywords: Adoption, Certified seed, Aromatic rice

คำสำคัญ: การยอมรับ เมล็ดพันธุ์รับรอง ข้าวหอม

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Introduction

Vietnam is one of the major rice exporters in the world, with 4.862 million tons in 2016 (Vietnam Food Association, 2017). The majority of Vietnam's rice export is attributed tolow-quality rice which has relatively stable markets within Asian region at about 76% of total rice export (General Statistic Office, 2016). Nevertheless, the exports of aromatic rice which are considered high-valued in the world's market still fluctuates in term of volume and value (General Department of Customs, 2016). As the world rice demand has shifted towards higher value due to higher income consumers in several countries, the export potentials of Vietnam aromatic rice is still limited as it cannot meet the consumer's requirements. Despite the lower price, Vietnam's aromatic rice still has to compete with high reputation and more desirable quality aromatic rice from the main competitors such as Thailand, India, and Cambodia. Under the new Vietnam aromatic rice standards (TCVN 2016), three aromatic rice varieties are included, namely Jasmine 85, RVT and Nang Hoa 9. These three varieties are considered good aromatic varieties and covered so that national aromatic rice products of Vietnam can be built for recognition in the world market (Ministry of Agricultural and Rural Development, 2016). Furthermore, it is important that Vietnam's aromatic rice will need more investments in elevating in the quality such as by improving rice varieties, seed quality, cooperation and trademark promotion.

Nowadays, the roles of high-quality seed have received more attention as it is an important requirement in quality rice production (Ministry of Industry and Trade, 2017). Certified seed commonly has higher germination rate, disease tolerance, and improved quality than uncertified seed, and it is believed to reduce chemicals uses and improve the rice quality (Bogdanovic et al., 2015; Dung et al., 2015). However, the rate of certified rice seed adoption is still very limited, Government set up the plan to increase the percentage of certified seed use in MRD until 2020 is 75% total rice area (Ministry of Agricultural and Rural Development, 2016). Despite perceived benefits, there are still many constraints to use adopt certified rice seed. There is two main aromatic rice seed sources: formal and informal system. The formal seed supply system includes seed centers, seed farms or stations, research institutes, universities, and cooperatives; these are considered certified seed suppliers. The informal seed supply includes saved seeds from farmers, seed clubs and others operated in the seed sector; these are considered uncertified seed suppliers. According to Vietnam Seed Ordinance, seeds are classified into four levels: breeder seeds, pre-basic seeds, basic seeds and certified seeds. Farmer often uses certified seeds in their production and the rest use uncertified seeds. Uncertified seeds may be multiplied by farmers from pre-basic seeds without certification or quality control by any authorities on seed quality. The problem of rice seed industry in Vietnam is that while the certification system ensures quality seeds, the quantity supply of those that meet the certification standards is insufficient to meet farmers' demand. In contrast, farmers' saved seeds contribute to a significant share of the seed needed at the local level but they do not get certification although many farmers believe that the quality produced by this group is equivalent to certified seeds. With the limited supply of certified seeds through a formal certification system, the majority farmer still purchases seed from seed clubs and local seed traders or kept the seed by themselves (Tin et al., 2011).

Like the rice seed industry in many developing countries, adequate information of seed quality may not be delivered to farmers. In Vietnam, certified rice seeds require at least the minimum standards of genetic purity,

physical purity, and germination rates and generally labeled (Ministry of Agriculture & Rural Development, 2011). Nevertheless, several farmers still lack information about certified seeds i.e. where seeds can be purchased, what cultivars are available, what choices of quality and prices are available. To indicate the factor affecting farmer's adoption of certified aromatic rice seed, the problems occur most frequently around the access to seed and farmer' attitude toward seed characteristics rather than the production of it (Sperling and McGuire, 2010). It is important to understand farmer' attitudes and expectations toward and what components are expected from certified aromatic rice seed. Mekong River Delta is the main rice production area in Vietnam that dominates more than 90% of rice export volume and is the main area for aromatic rice production (General Statistic Office, 2016). The purposes of this study were to assess farmer' attitudes and expectations toward certified aromatic rice seed and to indicate the factors influencing farmer's adoption of certified aromatic rice seed in Winter-Spring (the main rice cultivation season accounts for 40% of annual output) of 2016/2017 in MRD. The results from this study will be able to use for sustainable aromatic rice development in MRD and provide evidence-based policy recommendations.

In previous studies, the logistic and probit models have been widely used in wheat, rice and maize to analyze factors affecting adoption of improved technology (Thu, 2014; Tin et al., 2011; Dung et al., 2015). They found that the demographic characteristics include age, education level, family size, and sex had a significant influence on adoption of improved varieties. Gregory and Sewando (2013) also applied the same model to determine socio-economic characteristics (farm size, off-farm activities and livestock owned) and institutional characteristics (extension services, access to credit, membership to farmers' organization/group, contract farming) that affect the uptake of technology. Farmers' preferences on new technology's attributes play an important role in adoption (Trang and Napasintuwong, 2016; Ghimire et al., 2015). Based on the consumer behavior, when farmers decide to adopt improved or new technology, it is expected that higher benefits compared to the existing ones will be higher (Ghimire et al., 2015). Rogers (2005) suggested that perceived advantage is one of the key factors influencing the adoption of technology. Many farmers still do not see significant price differences between rice produced by uncertified and certified seeds while certified seeds generally have higher seed price; this became the main constraint for certified seed adoption (Thu, 2014). Farmers who are informed about marketability and higher output prices of products from certified seeds tend to adopt it faster than non–informed farmers. Farmers' expectations of potential yield also play a fundamental role in adopting a given variety (Langyintuo and Mekuria, 2008). If farmer perceives higher yield potential of the given variety or new technology than those of the existing ones, the probability of adopting will most likely increase.

Methodology

T-Test method

The t-statistic was introduced in 1908 by William Sealy Gosset. A t-test is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling

term is unknown and is replaced by an estimate based on the data, the test statistics (under certain conditions) follow a Student's t distribution.he t-test can be used to determine if two sets of data are significantly different from each other.

Most t-test statistics have the form:

$$t = \frac{Z}{s} = \frac{(X' - \mu)/(\frac{\sigma}{\sqrt{n}})}{s}$$

where X' is the sample mean from a sample $X_1, X_2, \ldots, X_n$ of size n, s is the ratio of sample standard deviation over population standard deviation, σ is the population standard deviation of the data, and μ is the population mean.

Empirical model of adoption and variables

Random utility theory is often applied to indicate individual's decision in adopting a technology with the assumption of utility-maximizing behavior (Train, 2009). Individuals will make a decision on adopting the technology if the choice he made maximizes the perceived utility(Fernandez and McBride, 2002).The decision maker *n* will make the choice of an alternative that maximizes the perceived utility if the utility of adoption (U_{nA}) is higher than non-adoption utility (U_{nNA}). The decision can be observed as a binary random variable:

$$y_n = \begin{cases} 1 \text{ if } U_{nA} > U_{nNA} \\ 0 \text{ otherwise} \end{cases}$$

Standard logistic distribution of unobserved components of utility or the error term is assumed in this study, and the logistic model is chosen to estimate farmer's adoption of certified aromatic rice seed.

The binomial logistic model is obtained by assuming each ε_n is independent, identically distributed extreme value. Assume that there is an underlying response variable y_n

$$y_n = \begin{cases} 1 \text{ if the farmer n adopts certified aromatic rice seed} \\ 0 \text{ otherwise} \end{cases}$$

$$\text{Prob}(y_n = 1) = \text{Prob}(\varepsilon_n > -\beta X_n) = 1 - F(-\beta X_n)$$

Where F(.) is the cumulative distribution function for ε_n. Thus, the functional form for F(.) will depend on the assumptions made about ε_n. The probability that an individual n chooses adopting a new technology is P, then $(1 - P_n)$ is the probability of not adopting a new technology ($0 \leq P_n \leq 1$).

If the cumulative distribution of ε_n is the logistic form, then the binomial logit model is established. In this case

$$F(-\beta X_n) = \frac{e^{(-\beta x_n)}}{1 + e^{(-\beta x_n)}} = \frac{1}{1 + e^{(\beta x_n)}} \qquad \text{Alternatively, } 1 - F(-\beta X_n) = \frac{e^{(\beta x_n)}}{1 + e^{(\beta x_n)}}$$

$$P_n = \frac{e^{(\beta x_n)}}{1 + e^{(\beta x_n)}} \text{ or } P_n = \frac{e^{Z_n}}{1 + e^{Z_n}} \text{where } Z_n = \beta_0 + \beta_1' X_n, \text{ hence } 1 - P_n = \frac{1}{1 + e^{Z_n}}$$

$$\text{Odds ratio} = \frac{P_n}{1 - P_n} = \frac{\text{Prob}(y = 1|X)}{\text{Prob}(y = 0|X)} = \frac{\text{Prob}(y = 1|X)}{1 - \text{Prob}(y = 1|X)} = e^{Z_n} \qquad (1) \qquad (5)$$

This is called log odds ratio: $L = Ln\left(\frac{P_n}{1-P_n}\right) = Z_n = \beta_0 + \beta_1 X_n$ (6)

The Likelihood function can be expressed as $L = \prod_{n=1}^{N} \left(\frac{1}{1+e^{(\beta x_n)}}\right)^{1-y_n} \left(\frac{e^{(\beta x_n)}}{1+e^{(\beta x_n)}}\right)^{y_n}$ (7)

Marginal probability effect

The marginal probability effect is $\frac{\partial Prob(y=1)}{\partial x_n} = \beta_n (1 - P_n) P_n$ (2) (8)

If $(1-P_n)P_n$ is equal to zero at $P_n = 0$ and at $P_n = 1$, and it reaches its maximum value of 0.25 at $P_n = 0.5$. So the marginal effect is greatest when the probability is near 0.5 and smallest when P_n is near 0 or near 1.

The list of variables used in adoption model is summarized in Table 1.

Table 1: Description of variables in the logistic model

Variable	Description
Dependent variable	(1=use certified aromatic rice seed, if farmers used the seed is provided by formal seed system and has met quality standards required by National Technical Regulation on Seed Quality of Rice; 0= use uncertified aromatic rice seed, if farmers used the seed is provided by informal seed system and has not met quality standards required by National Technical Regulation on Seed Quality of Rice.
Independent variables	
Age	Years old of household head (years)
Edu	Years of schooling of household head (years)
Lab	Number of family members working on farm (people)
Loans	Household makes the loans for farm production (1: yes, 0: no).
AR.Time	Years of growing aromatic rice (years)
Avail	Availability of certified aromatic rice seed (1: Always, 0: Sometimes)
Area	Size of aromatic rice plot (ha)
Seed.Rate	Amount of aromatic rice seed use (kg/ha)
Diff.Disease	Farmer perceives disease tolerance of certified seeds higher than uncertified seeds(0 = disagree, 1 = agree)
Diff.Price	Farmer perceives output price of certified seeds higher than uncertified seeds (0 = disagree, 1 = agree)
Diff.Yield	Farmer perceives yield of certified seeds higher than uncertified seeds (0 = disagree, 1 = agree)
Diff.Profit	Farmer perceives profit of certified seeds higher than uncertified seeds (0 = disagree, 1 = agree)
Prod.Seed	Farmer produces rice seeds for next crop (1: yes, 0: no)

Data collection and sampling

Aromatic rice farmers in MRD were selected for a face-to-face interview for the Winter-Spring 2016/2017 production data by employing a multi-stage random sampling procedure. The aromatic rice varieties included in this study are Jasmine 85 and RVT which are suitable for diverse areas in MRD, have high yield, tolerant to diseases and are the main aromatic varieties in MRD (Vietnam Food Association, 2016). In the first stage, two most adopted provinces of aromatic rice in Winter-Spring 2016 -2017 were selected from 13 provinces accounted for the total area of 381,386 hectares; Kien Giang province contributed to54,533 ha of Jasmine 85 and Soc Trang province contributed to 76,578 ha of RVT, dominated 14.3 % and 20.08% of total aromatic rice area in MRD, respectively. In the second stage, districts were stratified by certified aromatic rice seed adoption rate. One district has high adoption (higher than average rate of the province) and one district has low adoption (lower than average rate of the province) of certified aromatic rice seed (Kien Giang and Soc Trang Department of Agricultural and Rural Development, 2017). Nga Nam and Chau Thanh were selected to represent for high adoption districts in Soc Trang and Kien Giang province, respectively. Tran De (Soc Trang) and Giong Rieng (Kien Giang) districts were selected for low adoption districts.

For a large and infinite population, a sample size (n) is determined based on the confidence level and estimated proportion of an attribute (p) (Cochran,1977).

$$n = \frac{Z^2 p.q}{e^2}$$

where:

n is sample size

Z^2 is the Z-values of confidence level, which is the abscissa of the normal curve that cuts off an area α at the tails $(1 - \alpha)$ equals the desired confidence level

p is the estimated proportion of an attribute present in the population, and q is 1-p.

e is the desired level of precision

This study presumes that the confidence level is 95% (Z = 1.962); the desired level of precision 3% (e = 0.03), p is the estimated proportion of an attribute present in the population (p = 0.05)

$$n= \{1.962 \times (0.05 \times (1-0.05)\}/0.03 \sim 203$$

In MRD, household rice area is often separated into several plots, if all plots grow same aromatic variety and same type of seed, the largest plot area was selected. The two largest plots representing of each aromatic variety and/or type of seed were selected in the case that a farmer has more than one plot of different varieties and/or different types of seeds. A total of 203 farmers (with 206 plots) were selected randomly from four selected districts in two provinces (Table 2).

Table 2 Number of observations by selected areas

Province	District	Area		Number of observations	Number of plot
		ha	%		
Kien Giang	Chau Thanh	19,809	30.00	20	20
	Giong Rieng	46,740	70.00	83	83
	Subtotal	**66,549**	**100.00**	**103**	**103**
Soc Trang	Nga Nam	18,724	45.00	30	32
	Tran De	22,772	55.00	70	71
	Subtotal	**41,496**	**100.00**	**100**	**103**
Total				**203**	**206**

Results and discussion

A totalsample of 203 farmers with 206 plots was interviewed. About 34% of rice farmer did not adopt certified seeds. The main varieties grown in Winter-Spring 2016/2017 included Jasmine 85 and RVT with the share of 49.8% and 38.6%, respectively. Other aromatic rice varieties include ST5, ST24 and Dai Thom 8. The characteristics of certified seed adopters and non-adopters are generally similar in terms of age, education, ethnicity, agricultural work, number of household members (Table 3).

Table 3 Characteristics of aromatic rice cultivation in Mekong Delta

Item		Unit	Certified seed adopters	Non- certified seed adopters	Overall
Age		Year	51.8	50.7	**51.4**
Education		Year	6.4	6.2	**6.4**
Ethnicity	Kinh	%	73.3	70.8	**72.5**
	Hoa	%	1.5	1.5	**1.5**
	Khmer	%	25.2	27.7	**26.0**
Job	Agricultural	%	91.9	90.8	**91.5**
	Agricultural + Non-Agricultural	%	8.1	9.2	**8.5**
Labor	Male	Person	1.5	1.6	**1.5**
	Female	Person	1.0	1.2	**1.1**
Famers' Organizations	Yes	%	16.2	7.7	**13.3**
	No	%	83.8	92.3	**86.7**
Number of observations		plot	136	70	**206**

Among certified seed adopters, 16% of farmers take part in at least one of the organizations such as good agricultural practice (GAP), cooperative, large farm field, seed club and contract farming compared with only 7.7% among non-adopters. Similarly, farming characteristics such as area and experience in growing aromatic rice are not significantly different between two groups (Table 4).

Table 4 Area of aromatic rice cultivation in Mekong River Delta

Item	Unit	Certified seed adopters		Non- certified seed adopters		Total		t-test
		Mean	STD	Mean	STD	Mean	STD	
Total Area	ha	3.90	5.88	3.59	2.56	3.79	4.99	ns
Rice Area	ha	3.72	5.81	3.47	2.53	3.63	4.92	ns
Aroma Area	ha	3.43	4.73	3.37	2.47	3.41	4.09	ns
Time of growing rice	year	27.13	10.76	28.59	11.90	27.63	11.16	ns
Time of growing aroma	year	9.74	6.91	10.99	6.55	10.17	6.80	ns
Number of observations	plot		136		70		206	

It was found that seed center is the main formal supplier of certified seeds; however, in 136 plots used the certified seed, the percentage of buying the seed directly from seed centers is only 6% while most farmers bought certified aromatic seed from private companies (54% under contracts and 3% bought the seed retails shop within commune). The majority of non-adopted farmers kept the seeds (70 plots), only 22% bought or exchanged seeds with their neighbors. The reason was that farmers did not believe in other seed producers or farmers so they would buy basic seeds and produce seeds in a small area for next season's use.

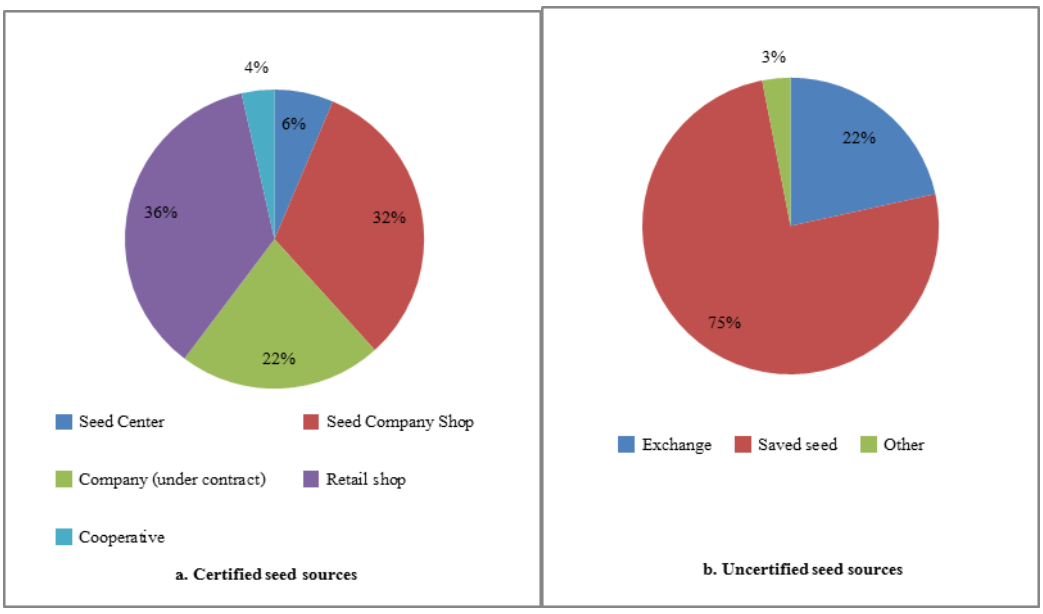

Figure 1 Certified and uncertified aromatic rice seed by sources

Figure 2 reflects farmers' perceptions on seed characteristics comparing between aromatic rice seeds produced by themselves compared with ones in the market. The majority of farmers agree that the purity and germination of the kept seeds is a lower than certified aromatic rice seeds on the market. The reason is that formal producers have modern machines and technology for moisture and storage treatments so the seeds can be kept for a longer period without affecting the germination rate. In contrast, their perceptions of disease tolerance, output price, yield, and profit are similar between two seed sources. When the collectors decide to buy the paddy from the fields, they focus on the appearances of the grains such as shape and color without focusing seed sources. For disease tolerance, most farmers agree that it is affected by the weather and has no correlation with sources of seeds.

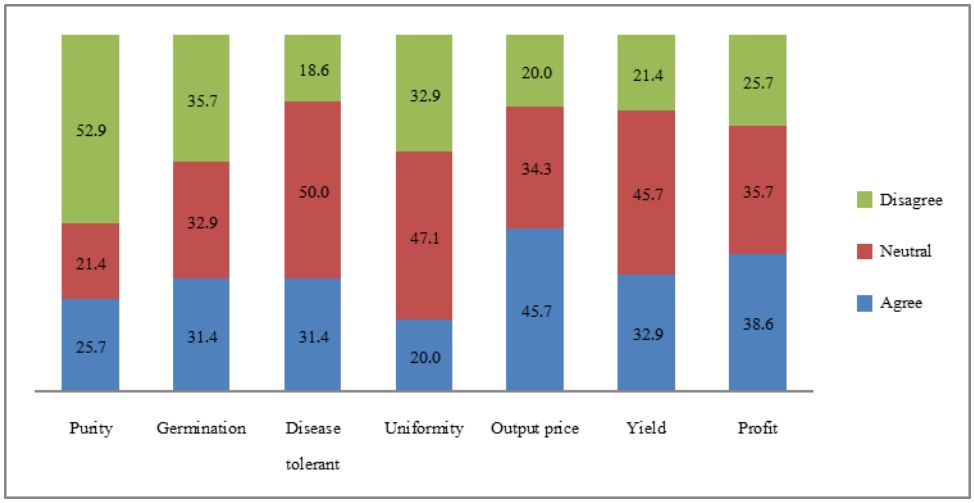

Figure 2 Farmers' perception about the aromatic rice seeds produced by themselves compared with ones in the market

When farmer considers using certified aromatic rice seeds, germination rate, purity, and uniformity are the main characteristics that farmer put high importance (over 50% said it is important) (Figure 3). Certified seed adopters rated germination rate and purity more important than non-adopters (72.1 % versus 60.0%; 52.2 versus 45.7%, respectively).

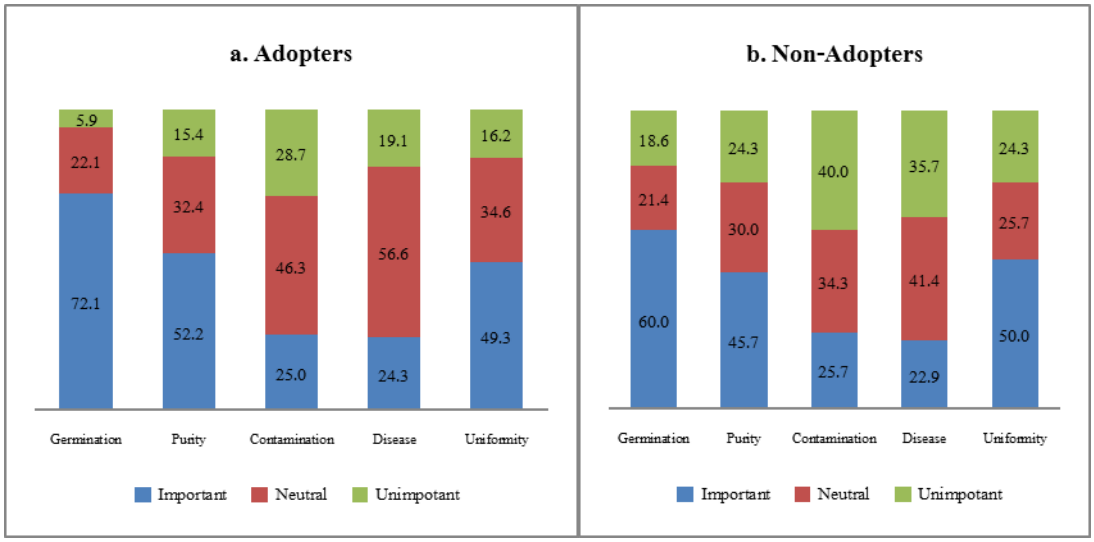

Figure 3 Certified seed adopters and non-adopters' attitudes towards characteristics of certified aromatic rice seeds

Adoption of certified aromatic rice seed in MRD

The estimate from the logistic model of adoption is shown in Table 5. There are four significant factors influencing the probability of adopting certified aromatic rice seeds. Availability of certified aromatic seed and difference in profitability were found to be positively related to a probability of adopting certified aromatic rice seeds while seed rate and own seed production reduced the probability of adopting them.

These results imply that when farmer perceived that certified aromatic rice seeds can provide higher profit, the probability of using certified seed increases. The positive influence of perception on profitability advantage was also found by Chi (2002) in the farming system. The marginal effect indicated that farmers were 36.49% more likely to use certified aromatic rice seeds in the rice cultivation compared to uncertified seeds when they believed that certified seeds give better benefits. Similarly, farmers who indicated that certified aromatic rice seeds were always available when they want to use them at the proper time, the probability adopting certified seeds increases. This finding is similar to a study by Ghimire et al., (2015) they found that the adoption of new improved rice varieties is positively influenced by the availability of seeds in the local stores when farmers can easily access and purchase the seeds in a local shop in a closer distance. In contrast, the higher seed rate is used, the lower probability to adopt certified aromatic rice seeds. When the seed rate increased by one kilogram per hectare, the probability of farmer likely to use certified seed reduced by 4.4%. This might be because higher seed rate resulted in higher production costs especially when the price of certified seeds is higher, farmers perceived certified seeds as a major cost disadvantage (Thu, 2014). The most influencing factor on certified aromatic rice seed adoption is the production of seeds for the next season. This finding was not found in earlier literatures. The results showed that farmers who produced and kept seeds for following crops are less likely to adopt certified seeds in Winter-Spring season, and the probability of adopting certified seed drops by 75.34%. This is because the representative plot interviewed is the

largest plot of aromatic rice in the Winter-Spring season, and many farmers left a small area for seed production for next crop. Likewise, they used uncertified seeds kept from last season for a larger area.

Table 5 Coefficient estimates of logistic model of certified aromatic rice adoption in Mekong River Delta, Vietnam, and marginal effects

Variable	Coefficients estimates			Marginal effect		
	Coef.	Std. Err.		Coef.	Std. Err.	
Age	-0.0145	0.0199		-0.0031	0.0042	
Edu	-0.0451	0.0599		-0.0096	0.0127	
Lab	-0.2048	0.1717		-0.0436	0.0364	
Loans	-0.0298	0.4209		-0.0063	0.0899	
AR.Time	-0.0338	0.0275		-0.0072	0.0058	
Avail	1.0638	0.5531	*	0.2479	0.1341	*
Area	0.1389	0.1454		0.0296	0.0308	
Seed.Rate	-0.0207	0.0064	***	-0.0044	0.0014	***
Diff.Disease	0.4565	0.4747		0.0944	0.0951	
Diff.Price	-0.2780	0.5047		-0.0593	0.1080	
Diff.Yield	-0.2604	0.5529		-0.0547	0.1143	
Diff.Pro	1.6830	0.6039	***	0.3649	0.1239	***
Prod.Seed	-4.1533	0.7842	***	-0.7534	0.0610	***
Constant	4.4726	1.7355	***			
Number of observation = 206						
LR chi2(13) = 97.96						
Prob> chi2 = 0.0000						
Log likelihood = -83.046764						
Pseudo R2 = 0.3710						

Conclusion

Changes in consumers' preferences towards aromatic rice are expected in the world market and Vietnam's policy to encourage quality aromatic rice production is being promoted. Aside from good varieties, using certified seeds to ensure quality and uniformity of rice products. To compete with the other aromatic rice exporters, Vietnam has to improve rice quality, and using certified aromatic rice seed is an initial condition for the high-quality product. The results revealed that many aromatic rice farmers still produce and keep the seeds in MRD. Their perceptions of certified and uncertified seeds are not too much different except for purity and germination rate.

The finding from the certified seed adoption model suggested that seed rate and availability of the seed affect the farmer's adoption. By reducing the amountof seed used, farmers can save the cost and get higher profit, and resulted in higher adoption of certified seeds. This is consistent with the policy to reduce the cost of production by using optimal seed rate but also high quality seeds. Availability of quality seeds is one of the biggest constraints in previous literatures, and also was supported by our results. Many farmers who were not able to access certified seeds at the appropriate time and those who have to produce seeds themselves for cost saving tend not to adopt certified seeds. It is suggested that policies towards delivering quality seeds at the affordable price so that farmers can have access to them and perceived relative more benefits in adopting certified seeds will be needed in order to promote the adoption of certified seeds which will result in improving the quality of aromatic rice in Vietnam.

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