ASSESSING CURRENT PADDY RICE CULTIVATION IN THAI NGUYEN PROVINCE OF VIETNAM

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ABSTRACT

Rice is one of the most important crop in Thai Nguyen province of Vietnam. Rice production is contributed guarantee food security and economic development for farmers in the province. By collecting secondary data and primary data method, this study pointed out the advantages and limitations in rice cultivation in Thai Nguyen province. The results of resreach showed that rice areas were not distributed relatively uniform in all districts and the rice yield had average level when compared with the other rice cultivation areas. Rice yields in Thai Nguyen province sharply increased from 4.87 tons/ha (2010) to 5.49 tons/ha (2020) with the slightly decreasing the rice areas, it is proved that the farmer was not concerned to increase the planting areas while they focused on rising the yield potential and quality. Rice cultivation was controlled by Intergated cultural management and Intergrated pests management. The findings of the study also counted the economic efficiency, the added value of summer rice growing areas was lower (611 USD/ha) while the added value of intensive rice growing areas was higher, ranging from 1,346 USD/ha to 5,706 USD /ha.

ĐÁNH GIÁ THỰC TRẠNG CANH TÁC LÚA NƯỚC TẠI TỈNH THÁI NGUYÊN, VIỆT NAM

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TỪ KHÓA

Diện tích lúa
Năng suất lúa
Sản lượng lúa
Hiệu quả kinh tế
Thái Nguyên

TÓM TẮT

Lúa là cây trồng nông nghiệp quan trọng của tỉnh Thái Nguyên. Sản xuất lúa gạo góp phần vào đảm bảo an ninh lương thực và phát triển kinh tế cho người dân trên toàn tỉnh. Bằng phương pháp điều tra thu thập các số liệu sơ cấp và thứ cấp, nghiên cứu này chỉ ra những thuận lợi và khó khăn trong canh tác lúa nước của tỉnh Thái Nguyên. Kết quả của nghiên cứu đã chỉ ra rằng diện tích trồng lúa phân bố tương đối đồng đều trên tất cả các Huyện và năng suất lúa đạt mức trung bình khi so sánh với các vùng trồng lúa trên cả nước. Năng suất lúa của tỉnh Thái Nguyên tăng mạnh từ 4,87 tấn/ha (2010) đến 5,49 tấn/ha (2020) nhưng diện tích trồng lúa lại giảm nhẹ trong giai đoạn này. Điều đó chứng tỏ rằng người dân Thái Nguyên không chú trọng vào việc tăng diện tích trồng lúa mà tập trung vào nâng cao năng suất và chất lượng lúa. Người dân đã áp dụng phương pháp quản lý cây trồng tổng hợp và quản lý dịch hại tổng hợp cho cây lúa. Về hiệu quả kinh tế, đất trồng lúa mùa cho lãi thấp (611 USD/ha) trong khi đó đất trồng lúa thâm canh có lãi cao hơn, dao động từ 1.346 USD/ha đến 5.706 USD/ha.

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1. Introduction

Rice (Oryza sativa L.) is a globally important cereal plant and necessary source food for more than 3 billions people in the world [1]. Nowadays, the sources of rice in the world market come from South and Southeast Asia (India, China, Indonesia, Bangladesh, Thailand, Vietnam, Myanmar, Philippines), and supply for many import rice nations to meet their local demand. Global rice production is reduced from 1.60% to 2.73% while global rice price increases from 7.14% to 12.77% [2]. In 2017, Vietnam was the third largest rice exporter in the world, behind India and Thailand, in which annual rice export volume accounted for 15% of the world's total figure [3]. Furthermore, the rice export revenue was amounted to 1.6 billion USD and accounted for 12% of the GDP [4].

Despite the large area of commercial rice production grown in many countries, the total demand often exceeds the production. In recent decades, major issues like rising population (consuming countries) [5], and climate change have pressured the global food demand and its production. The global rice consumption is forecasted to reach ~873 million tons by 2030 [6]. Vietnam's rice industry is facing many challenges. The limitation is mainly used the old cultivation methods and low-quality rice varieties [7]. With such problems of food security in many areas of the world, improvement of rice production and quality has been the focus of the national programs.

Thai Nguyen is a mountainous province located in the Northern Mountainous area. The natural land area of the province is 352,664 hectares. Rice cultivation area in 2020 is 44,753 hectares [8]. Rice is staple food and rice cultivation is one of the most important priorities to guarantee the nation's food security and economic development of the province.

In recent years, rice production has faced many difficulties due to the pressure of urbanization and industrialization, effect of disease and climate change, and low export prices and economic efficiency of rice producers.

The aim of this study is to show the advantages and limitations of rice production in Thai Nguyen province while it is faced many challenges. From that, it helps the government and provincial managers make the plan for effective rice cultivation.

2. Methodology

2.1. Study area

The study was conducted in Thai Nguyen province, which consists of 2 cities and 7 districts including: Thai Nguyen city, Song Cong city, Dai Tu district, Dinh Hoa district, Phu Luong district, Vo Nhai district, Phu Binh district, Pho Yen district, and Dong Hy district. It is located from Latitude 21º20' North to 22º03' North, and from Longitude 105°52' East to 106°14' East. The total natural land area of Thai Nguyen is 352,644 hectares, with a population of 1,29 thousand [8].

2.2. Methods of Data Collection

The secondary data were collected in the period from 2010 to 2020 from authorized provincial and district departments.

The primary data were collected through household surveys using questionnaire. The interview surveys were conducted at household, who are representatives for rice cultivation farmers in each district. Thirty (30) representative households were chosen per district for the interviews, with a total of 270 households surveyed for the study.

Yields of rice were harvested by sampling from a total of 15 representative rice fields in 2 cities and 7 districts of Thai Nguyen province. The dried yields were adjusted to 14% moisture content of fresh yields. The sampling area was 30 m^2 (5 m x 6 m) in three replicates.

2.3. Calculation of Rice Production Economic Efficiency

The economic efficiency assessment of the main types of rice land use was determined using the collected data and survey results on the economics of rice land use. The following parameters were derived:

Gross Output (GO): The total value of material goods and services created over a period of time (usually 1 year). GO was calculated using the formula:

$$GO = \sum_{i=1}^{n} Q_i x P_i \quad (1)$$

Where: GO is production value; Q*i* is the volume of product type i; P*i* is the unit price of product i.

Intermediary Costs (IC): The total costs of materials and services used in the production process (calculated according to the GO cycle). In agriculture, IC includes costs, such as seeds, fertilizers, pesticides, outsourcing, etc. IC was calculated using the formula:

$$IC = \sum_{j=1}^{m} C_j \quad (2)$$

Where: IC is the intermediate cost; Cj is the cost in the production season (j from 1 to m).

Added Value (VA): The value of physical products and services created by manufacturing industries in a year or a production cycle. VA was calculated as the difference between production value and intermediate costs, using the formula:

$$VA = GO - IC \quad (3)$$

3. Results and Discussion

3.1. Rice Area, Yield and Production

The figure 1 shows that rice areas slightly decreased from 2010 to 2020 in some districts of Thai Nguyen province. Phu Binh and Dai Tu districts had the largest rice planted areas on an annual basis covering more than 12,000 hectares, followed by Pho Yen and Dinh Hoa districts with about 9,000 hectares. Thai Nguyen, Song Cong, Dong Hy, Phu Luong and Vo Nhai districts had smaller rice cultivation areas about below 8,000 hectares.

The yield of rice referred to the main amount of seed per one area unit.

Harvested yield = harvested production/harvested area. [8]

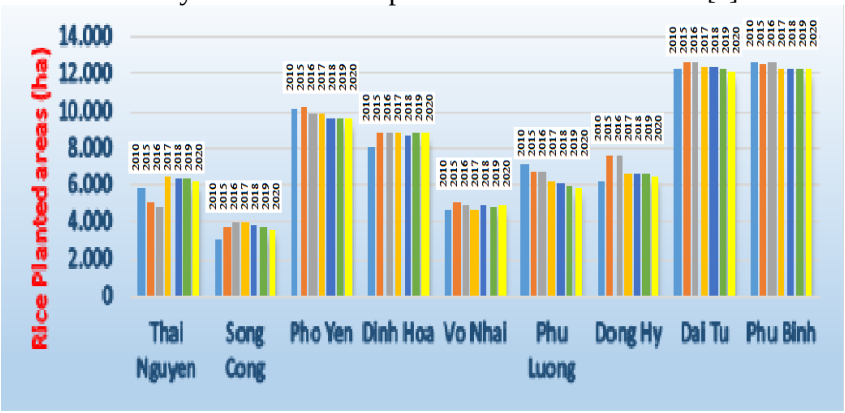

Figure 1. *Annual rice planted area in districts and cities of Thai Nguyen province 2010-2020*

Table 1. *Annual planted area, yield and production of rice in Thai Nguyen province 2010-2020*

Particular	2010	2015	2017	2018	2019	2020	Fluctuation
Annual							
Area (Thousand hectares)	69.74	72.48	71.08	70.67	70.12	69.76	0.02
Yield (tons/hectares)	4.87	5.26	5.34	5.47	54.9	5.49	0.62
Production (Thousand tons)	339.77	381.33	379.38	386.44	384.69	383.40	43.63
Spring paddy rice							
Area (Thousand hectares)	2.829	30.55	30.28	30.11	29.95	29.85	1.56
Yield (tons/hectares)	5.14	5.48	5.56	5.69	56.1	5.52	0.38
Production (Thousand tons)	145.28	167.36	168.50	171.22	168.01	164.62	19.34
Summer paddy rice							
Area (Thousand hectares)	41.49	41.94	40.80	40.56	40.17	39.91	-1.58
Yield (tons/hectares)	4.69	5.10	5.17	53.10	5.39	5.48	0.79
Production (Thousand tons)	194.49	213.96	210.87	215.23	216.68	218.78	24.29

Source: Statistical Yearbook of Thai Nguyen 2010, 2015, 2020 [8]-[10]

The results in table 1 show that rice annual planted areas in Thai Nguyen province were not significantly changed from 2010 to 2020 while yield and production were increased. Summer paddy rice production was higher than spring paddy rice production although rice yield during spring season was relatively higher than that in summer season.

The paddy rice planted areas were 69.74 thousand hectares in 2010, increased to 72.48 thousand hectares in 2015, and decreased to 69.76 thousand hectares in 2020. Spring paddy rice areas were covered more than 40% of total rice area within a year. The remaining areas were planted the summer paddy rice. The spring paddy rice areas had an increasing trend in years but it was decreasing trend with the summer paddy rice areas. The rice areas in Thai Nguyen province were distributed across districts, towns and cities of the Thai Nguyen province, in which the mainly rice planted areas were concentrated in Dai Tu, Phu Binh, Pho Yen, and Dinh Hoa.

Rice yields in the province increased from 4.87 tons/hectares (2010) to 5.49 tons/ hectares (2020). By cropping season, rice yield differed relatively due to climatic conditions, varieties, fertilizer… The yield of summer paddy rice (5.48 tons/hectares) was lower than the yield of spring paddy rice (5.52 tons/hectares). The highest rice yield was obtained in Dai Tu district (5.68 tons/hectares), while the lowest yield was gained in Dinh Hoa district (5.02 tons/hectares).

3.2. The yield of rice in crop cut samples

In Thai Nguyen province, rice yields varied in each district because of many reasons such as: different growing conditions, using different rice varieties, using different cultural practices... To have an accurate view of rice yield, we determined rice yields from 15 sites across the province through crop sampling.

Table 2. *The rice yield in sampling areas*

No	Collection site	Yield of collected plot (kg/30m^2)	Yield (tons/hectares)
1	Cu Van, Dai Tu	17.20^{abcd}	5.7
2	Yen Lang, Dai Tu	17.13^{bcd}	5.7
3	Nam Hoa, Dong Hy	17.43^{abc}	5.8
4	Quang Vinh, Thai Nguyen	16.60^{bcde}	5.5
5	Binh Son, Song Cong	15.90^{e}	5.3
6	Dac Son, Pho Yen	16.87^{bcd}	5.6
7	Minh Duc, Pho Yen	16.53^{cde}	5.5
8	La Hien, Vo Nhai	16.30^{de}	5.4
9	Nghinh Tuong, Vo Nhai	15.77^{e}	5.3
10	Dong Dat, Phu Luong	15.90^{e}	5.3
11	Du, Phu Luong	15.90^{e}	5.3

No	Collection site	Yield of collected plot (kg/30m^2)	Yield (tons/hectares)
12	Bao Cuong, Dinh Hoa	16.43^{de}	5.5
13	Binh Yen, Dinh hoa	16.57^{bcde}	5.5
14	Tan Duc, Phu Binh	17.47^{ab}	5.8
15	Tan Hoa, Phu Binh	18.03^{a}	6.0
	p	<0,01	
	CV(%)	3,04	

Source: The results of research

Rice yields of 15 sites across Thai Nguyen province fluctuated between 5.3 and 6.0 tons/hectares (table 2). Rice yield in Tan Hoa commune, Phu Binh district was the highest (6,0 tons/hectares), followed by Nam Hoa - Dong Hy, Cu Van - Dai Tu; Tan Duc - Phu Binh (5.7– 5.8 tons/hectares), then the group (Quang Vinh - Thai Nguyen; Minh Duc - Pho Yen; La Hien - Vo Nhai; Bao Cuong - Dinh Hoa, Binh Yen - Dinh Hoa, Yen Lang - Dai Tu, Dac Son - Pho Yen) had yield from 5.4 – 5.7 tons/hectares and finally, the rice yield at Nghinh Tuong - Vo Nhai, Dong Dat - Phu Luong, Du - Phu Luong, Binh Son - Song Cong was lowest of all districts in Thai Nguyen province (5.3 tons/hectares).

The average rice yield of Vietnam in 2021 gained 6.1 tons/hectares [11]. It showed that the average rice yield in Thai Nguyen was lower than that in Vietnam. The main reason leading to low rice yield was that rice cultivation was affected by climate change phenomena such as: drought, flooding, landslide... Moreover, the farmers cultivated the rice with the aim of maintaining the food security following the provincial policy. There was low investment of rice cultivation such as: fertilizer, new variety, modern technology… Besides, most young people who were the major of labor force in households worked in the industrial zones like Samsung, Sony, etc. They did not join in the agricultural production so most of elder members in household undertook to produce in rice cultivation. Therefore, the yield in Thai Nguyen was not high.

3.3. Cultural Practices and Management

Rice is mainly cultivated during spring and summer seasons in Thai Nguyen province. Early spring season starts at the beginning of January. The main spring season starts in mid-February, while the late spring season starts in early March. In the summer season, rice is usually sown at early to middle of June.

Based on the survey, the varieties used for spring season were: 1) hybrid rice varieties, such as SL8H-GS9, B-TE1, Golden TEJ, TH3-5, Thinh Du 11, TH3-3, HKT99, Q. Uu 1, 27P31, PHB71, Kinh So 1588, TH3-4, S9368; and 2) pure varieties, namely Bac Thom 7, HT1, Thien Uu 8, BG1, DS-1, J02, Khang Dan 18, DQ11, HT6, TBR225, Hong Duc 9 (Spring crop). For the summer season, varieties were: 1) hybrid rice varieties, such as Syn6, Bio 404, TH 3-3, TH3-4, TH 3-5; and 2) pure varieties (HT1, HT6, HT9, TBR 45, Bac Thom 7).

Recently, the province's agricultural extension unit regularly had conducted training for typical farmers on rice production techniques including the use of fertilizers. Depending on the economic level and technical requirements, farmers had various investment capability. Generally, the amount of fertilizers applied by the farmers ranged: 3-5 tons/hectares of organic fertilizers, 90-100 kg N, 50 kg P_2O_5 and 80 kg K_2O per hectare. It would get the highest yield with suitable fertilizer use. Organic fertilizers and bio-fertilizers were also widely used which had a positive impact on soil quality and food safety levels.

According to the Agricultural National Standard QCVN 01/55- 2011/ BNNPTNT [12], the recommended amount of fertilizer for rice was: 8-10 tons organic fertilizer; and 90-100 kg N, 60-90 kg P_2O_5, and 70-80 kg K_2O per hectare. In comparison with the farmers' fertilization practice, the amount of animal fertilizer being applied was lower than the recommended rate, while inorganic fertilizer being applied was relative to the recommended rate. The specific amount of fertilizer commodity was applied in following 2 cases:

Case 1: Application of Single Fertilizer (Fertilizer Applied per Hectare: 3–5 tons animal fertilizer, 195 kg urea, 300 kg superphosphate, 133 potassium chloride. The amount of fertilizer application was divided into three parts: 1) basal (before sowing): 100% animal fertilizer + 100% phosphate + 50% nitrogen + 30% potassium; 2) second portion: 40% nitrogen + 40% potassium; and 3) third portion (30-40 days after sowing): 10% nitrogen + 30% potassium.

Case 2: Application of Mixed Fertilizer, (Fertilizer Applied per Hectare): 3-5 tons animal fertilizer, 400 kg NPK (20:20:15), 33 kg potassium chloride. The amount of fertilizer application was divided into three parts: 1) basal (before sowing): 100% animal fertilizer + 50% NPK; 2) second portion: 50% NPK; and 3) third portion: 100% potassium chloride.

Pest control is an indispensable issue in agricultural production, particularly rice production. In Thai Nguyen province, integrated pest management (IPM) in combination with integrated crop management (ICM) was practiced in rice production. According to the results, some pesticides were used in rice and several rotation crops, such as vegetables and flowers. Some chemical pesticides were popularly used such as: Score 250EC™, Padan 95sp™, Arrivo 5EC™, Dinazin™, Carbenzim™, Senedan™, Ofatox 400EC™, Match™, and Tilsuper 300ec™. These chemical pesticides were included in the list of chemicals allowed by the government, and generally these were new generation and relatively safe chemicals.

Based on the survey, mechanization in Thai Nguyen's rice production focused on tillage and harvesting, while the remaining practices have to be done manually.

Due to the small farming area, most farmers dried their harvested rice grains on cemented pavements or brick yards. Therefore, loss of rice production due to not being dried properly and preserved in time was still high. This method also affected to rice grain quality. Rice production mainly served for the family's consumption, small amount of production for selling to the market.

3.4. Economic Efficiency of Rice Growing Areas

Economic efficiency is a broad term typically used in microeconomics to denote the state of best possible operation of a product or service market. Economic efficiency assumes minimum cost to produce a good or service, maximum output, and maximum surplus from the operation of the market. Economic efficiency is the sum, and outcome of, static efficiency and dynamic efficiency [12]-[15].

For rice cultivation in Thai Nguyen province, there were two main land use types: 1) Summer paddy rice growing areas (the rainfed land where the rice cultivation depended completely on natural rainfall because of relatively high terrain without irrigation systems or canal systems for irrigation) and 2) intensive paddy rice growing areas (irrigated lands where have favorable rice growing conditions). In the intensive rice growing areas, there were a number of land use types or crops rotation types, such as: Spring paddy - summer paddy - winter tomatoes; Spring paddy - summer paddy - winter sweet potatoes; Spring paddy - summer paddy - winter potatoes; Spring paddy - summer paddy - winter corn; Spring paddy - summer paddy - winter vegetable; Spring paddy - summer paddy - winter groundnut; and Spring paddy - summer paddy.

Table 3. *Economic efficiency of land use types in Thai Nguyen Province in 2020.*

Unit: 1000 VND per hectare

Particular	Summer Rice Growing Areas	Intensive Rice Growing Areas						
	Summer rice	Spring paddy - summer paddy - winter tomatoes	Spring paddy - summer paddy - winter sweet potatoes	Spring paddy - summer paddy - winter potatoes	Spring paddy - summer paddy - winter corn	Spring paddy - summer paddy - winter groundnut	Spring paddy - summer paddy - winter vegetable	Spring paddy - summer paddy
Material cost	10,890	46,970	32,120	58,520	29,110	35,480	30,150	19,510
Labor cost	11,850	61,100	61,100	72,100	35,100	43,230	61,100	24,600
Other cost	300	1,370	800	1,320	600	600	600	600

Gross output (GO)	37,100	240,677	148,277	257,177	105,577	127,577	180,677	75,677
Added value (VA)	14,060	131,237	54,457	124,937	40,767	30,967	88,827	30,967

(Source: survey research and calculations)

The economic efficiency of each land use type was different. Table 3 shows that the economic efficiency of intensive rice growing areas is higher than that of summer rice growing areas. In summer paddy rice land, rice can grow and develop based on rainy water because it lacked irrigation system. So, rice was planted only in summer to avoid waste land use. The added value of summer rice per hectare was lowest with 14,060 thousand VND (611 USD). In the intensive rice growing areas, the added value per hectare was high. It ranged from 30,967 thousand VND (1,346 USD) to 131,237 (5,706 USD). Highest economic efficiency in intensive rice growing areas was obtained in the land use type of spring paddy - summer paddy - winter tomatoes with added value per hectare 131,237 (5,706 USD). The substance of high economic efficiency in spring paddy - summer paddy - winter tomatoes was that the price of tomatoes in market was high leading to the added value of winter tomatoes was high while the added value of spring rice and summer rice were constantly low. The same trend with the models of spring paddy- summer paddy - winter potatoes, spring paddy - summer paddy - winter vegetable.

According to T.T Le, 2021 [17], the added value of 1 hectare of green tea with traditional cultivation was 67,996 thousand VND. It was lower than the 3 models of rice land use types such as: spring paddy - summer paddy - winter tomatoes, spring paddy- summer paddy - winter potatoes, spring paddy - summer paddy - winter vegetable. So, these models of rice production which have high added value should be maintained and developed. Beside this, the model summer rice should be considered to change to another effectively land use or transfer to cultivate different crop to get more effects.

4. Conclusions

Rice production is still very important for the farmers. It was considered as the main product of Thai Nguyen province but it brings low profit for the rice cultivation farmers. Beside the advantage is to guarantee the food security, the disadvantage is to create the unhigh added value for rice producers. This is a critical problem for rice production in Thai Nguyen province, it needs to solve in the next period. The results of this research may contribute to the reference for provincial authorities and researchers to set up the rice production plan or conducting further researches to improve the economic efficiency of rice cultivation.

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