NEW TECHNOLOGY FOR RICE PRODUCTION: ECONOMIC EFFICIENCY AND POLICY IMPLICATIONS

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Vietnam has become the world's second largest exporter of rice (after Thailand). The rice export volume of 4-5 million tonnes since 2005 earning over US$2 billion a year promises a possibly sustainable development of rice production. In achieving this result, the Mekong Delta plays a decisive role in terms of rice output and export volume. Rice producers, however, still have to face many difficulties – fluctuations in price and income, weather risk, and keen competition when integrating into the world market. Helping farmers increase rice output and their income has become the biggest challenge to researchers and policy makers in Vietnam today.

To achieve this aim, there is no alternative but to apply new technologies to rice production. The national agricultural extension machinery has transferred several new technologies (three-decrease and three-increase; or one-must plus five-decrease methods) to help peasants reduce production cost and adapt to climate change. Based on theories of economics and current conditions in Vietnam, we employ Independent Sample T-test and Chi-Square Test to evaluate elements of new technologies that affect economic efficiency and peasants' adaptation to the environment. Our research is based on a direct survey of 309 peasants in the Mekong Delta, comprising 176 who attended training courses in three-decrease and three- increase, or one-must plus five-decrease techniques; and 133 who failed to do so. We identify three factors - decreases in seeds, fertilizer and pesticide – that affect increases in income, selling price, and rate of return; and decrease in production cost.

Keywords: New technologies, agricultural extension, three-decrease and three- increase technique; one-must plus five-decrease technique

1. Introduction

The most noticeable achievement in Vietnam's agriculture in the past few decades was the rise in rice production. As an importer of some 900,000 tonnes of rice a year in 1976-1980 [5], Vietnam has become the world's second largest exporter of rice (after Thailand). The rice export volume of 4-5 million tonnes since 2005 with over US$2 billion in revenue a year promises a possibly sustainable development of rice

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production. Vietnam's supply of rice meets demand from both domestic and foreign markets. In achieving this result, the Mekong Delta plays a decisive role because it accounts for 90% of rice output and 50% of Vietnam's rice export volume [2]. Rice producers, however, still have to face many difficulties – fluctuations in price and income, weather risk, and keen competition when integrating into the world market. Helping peasants increase rice output and their income has become the biggest challenge to researchers and policy makers in Vietnam today.

No country by itself can control fluctuations in rice price and changes in climate and eco-system. Rice producers, however, regardless of changes or fluctuations, can always stabilize and increase their income if they can cut production cost and enhance product quality as required by the market. To achieve this aim, they have no alternative but to apply new technologies to their business. As from 2005, the agricultural extension system with technical assistance from International Rice Research Institute (IRRI) has transferred many technologies to peasants (three-decrease and three- increase; or one-must plus five-decrease techniques) to help peasants reduce production cost and adapt to climate change. The paper focuses on two principal issues: (1) economic efficiency of application of new technologies; and (2) implications for policies to disseminate such technologies among rice producers. The Mekong Delta is chosen as a representative area for collecting data and evidence.

2. Theoretical and practical bases

According to Feder & Slade (1993) [6], and Van den Ban (1996) [9], agricultural extension organizations act as intermediaries between investors of new technologies and users (i.e. farmers). Technologies are transferred through training programs and mass media. Results produced by trained peasants help disseminate new technologies among neighboring peasants. Thus, extension organizations play a decisive role in improving farmers' agricultural knowledge, and disseminating ways of applying new technologies among peasants. In Vietnam, main agricultural extension methods are (i) building models of technical demonstration and training; (ii) making community development plans with participation of peasants; (iii) providing farmers with training courses; and (iv) disseminating knowledge through mass media [1].

Research on "three-decrease and three-increase" (3G3T) technique was conducted by Nguyễn Hữu Huân in 2006 [8]. This technique aims at reducing volumes of seed, inorganic fertilizer and pesticide; and increasing yield, quality and profit. "One-must plus five-decrease" (1P5G) technical package is an extension of the 3G3T technique. It includes use of certified seed, reduction in use of water (by applying the alternative wet and dry watering method) and reduction in post-harvest loss by use of combine harvester and new drying techniques.

Results of this research helped persuade the IRRI to finance a project to develop large-scale pilot models in Cần Thơ and Tiền Giang in 2002-2004, and Ministry of Agriculture and Rural Development to officially launch its national program to apply these techniques.

To estimate effects of the technical packages, an IRRI expert team carried out an independent survey in An Giang and Cần Thơ in July and August 2006 [7]. Three districts in each province, and three communes in each districts, were selected and 200 farmers from these communes were interviewed about their 2005-06 winter-spring and 2006 summer-fall crops. The survey revealed that 86% of them learned about the program; 47% of them applied from one to three methods of the 3-decrease technique while 57% did not apply anything. They received information about new techniques from radio or TV set (24% - 35%), agricultural extension technicians (18% - 25%) and family members, neighbors and relatives (5% - 32%).

The new technologies aim at helping farmers enhance efficiency of rice production by reducing production expenses and costs and increasing profit and rate of return, and more importantly,

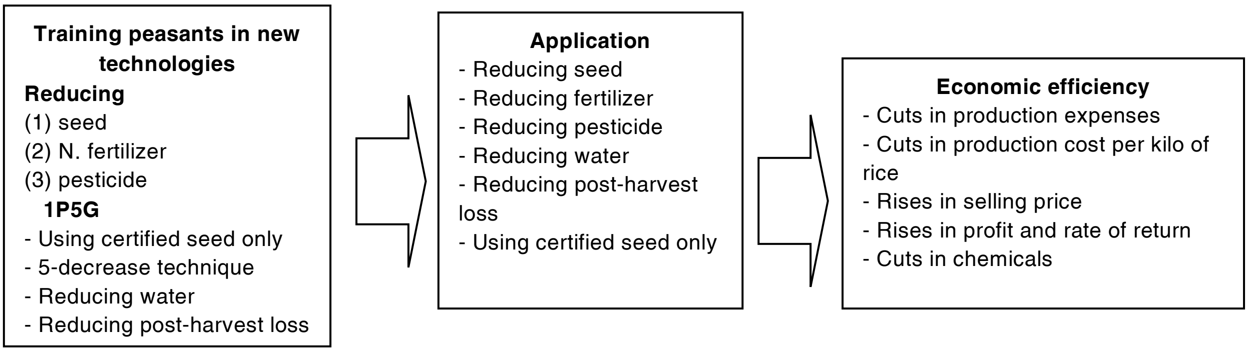

Figure 1: Effect of new technologies

reducing the use of chemicals for the sake of environment.

3. Methodology

Locality for this research includes three provinces participating in the new technology program: An Giang, Cần Thơ and Tiền Giang. Randomly stratified sampling was carried out in 2010 and three districts were selected: Châu Thành in An Giang, Thốt Nốt in Cần Thơ and Cai Lậy in Tiền Giang. In each district, authors selected three communes where farmers were interviewed. The sample comprised 309 farmers: 176 of them took part, and 133 did not, in training courses in 3T3G or 1G5P techniques. Independent sample T-test and chi-square test were used to estimate differences caused by new techniques between farmers applying new techniques and farmers following customary methods. SPSS 16.0 software was used for processing data.

4. Research results

- Seed quality: Farmers, after training courses, used more seeds of high-quality strains, such as Jasmine 85 and OMCS 2000; and less seeds of medium-quality ones such as IR50404 and OM 2514 than peasants following customary methods.

Table 1: Rice strains used by groups of peasants

Strain	Users as % of surveyed farmers	
	Non-participants	Participants
JASMINE 85	13.7	86.3
OMCS 2000	20	80
IR 50404	55	44
OM 2514	72	27

Source: Data collected by authors

Regarding sources of seeds, trained farmers (63%) used certified seeds or the like while untrained peasants (37%) used other seeds. Chi-square tests showed that a relation existed between the two groups of farmers and use of certified seed was significant to the level of 99%. This affirmed that trained farmers applied "one-must" method (using certified seed only) better than untrained farmers.

Table 2: Seeds used by groups of peasants

	Users as % of surveyed farmers	
	Non-participant	Participant
Common seed	51.39	48.61
Certified seed	37.01	62.99
Chi-square test	Value	Sig. (2-sided)
Pearson Chi-square	6.243	0.01

Source: Data collected by authors

Reduction in seed volume: In the 3G3T technical package, "reducing the seed volume" is the most important because it leads to reduction in volumes of fertilizer and pesticide. The seed volume for a hectare is 150.11 kg on average. This figure varied from the lowest of 134.36 kg in Tiền Giang to 147.52 kg in An Giang and the highest of 167.31 kg in Cần Thơ. Although this volume was still higher than the recommended level (from 80 to 120 kg), a remarkable decrease was reported because in the past farmers in these provinces used from 200 kg to 300 kg for a hectare. Statistics showed that a noticeable difference in the seed volume existed between two groups of farmers: Participants in training course used 141.1 kg of seed on average compared with 162 kg used by non-participants. The difference was significant at a level of reliability of 95% as shown by the independent sample T-test (See Table 3)

Table 3: Changes in surveyed factors

	Trained farmers	Untrained farmers	Test	
			Chi-square test Sig. (2 sided)	Independent sample T-test Sig. (2 tailed)
Seed (kg/ha)	141.10	162.04		0.000 *
N. fertilizer (kg /ha)	101.53	115.90		0.000 *
Chemicals				
Pesticide (gram /ha)	1,047.37	1,275.84		
Weed-killer (gram /ha)	345.13	407.11		0.001*
Not using pesticide 40 days after				0.039**
sowing (%)	70.5	29.5	0.000*	
Water (time of pumping water)	4.5	5.1		*0.124*
Post-harvest loss				*0.828*
Use of swather (%)	55.5	45		
Use of combine harvester (%)	61.5	38.5		

Source: Data collected by authors
*Significant at 99%; ** Significant at 95%.

Reduction in inorganic fertilizer: Trained farmers used 101.5 kgs of N fertilizer per hectare compared with 115 kg used by untrained farmers. The difference was significant at a 99% level as shown by independent sample T-test.

Reduction in chemicals: Common chemicals include pesticides and weed-killers. Trained farmers used 1,074.4 grams of chemicals per hectare on average while untrained farmers used 1,277.8 grams per hectare. The difference was significant at 99% as shown by independent sample T-test.

To reduce the volume of chemicals and limit crop diseases according to IPM (Integrated Pest Management) method introduced by the FAO in 1991, farmers were required not to use pesticide in 40 days after sowing: 70.5% of trained farmers and 29.5% of untrained farmers met this requirement. The difference was significant at a reliability level of 99% as shown by chi-square tests.

Reduction in water volume: Trained farmers pumped water to their field 4.5 times while untrained farmers pumped 5.1 times. This difference, however, was not significant (Sig. > 0.05) as shown by independent sample T-test.

Reduction in post-harvest loss: Use of harvesters is considered as a way of reducing post-harvest loss. Swathers were used by 55% of trained peasants and 45% of untrained farmers while figures for the use of combine harvesters by the two groups of farmers were 61.5% and 38.5% respectively. The independent sample T-test, however, shows that this difference was not significant (Sig. > 0.05).

Thus, farmers trained in new techniques applied them better than untrained farmers. Regarding the application of the 5-decrease technique, reduction in three factors (seed, inorganic fertilizer and chemicals) was statistically significant and raised interest among farmers.

Economic efficiency of application of new technologies: Due to effects of the 5-decrease technique, economic efficiency of rice production by trained farmers was different from what was obtained by untrained farmers.

or weed-killer in 40 days after sowing. These techniques helped them reduce total expenses and gain higher selling price because of their use

Table 4: Economic efficiency of application of new technologies

Indicator	Trained peasants	Untrained peasants	Difference	Sig. (2-tailed)
Selling price (VND/kg)	4,467	4,224	243	0.000 **
Revenue (VND/ha)	33,200,668	31,327,726	1,872,942	0.000 **
Total expense (VND/ha)	13,832,383	14,928,306	1,095,924	0.005 **
Profit (VND/ha)	19,368,285	16,399,420	2,956,685	0.000 **
Production cost (VND/kg)	1,785	2,023	148	0.008 **
Rate of return (%)	149	120	29	0.000 **

Source: Data collected by authors
**Significant at 99%

of better strains of rice. Consequently, farmers could reduce production cost and increase profit and rate of return. The program to apply new technologies to rice production produced a higher economic efficiency and helped support a sustainable development for the Mekong Delta. This program, therefore, should be carried out at the national scale as soon as possible.

Results of independent sample T-tests presented in Table 4 show that rice production based on new technologies was better than that on customary techniques in three aspects:

(i) Selling price was VND234 higher per kilogram because of better quality.

(ii) Total expenses per hectare was VND1,095,924 lower and production cost per kilogram was VND148 lower.

(iii) Profit per hectare was VND2,956,685 higher and rate of return rose by 29%.

Additionally, the volume of chemicals (pesticide and weed-killer) was 1,682 grams lower for a hectare (Table 3).

These results are important to efforts to enhance farmers' income and competitiveness of their produce, and reduce pollution. Moreover, they support the sustainable development of rice production in the context of international integration.

4. Conclusion and policy implications

Training courses provided farmers with the following basic techniques: using certified seeds, reducing volumes of seed, inorganic fertilizer and chemicals, and refraining from spraying pesticide

To expand application of such techniques to rice production, policies should focus on:

(1) Research results show that proper stress should be put on three out of five inputs to reduce, namely seed, fertilizer and chemicals, because they help reduce the production cost effectively and produce real effects on rice production. More decreases in these inputs could be achieved because even trained farmers still use higher volumes of seeds and nitrogenous fertilizer as compared with recommendations from agricultural extension experts. Therefore, the agricultural extension system should promote reduction in the three inputs and reasonable use of nitrogenous fertilizer and seeds when giving training courses to peasants and local agricultural technicians, and disseminating new techniques through mass media.

(2) Methods of using water reasonably and reducing post-harvest loss failed to produce intended results because rural infrastructure, such as roads and irrigation system, is poor. Increasing investment in agricultural and rural areas, especially rural infrastructure, has become a matter of great urgency, an effort to enhance competitiveness of Vietnam's rice and an act of repaying rice producers for their great contribution to national food safety and accumulation of capital needed for industrialization in the past 35 years.

(3) More investment in the national agricultural extension system: The role of this system proves to be indispensable in enhancing farmers' agricultural knowledge. Foreign experience shows that developing the agricultural extension system is the most effective use of public investment in agriculture [4]. Under restrictions set by the WTO, increasing public investment in this system and helping it operate at full capacity and efficiency is a right policy to support farmers. Financial support from the government for this system should be oriented towards the following priorities: (i) funds for its operations; (ii) army of local extension technicians and their quality; and (iii) use of state-controlled mass media for disseminating knowledge among farmers.

(4) Encouraging public participation in agricultural extension

In the traditional model found in many countries, the national system of agricultural extension acts as a bridge between suppliers of technologies and farmers. In the past 10 years, this system has affirmed its important role in transferring new technologies to farmers. Its operations have depended mostly on public funds. Under current conditions where such funds are limited, public participation is the best way to mobilize all possible resources for transfer of technologies and agricultural knowledge to farmers.

In practice, this 4-party model [3] in which companies engage in agricultural extension has shown great potentials for public participation in recent years. The government should enhance sustainability of this model in order to accelerate the transfer of technology to farmers.

The sustainability of the model can only be achieved when benefits for all involved parties are ensured.

- Farmers improve their agricultural knowledge; get access to and obtain facilities for applying new techniques; and increase their income by reducing production cost, increasing rice yield and quality, and using right factor inputs when the quality of such inputs cannot be

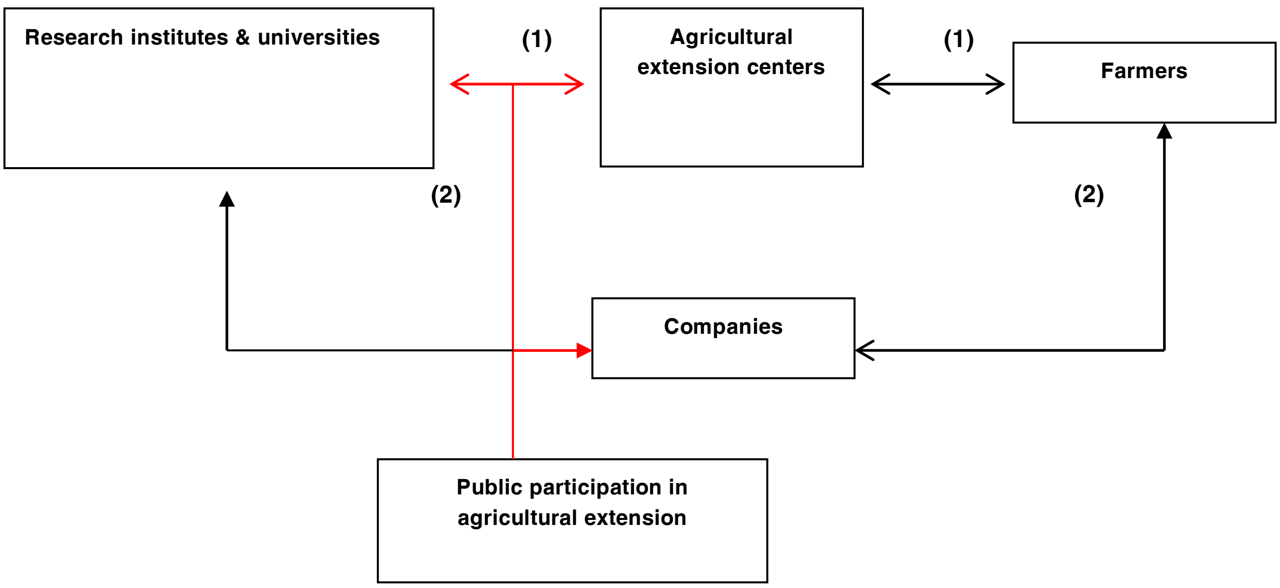

Figure 2: Model of public participation in agricultural extension

controlled.

- Scientists invent new technologies based on demand by rice producers and get necessary facilities for carrying out researches and applying results to production.

- Farm materials trading companies enhance their public image among farmers, and increase their profit by sharing "profit and risk" with farmers because they cannot prosper when farmers fail.

- Government carries out successfully program to develop rice production, ensure a sustainable agriculture and increase farmers' income.

In the 4-party model, companies serve as a sustainable link when they supply facilities for connecting scientists and farmers. To ensure success for public participation in the agricultural extension, the government should take measure to encourage technology transfer by companies, give tax incentives to R&D activities that serve agriculture, supply low-interest loan or fund for training to companies that engage in the model■

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