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Agricultural extension services to foster production sustainability for food and cultural security of glutinous rice farmers in Vietnam

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ABSTRACT

In Vietnam, while glutinous rice farming represents a very small sub-sector of rice production, it plays an important role in the food and cultural security of farming households in many remote areas. This paper examined glutinous rice farming in households, as a food and for cultural security, and the extension services in areas producing glutinous rice. Data were collected from 400 local farmers based on interview schedules and statistical analysis using the percentage, arithmetic mean, and hypothesis testing with logistic regression. It was found that most glutinous rice farmers were small-scale producers, with an average glutinous rice-growing area of 0.15 ha and a yield of 3,200 kg per ha. Local as well as breeding varieties of seeds were supplied. Most farming households had sufficient glutinous rice for regular food and cultural consumption. Other starchy products were also consumed as part of their traditional diets. Supporting extension services were found to be very active and comprehensive, playing a key role in fostering the sustainable production of glutinous rice and helping to ensure local food and cultural security in Vietnam.

Introduction

Vietnam is a country in Southeast Asia well known for its ability to grow rice for food consumption and also for export. It has been a rice export country since 1988, just two years after implementing the "renovation program" (Doi Moi Policy). The volume of rice export (mainly of the non-glutinous variety) has increased over time so that four years after this program started, Vietnam stopped importing rice (Bui, 2010; Nguyên, 2001). Currently, Vietnam is an emerging and fast-growing economy in Southeast Asia.

Vietnamese farmers grow both glutinous and non-glutinous rice, making the country one of the important glutinous rice producers of the Greater Mekong Subregion (GMS), sometimes referred to as mainland Asia or northern Asia. Glutinous rice is culturally preferred as a staple food by the people living in the lower Mekong River basin, particularly the Tai ethnic group. It is also traditionally used for special occasions such as ritual celebrations and Vietnamese ceremonies (Nguyên, 2001; Sharma, 2010; Sikor & Dao, 2000).

In terms of rice production, there are no substantial differences between the glutinous rice and non-glutinous rice cropping systems and which crop is grown depends on the geographical area. However, the production of glutinous rice fluctuates according to the demand and market price. This fluctuation has induced a slow rate of glutinous rice improvement, compared to non-glutinous rice. Consequently, many problems still remain, concerning the limited growing area and farm practices, such as seed quality, pest control, harvesting, and post-harvesting.

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In order to help farmers solve these problems, appropriate technologies from researchers and agricultural extension workers should be transferred to them. Therefore, agricultural extension services are considered to be very important for the development of glutinous rice production, particularly for food and cultural security.

Therefore, it is desirable to conduct field research into the current practices of glutinous rice production and supporting agricultural extension services in key production areas. Thus, the hypothesis of the study was that the agricultural extension services play crucial roles to foster sustainable production of glutinous rice to ensure local food and cultural security. It is anticipated that the study results can be used as a basis for future policy formulation and strategic planning for glutinous rice production to ensure food and cultural security, especially for those who consume glutinous rice.

Literature Review

Two types of rice are grown in Vietnam: 1) non-waxy rice (*Oryza sativa* var. *indica*) also known as ordinary rice or non-glutinous rice; and 2) glutinous rice (*O. sativa* var. *glutinosa*) also known as sticky rice or waxy rice. There are clear differences between the two kinds of rice as the raw grains of ordinary rice are translucent in color and after cooking turn opaque white, but the raw glutinous rice grains are an opaque white color and turn translucent after cooking. Generally, a non-glutinous rice grain contains two types of starch (amylose and amylopectin), but glutinous rice has mostly amylopectin in its endosperm (Sattaka, Latvilayvong, & Padakan, 2013; Sharma, 2010).

In Vietnam, the glutinous rice growing areas are located in the provinces of Ninh Binh, Son La, Phu Tho, Thanh Hoa, Viet Tri, Son Tay in the North; Quang Tri in Central; Vietnam, and Ca Mau, An Giang in the South (Hannah, Dao, & Pham, 2010; Nguyên, 2001; Trudel, 2012). Glutinous rice is a traditional food, even though it is not a staple food everywhere (such as in Laos, where it is eaten at every meal), but it is still indispensible in Vietnam for its unique taste and aroma. However, there are Tai ethnic groups in the North who still consume glutinous rice as their staple food (Sattaka, Pattaratuma, & Attawipakpaisan, 2014; Trudel, 2012). Nguyên (2001) cited records of Vietnamese glutinous cultivars that indicated there were two cultivars that were opaque white, aromatic, and had a sweet grain quality, namely Lúa Nêp Den and Lúa Côm, while some cultivars were opaque white and had an aromatic grain quality, namely Lûa Nêp Huong, Lúa Chúe, and Lúa Cu Nâu. In addition, Lúa Nêp Qua is a black, aromatic and smooth glutinous rice. In recent decades, local glutinous rice varieties grown in Vietnam (Ga Gay sticky rice and Hoa Vang sticky rice) have been supplemented with hybrid varieties such as N97, N98, Dn20. However, the commercial varieties of glutinous rice in Vietnam have both local varieties and breeding varieties, which are Nhung, Ga Gay, Hoa Vang, and N97.

In Vietnam, the household area of rice cultivation is rather small with an average of 0.49 ha, but in the North, particularly in the densely populated Red River delta, the average area of cultivated rice is just 0.22 ha (Nguyên, 1999). With regard to the cropping system used by Vietnamese farmers, Nicholas and Francesco (2000) reported that of the total ordinary planting area, 8.8 percent was triple cropped, 55.2 percent double cropped, and 36.0 percent single cropped. In the North, Eliste and Santos (2012) reported that most of the rice planting area was under single and double cropping. There are three rice planting methods used: transplanting, broadcasting, and direct seedling. Before planting, the seeds have to be soaked in cold water to absorb sufficient water before they can germinate.

To increase glutinous rice production, Vietnamese farmers have to use chemical fertilizers, organic fertilizers, and insecticides, but weed control is more often done using physical methods than herbicides (Pingali, Xuan, Khiem, & Gerpacio, 1998). The ripened rice seeds are harvested 28–32 days after flowering or when 85–90 percent of the rice seeds are ripe, using normal sickles or sickles with saw-like blades, or by machine. If the harvest is cut early or delayed, the loss rate of rice grains will be increased. Following harvesting the rice grains are threshed using human labor or machines, and grains are dried under the sun for a few days and then stored in a dry and airy place. If the storage period is less than 3 months, the grain moisture should be 14–15 percent (Dac, 1996).

By developing their farming system and having access to successful agricultural extension services, the farmers have been able to improve their production efficiency for all major agricultural products to assure optimum food production, especially of glutinous rice. For example, the important agricultural extension measure of rice production in Vietnam was “Three Reductions, Three Gains” project that aimed to reduce the production cost by reducing the amount of seed, fertilizer, and pesticides, whilst gaining a higher yield, better rice quality, and more profit. The mass media used in the project campaign to reach and motivate farmers were television, radio, printed material, and practical demonstrations, and the important services were meetings, training, and learning through practice in their field (Nguyên, Ho, & Le, 2010; Zenaida, Deborah, & Pamela, 2008). The campaign indicated that farmers can improve rice production through appropriate agricultural extension services coupled with credit facilitation and the creation of domestic and export markets for projected farm products. Finally, these services will help to address farmers' concerns regarding food security.

Methods

Study Areas, Population and Sample

The study area consisted of the eight provinces of Vietnam where farmers grew glutinous rice and most of the population consumed glutinous rice, namely, Son La, Phu Tho, Thanh Hao, An Giang, Nghệ An, Dien Bien, Hoa Binh, and Ninh Bình (Hannah et al., 2010; Nguyên, 2001; Trudel, 2012) with a population of 1,690,905 people (General Statistics Office of Vietnam, 2013). Four provinces out of eight province were identified, using a simple random sampling method to obtain 50 percent as recommended by

the relevant agriculture official, resulting in Ninh Binh, Son La, Phu Tho, and Thanh Hao in the North. The required number in the sample was determined to be 400 farmers, based on the Taro Yamane formula at the 95 percent confidence level (Yamane, 1973).

Research Tool

An interviewing schedule was constructed consisting of baseline information on socio-economics, glutinous rice production, local glutinous rice security, and agricultural extension services. The survey of glutinous rice security of the farmers' household was comprised of four parts: monthly glutinous rice consumption sufficiency of farmers, glutinous rice production stability, glutinous rice utilization, and the important practical factors of glutinous rice production (modified from Jenson & Nord, 2012; Prachasan, 2012).

1) Monthly glutinous rice consumption sufficiency of farmers comprised the 12 months of the year and the criterion for scoring and measurement were: 0 = "insufficient" and 1 = "sufficient".

2) Glutinous rice utilization consisted of three items: farmers consume clean and safe glutinous rice, farmers consume other dishes instead of glutinous rice, and farmers are able to process glutinous rice to use in edible dishes, with the criterion for scoring and measurement being: 0 = "no" and 1 = "yes".

3) Glutinous rice production stability comprised seven situations: farmers have sufficient water for growing glutinous rice, keeping water in a well for using on-farm, improving the soil fertility for growing glutinous rice every year, planning to produce glutinous rice for consumption throughout the year, keeping glutinous rice for emergencies (natural disasters, war, climate change), having a plan to reduce chemical agents involved in glutinous rice production, and farmers have community sources of glutinous rice knowledge. The criterion for scoring and measurement were: 0 = " unstable" and 1 = "stable".

Agricultural extension services consisted of 12 methods: agricultural extension officials visit the paddy field, training, meetings, agricultural exhibitions, demonstration methods, demonstration of results, agricultural visits, VCD media, TV programs, radio programs, printed material, and internet. The criterion for scoring and measurement were: 0 = "not applied" and 1 = "applied".

Data Collection

The interview schedule was developed and then edited and corrected by experts and finally translated into Vietnamese by an interpreter. This was followed by pre-testing using 30 farmers, after which the schedule was further corrected and edited in preparation for data collection. Data were collected using the simple random sampling method in Ninh Binh (100 farmers), Son La (100 farmers), Phu Tho (100 farmers), and Thanh Hoa (100 farmers), during January to May 2014.

Data Analysis

The survey used square meters for unit of area and the Vietnamese currency (VND) for all monetary values to make it easier for the farmers to provide their data. All survey results were converted into hectares (10,000 m^2 = 1 ha), and VND were converted to USD at a rate of USD 1 = VND 21,590. After collecting the data and checking for errors, the percentage and arithmetic mean were used to analyze the data. For hypothesis testing, the Wald chi-square test using the enter method was performed for logistic regression analysis.

Results and Discussion

Baseline Information of Socio-Economic of Vietnamese Farmers

Of the farmers, 68.5 percent were male and 31.5 percent were female, with an average age of 48 years. Of the respondents, 49.5 percent of farmers had completed junior high school education and 35.7 percent had obtained vocational certification. It was found that 51.8 percent of the farmers owned an area of 0.2–0.6 ha, with the average area being 0.4 ha. The average number of family members was five.

The study showed that approximately 90 percent of farmers had education higher than elementary level, which meant that the farmers had a literacy level equal to 93 percent of the Vietnamese literacy rate (Metcalf, 2013). The area for planting rice was limited to only 0.41 ha per household, which was similar to the 0.49 ha reported by Nguyên (1999). Moreover, it was found that 63.5 percent of the farmers had rice planting experience of 1–10 years with the overall average experience being nearly 13 years. Limited historical data are available on planting experience because of the division of the country into North and South Vietnam at the 17th Parallel in 1955 after much fighting. Later in 1975, both North and South Vietnam were reunited. Finally, in 1986, Doi Moi (renovation program) provided an important step in economic reform, which provided the opportunity for the rapid development of agricultural production (Stewart, Atkinson, Harper, & Ray, 2014, pp. 428–432).

Glutinous Rice Planting Methods in Vietnam

The study found that 57.8 percent of farmers grew glutinous rice using a single cropping system and 42.2 percent used the double cropping system with the transplanting method being common (94.5%). Approximately 65.2 percent of farmers used local seed varieties such as Hoa Vang, Ga Gay, and Nêp Tan Nhe, and 34.8 percent used bred varieties, such as N97, C98, and N98. Glutinous rice seeds were purchased mainly from governmental organizations (54.5%) while 29.2 percent used their own seed.

Approximately 98.2 percent of the farmers pre-soaked seeds before planting. Approximately 43.0–62.0 percent of farmers included one to three applications of chemical fertilizers, with mixed-chemical fertilizer applied by more than 25.7 percent of farmers. Most farmers harvested glutinous rice by hand (93.7%) and kept their harvest at home (77.5%).

Most farmers had to grow glutinous rice using single cropping because most of them used local varieties, which are photoperiod-sensitive such as Ga Gay and Hoa Vang sticky rice. These local varieties are suitable for planting as in-season rice or in the wet season during May to late October and have a low yield. In recent decades, local varieties have been replaced by hybrid varieties such as N97, N98, and C97 sticky rice that have a high yield. New rice varieties have been regularly released to farmers in Vietnam over recent decades (Brennan & Malabayabas, 2011; Trudel, 2012). At the same time, the governmental organizations have been promoting high quality local varieties for farmers in the study area. Therefore, approximately 54.5 percent of the farmers bought glutinous rice seeds from the governmental organization in preference to seed produced by the farmers themselves.

Approximately 94 percent of the farmers used the transplanting method consistent with that of their ancestors, where rice seed was planted in the nursery and then transplanted to the field using human labor or a transplanting machine. Moreover, the transplanting method can reduce the amount of seed rice seed required. Harvesting and storage were still done by hand by most farmers because they could reduce expenditure and also they kept the harvested rice at home for safety reasons.

Glutinous Rice Production for Food and Cultural Security in Vietnam

Glutinous Rice Production

In the study, the minimum area of glutinous rice was 0.1 ha and the maximum area was 2.0 ha with an average glutinous rice growing area of 0.15 ha. The glutinous rice production by the farmers ranged from a minimum of 1,944 kg/ha to a maximum of 3,737 kg/ha, with an average glutinous rice yield of 3,200 kg/ha. Moreover, it was shown that 86.0 percent of the farmers harvested yields of glutinous rice in the range 3,001–3,500 kg/ha. Annual glutinous rice production ranged from a minimum of 32 kg per household to a maximum of 6,250 kg per household, with the average being 484 kg per household. Approximately 49 percent of the farmers had annual glutinous rice production in the range 300–900 kg. Income from glutinous rice sales ranged from nothing to a maximum of USD 1,880, with an average income of USD 351.

It was found that most households had a very limited area for growing glutinous rice, with an average of 0.15 ha, similar to the report of Dao and Pham (2013) which indicated that the average area per household for growing glutinous rice was 0.18 ha. The study found that the household income from selling glutinous rice, averaged of USD 351 per year, which was similar to the income reported by Dao and Pham (2013) of USD 324–463 per ha.

The study indicated Vietnamese farmers had low annual yields of glutinous rice (approximately 300–900 kg), because the farmers had a limited glutinous rice growing area, used varieties that were low-yielding of good quality such as Hao Vang and Ga Gay sticky rice and grew only one crop per year. Consequently, the farmers had to grow both glutinous rice and non-glutinous rice in order to be self sufficient in rice for their own household consumption, as the non-glutinous varieties could yield more than one crop per year and had a high yield.

Glutinous Rice as Food and Cultural Security

The study on glutinous rice sufficiency found that more than 90 percent of the farmers had glutinous rice consumption sufficiency for 6 months (January, February, September, October, November, and December) while for the rest of the year, more than 85–90 percent of the farmers had glutinous rice consumption sufficiency. However, there was a period of insufficiency during April to May and during July to August, because these were times before harvesting.

For glutinous rice stability, it was found that most of farmers (89.8%) had a plan to produce glutinous rice for the whole year's consumption, 88.2 percent had sources of glutinous rice knowledge in community, and 85 percent improved the soil fertility every year. Furthermore, 75.5 percent of respondents had sufficient water for growing rice, 72.8 percent kept water in a well for use on their farm, and 64 percent had a plans to reduce chemical agents for glutinous rice production. Only 24.8 percent of Vietnamese farmers kept glutinous rice for emergencies.

The results showed that 97.8 percent of farmers were able to consume clean and safe glutinous rice and 92.3 percent were able to use glutinous rice to make other edible dishes. Moreover, 42.8 percent of farmers consumed other dishes instead of glutinous rice.

Even though the farmers had a low annual glutinous rice yield, the study indicated that Vietnamese farmers had more than 85 percent glutinous rice sufficiency because: 1) the average Vietnamese consumption of glutinous rice reaches 10–12 kg per capita per year and 2) both glutinous and non-glutinous rice were consumed daily as well as other forms of starch products. Moreover, some farmers did not consume glutinous rice as a staple food, but rather, used it as a complementary ingredient in their diet and as a main offering in ritual and ceremonial festivities (Nguyên, 2001). The study found that more than 72 percent of farmers had sufficient water for rice production, and 85 percent improved the soil fertility every year, following agricultural development since the food crisis in 2008. The Vietnamese government has focused on improving food security through many projects including: land reforms, encouraging farmers to increase rice production, increased yield through improved irrigation and new rice seed varieties, and pest control. Consequently, Vietnam has achieved self-sufficiency in rice and food security with the remaining 20 percent of rice production available for export, with Vietnam being the leading rice-exporting country. However, the agricultural extension officials should increase awareness of saving glutinous rice for emergencies, as only 24.8 percent of farmers kept glutinous rice for such a use, and only 42.8

percent of farmers could consume other dishes instead of glutinous rice. The study found that most of the Vietnamese farmers were able to make glutinous rice into other dishes. This was consistent with Nguyên (2001) who reported that glutinous rice was an important ingredient in over 400 kinds of dishes, 70 kinds of cakes and sweetmeats, 22 kinds of Ché (sweetened porridges), Cháo (soups, gruels), 20 kinds of beverages (liquors, spirits, wines, alcohols, and beers), 30 kinds of pickles, and in pickled fish and shrimps.

Agricultural Extension Services to Support Glutinous Rice Production

The supporting agricultural extension services to promote glutinous rice production were found to be comprehensive, ranging from training, agricultural extension officials visiting planting fields, and meetings (59.5%, 57.2%, and 55.8%, respectively). The agricultural extension services provided were used on average by 40–49 percent of the farmers and consisted of demonstration methods (45.00%), printed material (43.8%), agricultural visits (9%), internet (42.5%), and radio programs (40.8%). It was also found that farmers utilized the demonstrations of results and TV programs to assist in the production of glutinous rice, with responses of 38.2 percent and 35.5 percent, respectively. Approximately 22.5 percent of the farmers received VCD media and only 9.8 percent of the farmers attended exhibitions related to glutinous rice production.

The hypothesis testing indicated that the agricultural extension services influence monthly glutinous rice consumption sufficiency of farmers as follows:

1. Training ($p = .005$), meetings ($p = .044$), agricultural visits ($p = .042$), VCD media ($p = .007$), radio programs ($p = .000$), and printed material ($p = .000$) influenced glutinous rice consumption sufficiency in January. The model explained 66 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 96.5 percent.
2. TV programs ($p = .004$), radio programs ($p = .000$), and printed material ($p = .004$) influenced glutinous rice consumption sufficiency in February. The model explained 49.1 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 96.3 percent.
3. Demonstration of results ($p = .041$), radio programs ($p = .000$), and printed material ($p = .000$) influenced glutinous rice consumption sufficiency in March. The model explained 42.4 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 92.8 percent.
4. Agricultural extension officials visiting paddy fields ($p = .004$), VCD media ($p = .031$), TV programs ($p = .001$), and printed material ($p = .027$) influenced glutinous rice consumption sufficiency in April. The model explained 40.5 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 88.3 percent.
5. Agricultural extension officials visiting paddy fields ($p = .002$), training ($p = .029$), meetings ($p = .006$), demonstration of results ($p = .005$), VCD media ($p = .039$), TV programs ($p = .005$), and printed material ($p = .011$) influenced glutinous rice consumption sufficiency in May. The study showed that a lot of agricultural extension services influenced glutinous rice consumption sufficiency in May (the time before harvesting) because glutinous rice knowledge and technology were supported by the agricultural extension workers before commencing the new crop. The model explained 40 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 88.3 percent as shown in Table 1.
6. Agricultural extension officials visiting paddy fields ($p = .001$), training ($p = .011$), meetings ($p = .004$), TV programs ($p = .000$), and radio programs ($p = .000$) influenced glutinous rice consumption sufficiency in June. The model explained 31.6 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 90 percent.
7. Agricultural extension officials visiting paddy fields ($p = .001$), training ($p = .030$), meetings ($p = .000$), demonstration of results ($p = .012$), and TV programs ($p = .000$) influenced glutinous rice consumption sufficiency in July. The model explained 48.4 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 90.8 percent.
8. Agricultural extension officials visiting paddy fields ($p = .001$), meetings ($p = .008$), demonstration of results ($p = .020$), TV programs ($p = .000$), and printed material ($p = .017$) influenced glutinous rice consumption sufficiency in August. The model explained 52.1 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 91.3 percent.
9. Agricultural extension officials visiting paddy fields ($p = .001$), meetings ($p = .047$), and TV programs ($p = .001$) influenced glutinous rice consumption sufficiency in September. The model explained 33 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 92.3 percent.
10. Agricultural extension officials visiting paddy fields ($p = .004$) and TV programs ($p = .010$) influenced

Table 1
Logistic regression results of agricultural extension services for glutinous rice consumption sufficiency in May

Model	B	SE	Wald	p	Odds ratio
(Constant)	2.867	.360	63.346	.000	17.582
Agricultural extension officials visiting paddy field	−1.850	.593	9.719	.002**	.157
Training	−1.336	.611	4.771	.029*	.263
Meetings	1.428	.522	7.476	.006**	4.171
Agricultural exhibitions	−.307	.587	.274	.601	.735
Demonstration of methods	.203	.593	.118	.732	1.225
Demonstration of results	1.505	.534	7.957	.005**	4.506
Agricultural visits	.040	.540	.005	.941	1.040
VCD media	−1.025	.496	4.268	.039*	.359
TV programs	1.681	.600	7.835	.005**	5.368
Radio programs	1.190	.642	3.440	.064	3.288
Printed material	−1.581	.622	6.456	.011*	.206
Internet	−.696	.538	1.673	.196	.499

*$p < .05$, **$p < .01$, $\chi^2 = 30.97$, p-value = .000, Nagelkerke $R^2 = 0.400$ (40%)

glutinous rice consumption sufficiency in October. The model explained 24.9 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 91.5 percent.

11. Agricultural extension officials visiting paddy fields ($p = .010$) and internet ($p = .044$) influenced glutinous rice consumption sufficiency in November. The model explained 27.1 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 93 percent.
12. Demonstration of results ($p = .018$) and internet ($p = .006$) influenced glutinous rice consumption sufficiency in December. The model explained 18.8 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 96.5 percent.

The study found that the agricultural extension services influenced glutinous rice utilization as follows:

1. Demonstration of results ($p = .038$) and internet ($p = .016$) influenced the farmers' consumption of clean and safe glutinous rice which were important indicators of food utilization. The model explained 27.2 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 98 percent as shown in Table 2.
2. Training ($p = .027$), meetings ($p = .011$), radio programs ($p = .041$), and printed material ($p = .020$) influenced the farmers' consumption of other dishes instead of glutinous rice. The model explained 23.8 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 69 percent.
3. Agricultural visits ($p = .015$) and VCD media ($p = .006$) influenced farmers ability to process glutinous rice into edible dishes. The model explained 12.7 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 92 percent.

Moreover, the study indicated that the agricultural extension services influenced glutinous rice stability as follows:

1. Training ($p = .027$), agricultural visits ($p = .000$), and VCD media ($p = .000$) influenced sufficient availability of water for growing glutinous rice. The model explained 19.7 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 76.3 percent.
2. Demonstration of methods ($p = .006$), demonstration of results ($p = .000$), agricultural visits ($p = .000$), VCD media ($p = .000$), radio programs ($p = .002$), and printed material ($p = .016$) influenced keeping water in a well for use on-farm. The model explained 33 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 79 percent.
3. Meetings ($p = .011$) and VCD media ($p = .020$) influenced improving soil fertility for growing glutinous rice every year. The model explained 21.6 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 84.8 percent.
4. Training ($p = .001$), meetings ($p = .000$), and radio programs ($p = .038$) influenced planning to produce glutinous rice for all year consumption. The model explained 25.5 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 91 percent.
5. Meetings ($p = .031$), agricultural visits ($p = .009$), VCD media ($p = .000$), radio programs ($p = .000$), and printed material ($p = .000$) influenced keeping glutinous rice for emergencies. This was an important indicator for ensuring that the farmers could access glutinous rice if they encountered a natural disaster, war, or climate change. The model explained 39.2 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 81.8 percent as shown in Table 3.
6. Training ($p = .019$), agricultural exhibitions ($p = .001$), demonstration of methods ($p = .000$), agricultural visits ($p = .033$), and TV programs ($p = .040$) influenced having a plan to reduce chemical agents for glutinous rice production. The model explained 35.1 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 69.3 percent.
7. VCD media ($p = .031$) influenced sourcing of glutinous rice knowledge in the community. The model explained 10.7 percent (Nagelkerke R^2) of glutinous rice consumption sufficiency and correctly classified 89 percent.

Table 2
Logistic regression results of agricultural extension services for clean and safe glutinous rice consumption

Model	B	SE	Wald	p	Odds ratio
(Constant)	5.271	1.072	24.153	.237	.156
Agricultural extension officials visiting paddy fields	−1.860	1.571	1.401	.237	.156
Training	.313	1.428	.048	.827	1.367
Meetings	1.413	1.162	1.479	.224	4.108
Agricultural exhibitions	−2.272	1.208	3.540	.060	.103
Demonstration of methods	.281	1.132	.061	.804	1.324
Demonstration of results	2.300	1.109	4.300	.038*	9.971
Agricultural visits	−1.606	1.210	1.762	.184	.201
VCD media	1.741	1.051	2.744	.098	5.702
TV programs	1.001	1.147	.761	.383	2.720
Radio programs	.398	1.244	.102	.749	1.488
Printed material	.556	1.160	.229	.632	1.743
Internet	−3.746	1.549	5.850	.016*	.024

*$p < .05$, $\chi^2 = 13.579$, p-value = .000, Nagelkerke $R^2 = 0.272$ (27.2%)

Table 3
Logistic regression results of agricultural extension services for keeping glutinous rice for emergencies

Model	B	SE	Wald	p	Odds ratio
(Constant)	−1.960	.247	62.999	.000	.141
Agricultural extension officials visiting paddy fields	.587	.465	1.593	.207	1.799
Training	−.458	.530	.748	.387	.633
Meetings	1.038	.482	4.640	.031*	2.822
Agricultural exhibitions	.870	.477	3.331	.068	2.387
Demonstration of methods	.017	.600	.001	.977	1.017
Demonstration of results	−.328	.568	.333	.564	.720
Agricultural visits	−1.473	.568	6.731	.009**	.229
VCD media	1.924	.433	19.790	.000**	6.851
TV programs	−.319	.522	.374	.541	.727
Radio programs	−3.347	.888	14.195	.000**	.035
Printed material	3.378	.868	15.150	.000**	29.312
Internet	.357	.472	.573	.449	1.429

*$p < .05$, **$p < .01$, $\chi^2 = 27{,}849$, p-value = .000, Nagelkerke $R^2 = 0.392$ (39.2%)

Therefore, the study indicated that agricultural extension services influenced glutinous rice production, especially for local food security. The results also signified a relationship between agricultural extension services—especially agricultural extension officials visiting paddy fields, training, meetings, result demonstrations, VCD media, radio programs, and printed material—and local glutinous rice security because periodic visits to paddy fields by agricultural extension officials, training, and meetings were suitable for promoting glutinous rice production to farmers with less planting experience, allowing direct contact with farmers and providing solutions to their problems. The utilization of demonstrations result, VCD media, and radio programs were found to be suitable to motivate the farmers interested in improving their production. These materials were also suitable for the more experienced farmers through a one-way contact approach.

It was noted that the results were similar to those of the "Three Reductions, Three Gains Project" operated in Vietnam. That Project used the mass media in various forms ranging from television, radio, and printed material to demonstrations to reach and motivate farmers. The most important methods were meetings and training to provide knowledge, technology and related information (Zenaida et al., 2008). Similarly, the extension workers of the glutinous rice project in Phu Tho province used such services and approaches including practical training and on farm trials (Trudel, 2012).

Conclusion and Recommendation

The study revealed that the majority of glutinous rice farmers in Vietnam were small-scale producers, with an average glutinous rice growing area of 0.15 ha and a relatively low yield of about 3,200 kg/ha. However, it was found that most of them had sufficient rice for household consumption, partly because their staple diet included non-glutinous rice as well as other forms of starch products. Consumption of glutinous rice has been and appears to continue to be their traditional and cultural preference despite the increased modernity of their lifestyles and a diet of non-glutinous rice.

The extension services provided to farmers were very comprehensive, ranging from demonstration plots to training and meetings, with multimedia educational materials as well as regular field visits for monitoring and technical consultations. Other supporting services included supplying seeds of local and breeding varieties and periodic related exhibitions. It can be concluded that such active and comprehensive extension services played crucial roles in fostering the sustainable production of glutinous rice, thus ensuring local food and cultural security. Nevertheless, it is believed that better yield and quality can also be achieved through more research on varietal improvement and good agricultural practices.

Conflict of interest

There is no conflict of interest.

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