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Farming Systems Improvement of Rice-based Farms in Huay Khan Lean Sub-district, Ang Thong Province, Thailand

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ABSTRACT

The objectives of this research were to study the socio-economic characteristics of rice-based farm households, to study current main agricultural production systems of rice-based farming systems, and to identify selected bio-physical factors and socio-economic factors related to farm household income. The data was collected by using interview schedules from 116 representatives of farm households in Huay Khan Lean Sub-district, who had practiced rice farming integrating with other types of farming. The farm households were selected by purposive sampling methods. Data analyses were done by using various statistical measures.

The findings revealed that there were 2 main types of rice-based farming systems in the study site. The major type of rice-based farming systems was rice-livestock farming systems (50.0%). The types of livestock raised were chicken (37.9%), swine (29.3%), frog (24.1%), duck (5.2%), beef cattle (1.7%) and chicken and swine (1.7%). The second major type was rice-fruit (mango) farming systems (24.1%). In agricultural production systems, rice farming was similarly practiced in rice-livestock and rice-fruit farming systems. On the average, farm households held 25.3 rai (rice-livestock) and 31.5 rai (rice-fruit) land, and had 2.5 persons in farm labor. Irrigation were well facilitated, however, most of them cultivated both high-yield varieties and local varieties. Rice was directly seeded on rice fields with chemical applications. Harvested rice was sold to local markets, provincial markets and agricultural cooperatives at the farm gate price of 3.15-3.96 baht/kg. The amount of production was 14,175 kg/year (rice-livestock) and 17,942 kg/year (rice-fruit). In livestock raising, all types of livestock are local breeds. Drug and vaccine were treated by most farm households. Livestock were mainly sold to local merchants. In fruit farming, mango planting areas

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accounted for 3.6 rai. Chemicals were also used. Mango was mainly sold to local merchants and local markets at the farm gate price of 24.2 baht/kg. The amount of production was 860 kg/year. Rice-livestock farm households gained a net income of 272,698 baht/year while rice-fruit farm households gained a net income of 70,875 baht/year.

Hypothesis testing indicated that in the bio-physical factors, there was a significant relationship between rice varieties and farm household income. In addition, in the socio-economic factors, there were a significant relationship between age, occupational experience, farmer organizations' membership and financial sources, and farm household income.

Based on the study, following recommendations are suggested: Firstly, implementation guidelines of agricultural diversification program and sustainable agriculture should be developed in the provincial level with regular monitoring and evaluating the activities. Secondly, effort should be made to make farmer organizations attractive to be able to encourage membership among farm households by participatory management approach. Thirdly, farm households need to be informed through workshops, discussions and demonstrations on available resources to be sustainable. Fourthly, a network of the different organizations including farmers' organization, the district agricultural office and the agricultural technology transfer center should be developed to improve farming process. Lastly, farmers' capacity building should be done by using model farms and giving awards to outstanding producers in terms of maximum utilization of resources through integrated farming systems.

Key words: farming system, rice-based farm, Thai farmer

INTRODUCTION

The agricultural sector remains an important sector of Thailand although the manufacture and service sectors have occupied the larger share in Thai economy development. The agricultural sector accounts for 9.1 % of GDP with a value of 446.9 billion baht in 2000. Land utilization for agriculture is 46% of the total land in the country and there are approximately 16 million people, about 49% as an agricultural population (UN, 2001). This indicates the role of agriculture contributing to the Thai people more than figures stated in GDP.

In Thailand, farming has long been practiced in the form of integrating rice farming with several kinds of production such as other field crops, fruit trees, vegetables, livestock and fish raising (Chomchalow, 1993). The patterns of these associated productions rely on physical factors such as geography and climate and socio-economic factors such as farmers' need and limitations (Narong, 1988; Mcdowell, 1980).

In the central plain of Thailand, located in the Mekhong Delta, farmers enjoy plenty of soil fertility and water supply with well irrigated condition, achieving higher rice production yield of 349 kg/rai and 667 kg/rai of major rice and second rice, respectively, than any other regions (The Japan Chamber of Commerce and Industry in Bangkok, 2001). They have conducted rice mono-culture

farming for decades because this region has been put a great effort to produce rice for both domestic consumption and export by government. On the other hand, during 1993 to 1995, the government set the agricultural diversification policy and conducted the agricultural diversification programs in the Chao Phraya rice basin areas, including 22 provinces, to encourage farmers to adopt permanent crops or other alternatives to rice to obtain higher incomes and consume much less water than by rice farming only. These programs were designed to solve problems such as farmers' lower income due to low world market price of rice, and competition of the urban-industrial sector for national water resources (Sirisup and Kammeier, 2000). Some farmers have changed rice mono-culture farming to rice-based farming integrating with other kinds of crops, fruit trees, vegetables, livestock or fish raising along due in part to the impact from this programs. From this point of view, in the Central region, transformation to rice-based farming has occurred to obtain higher farm income and to utilize natural water resources efficiently, rather than to achieve sustainable agriculture in terms of environment conservation and self-sufficient farming.

Statement of the Problem

Farming is the largest sector in population. This sector has supported Thai populations even though the share of GDP in the agricultural sector has been decreasing. Generally, farmers have faced a lot of problems. There are: (i) agricultural systems structure (mono-cropping), which has caused high risks from climatic variations, insects and diseases, price fluctuation and shift in market demands, (ii) low productivity, due to improper farming practice, heavy use of external inputs and depletion of land and water resources, (iii) low quality of product, and (iv) insufficient utilization of natural resources (Chomchalow, 1993). In addition, as institutional problems, (i) lack of research on animal-fish-crop integration systems, (ii) inadequate extension in an integrated manner, (iii) lack of financial support and (iv) lack of variable institutions to provide production inputs are raised (Delmendo, 1980).

In Ang Thong Province, farmers have faced similar problems. Located in the Central region, Ang Thong Province has been "the rice bowl" of the country. Rice production accounts for 430.9 thousand tons in 2002, occupying 69% of total farm holding land. Farmers have shifted to mono-cultural or commercial farming for a few decades. Due to transformation of farming activities, currently, they have faced physical and biological problems such as land water depletion, insects and diseases of crops, and low productivity, and socio-economic problems such as unstable price of product in markets, increasing debt for purchasing production inputs, lack of opportunities to obtain useful information, knowledge, and technologies for agriculture and lack of capital to diversify production.

The agricultural development policy in Ang Thong Province has been designed to encourage farmers to increase and obtain stable income through the year from both agricultural activities and non-agricultural activities. In 2000, the agricultural diversification projects was implemented, which encouraged farmers to introduce other field crops, fruit tree and/or vegetable production, livestock production or fish production in addition to current

rice production to solve aforementioned problems that farmers faced. A number of extension projects and financial support concerning the transformation into such rice-based farming systems were implemented at the Sub-district and District level (The Agricultural Office in Ang thong Province, 2000 and Office of Agricultural Economics, 2003).

From the above-mentioned background of problems in Ang Thong Province, this study was conducted to identify factors, influencing income of farm households implementing rice-based farming in Huay Khan Lean Sub-district, Wiseetchaychaan District, Ang Thong Province,. Farming systems approach was adopted in this study to holistically consider the bio-physical factors on rice-based farms and socio-economic factors of farm household.

Objectives of the study

This study was conducted with the following main objectives: i) to study the socio-economic status of rice-based farm households, ii) to study current main agricultural production systems of rice-based farming systems, and iii) to identify selected bio-physical factors and socio-economic factors relating to farm household income.

METHODOLOGY

This study was conducted in Huay Khan Lean Sub-district of Wiseetchaycaan District, Ang Thong Province. The population of the study was 116 representatives of farm households engaged in rice-based farming, which was selected from 385 farm household in the Sub-district by purposive sampling methods. The data was collected by interview schedules consisting of three parts: i) socio-economic data of farm households, ii) agricultural production systems of rice-based farming systems and iii) problems and recommendations for improvement of rice-based farming systems. Secondary data such as records, documents and annual statistical reports of both the agricultural office in Wiseetchaychaan and the agricultural office in Ang Thong Province, and from Internet websites were used.

After collecting data, rice-based farming systems were classified into 10 types according to farm activities. The 2 main rice-based farming systems were selected to study these agricultural production systems.

Data analyses were conducted by various statistical measures. For measuring the level of information exposure, Likert interval scale was used and assigned corresponding scores such as: never = 1 score, little = 2 scores, moderate = 3 scores and much = 4 scores. The mean scales were interpreted as follows: $\overline{X}$ = 1.00-1.75 mean Never, $\overline{X}$ = 1.76-2.50 mean Little, $\overline{X}$ = 2.51-3.50 mean Moderate and $\overline{X}$ = 3.51-4.00 mean Much. The hypotheses were tested by Chi-square test at .05 significant level to identify the relationship between the selected bio-physical factors and socio-economic factors, and farm household income.

RESULTS AND DISCUSSION

1. Socio-economic characteristics of rice-based farm households

Farm households were 52.9 years old on average. Most of them had primary school education.

Experiences in farming accounted for 32 years and almost half of them had off-farm work. They had relatively a small land of 28.4 rai and those who held only rented land were considerably high (28.5%) in the central region. Almost all of the farm labor force was utilized from family members, accounting for 2.5 persons per year. Farm households had achieved a net income of 200,540 baht/year. On-farm income had remarkably contributed to farm household income maybe because they had obtained stable income though a year from double or triple cropping cultivation.

Memberships to farmer organizations accounted for 46.4% of the farm households and they had participated in the organizations for 2 years on the average. Of all the farmer organizations, the Bank of Agriculture and Agricultural Cooperatives was a major type (43.5%); followed by 5 kinds of farmers' groups including accounting for 53.5%. In terms of governmental services, those who had received extension services accounted for only 11.2%. Majority of the farm households (56.9%) had managed their rice-based farming by both self-fund and governmental loans. There were no farm households who had borrowed a loan from private agencies. Governmental loans were important financial sources as an external financial source in the study site, accounting 85.3% of the farm households.

Regarding information exposure, TV was the most popular mass media on information related to rice-based farming among farm households ($\overline{X}$ = 3.97). Radio ($\overline{X}$ = 3.48) and newspaper ($\overline{X}$ = 2.86) had moderately given information. In addition, inter-personal communication channels such as talks with neighbors ($\overline{X}$ = 3.48), extension workers ($\overline{X}$ = 2.52) and local officers ($\overline{X}$ = 3.15) were also moderately exposed to farm households.

2. Current main types of rice-based farming systems

It was found that there were 10 types of rice-based farming systems in the study site such as rice-livestock (50.0%), rice-fruit (24.1%), rice-fruit-livestock (6.0%), rice-vegetable (5.2%), rice-fish-livestock (5.2%), rice-fish (2.6%), rice-fruit-vegetable (2.6%), rice-vegetable-livestock (1.7%), rice-vegetable-fruit-livestock (1.7%) and rice-fruit-fish (0.9%). The main types were rice-livestock farming systems (50.0%) and rice-fruit farming systems (24.1%).

3. Agricultural production systems of main types of rice-based farming systems

3.1 Rice-livestock farming systems

Table 1 presents agricultural production systems of rice-livestock farming systems. Farm households had practiced livestock raising such as chicken (37.9%), swine (29.3%), frog (24.1%), duck (5.2%), beef cattle (1.7%) and chicken and swine (1.7%). The total area was 23.5 rai with irrigated condition (60.3%) or both irrigated and rainfed condition (39.2%). There were 2 persons in farm labor forces. In rice production, most of farm households (72.4%) cultivated both high-yield varieties (Suphanburi 1, 35 and 45) and local varieties (Koon Keaw). These were cultivated for 105-120 days and for 210 days, respectively. Planting by direct-seeding methods, they applied fertilizers, pesticides, insecticides and herbicides. After harvesting, rice was transported for sales by trucks without storing and milling. Harvested rice was sold to local markets (61.3%),

Table 1 Agricultural production systems of rice-livestock farming systems.

Rice	Agricultural Production Systems
1. Total area (average)	25.3 rai
2. Farm labor (average)	2.5 persons/year
3. Rice varieties	Local varieties; Koon Keaw (8.6%)
	High-yield varieties; Suphanburi 1, 35, 45 (19.0%)
	Both; (72.4%)
4. Land preparation	Rainfed land (0.0%)
	Irrigated land (60.3%)
	Both (39.7%)
5. Planting	Direct-seedling; 25-30kg/rai
6. Period	Local varieties; 105-120 days, High-yield varieties; 210 days
7. Fertilizing	3 times/crop season, formula; 46-0-0, 16-20-0, 15-5-20
8. Pest control	Use pesticides , insecticides and fungicides
9. Weed control	Use herbicides
10. Harvesting	By machine at hiring price of 360 baht/rai
11. Post-harvest	No storage, No milling (selling rice on harvested day)
12. Transportation	By trucks at hiring price of 1.33 baht/kg
13. Markets	Provincial markets (61.3%), Agricultural Cooperatives (22.6%),
	Local markets (14.5%), Local merchants (1.6%)
14. Farm gate price	3.96 baht/kg
15. Consumption	No
16. Production	14,175 kg/year

Livestock	Chicken	Swine	Frog	Duck	Cattle (beef)
1. Breeds	Local	Local	Local	Local	Local
2. Period	95 days	30-240 days	90 days	80-120 days	80-120 days
3. Feed	Rice brans	Rice brans	Ready-made feeds	Ready-made feeds	Natural grass
	Broken rice	Vegetables			Rice by-products
		Ready-made feeds			
4. Drug/Vaccine	Use (80.0%)	Use (100.0%)	Use (93.0%)	Use (66.0%)	Use (100.0%)
5. Markets	Local markets	Local merchants	Local markets	Local markets	Local merchants
	(56.0%)	(80.0%)	(92.3%)	(75.0%)	(100.0%)
	Local merchants	Local markets	Provincial markets	Local merchants	
	(44.0%)	(20.0%)	(7.1%)	(25.0%)	
6. Farm gate price	35 baht/kg	35-87 baht/kg	26 baht/kg	25 baht/head	50 baht/kg
				1.5 baht/egg	
7. Consumption	No	No	No	No	No
8. Production	92 kgNo	2,740 kg	22,200 kg	30-200head	400 kg
	(10-600kg)	(110-17,000kg)	(1,500-30,000kg)	1,000-7,000 eggs	

Source: Survey, 2002

agricultural cooperatives (22.6%) and provincial markets (14.5%) at the farm gate price of 3.96 baht/kg. There was no rice for consumption. The amount of production was 14,175 kg/year. In livestock raising, all types of livestock which were local breeds were fed by rice by-product, ready-made feed or natural grass with drug and vaccine treatment. Meat and eggs of livestock were mainly sold to local merchants. These were mostly not consumed.

Rice-livestock farm households had obtained a net income of 153,324 baht (chicken), 17,737 baht (swine), 383,921 baht (frog), and 59,610 baht (chicken and swine), however, duck and cattle raising had resulted in -3,123 baht and -32,324 baht per year, respectively. Income from livestock occupied 58.6% of the total income. Livestock raising had contributed significantly to rice-livestock farming systems from the point of income.

Problems in rice-livestock farming which had been raised by farm households were high production costs (chicken and swine), need much time to operate (chicken, swine and cattle), influence of market fluctuations (chicken, frog and duck), a lack of extension services (chicken) and a lack of information on rice-based farming (chicken). Rice-chicken raising farm households had faced most problems of all types of rice-livestock farm households.

3.2 Rice-fruit farming systems

Table 2 shows agricultural production systems of rice-fruit farming systems. Farm households had practiced mango production as the sole of fruit farming. The total area was 31.5 rai with irrigated condition (89.0%) or both irrigated and rainfed condition (11.0%). There were 2 persons in farm labor forces. In rice production, most of farm households (75.0%) cultivated both high-yield varieties and local varieties. Rice farming practices were similar to that of rice-livestock farming. Rice was sold to provincial markets (62.5%), agricultural cooperatives (25.0%) and local markets (12.5%) at the farm gate price of 3.15 baht/kg. The amount of production was 17,942 baht/year. In fruit farming, mango planting areas accounted for 3.6 rai. Fertilizers, pesticides, insecticides and herbicides were also used. Mango was mainly sold to local merchants (50.0%) and local markets (47.5%) at the farm gate price of 24.2 baht/kg. Mango was also consumed by farm households. The amount of production was 860 kg/year.

Rice-fruit farm households had obtained a net income of 70,875 baht/year. Income from fruit occupied only 10.0% of the total income. Fruit production had provided just supplemental income for rice-fruit farm households.

Problems in rice-fruit farming which had been raised by farm households were high production costs, difficulties in taking care of both rice fields and fruit trees in case of larger agricultural land and fewer farm laborers, and a lack of dissemination of knowledge and practice of rice-fruit farming at the village level.

4. Relationship between bio-physical and socio-economic factors and farm households

In bio-physical factors, rice varieties, land preparation (irrigation systems), fertilizing, pest and weed control were set as the independent variables. In socio-economic factors, age, education level, occupational experience, types of occupation, land holding size, land holding type, farm labor, farmer

Table 2 Agricultural production systems of rice-fruit farming systems.

Rice	Agricultural production systems
1. Total area (average)	31.5 rai
2. Farm labor (average)	2.6 persons/year
3. Rice varieties	Local varieties: Koon Keaw (10.7%)
	High-yield varieties: Suphanburi 1, 35, 45 (14.3%)
	Both: (75.0%)
4. Land preparation	Rainfed land (0.0%)
	Irrigated land (89.0%)
	Both (11.0%)
5. Planting	Direct-seedling; 25-30kg/rai
6. Period	Local varieties: 105-120 days, High-yield varieties: 210 days
7. Fertilizing	3 times/crop season, formula; 46-0-0, 16-20-0, 15-5-20
8. Pest control	Use pesticides , insecticides and fungicides
9. Weed control	Use herbicides
10. Harvesting	By machine at hiring price of 1.33 baht/kg
11. Post-harvest	No storage, No milling (selling rice on harvested day)
12. Transportation	By trucks at hiring price of 360 baht/rai
13. Markets	Provincial markets (62.5%),
	Agricultural Cooperatives (25.0%),
	Local markets (12.5%),
14. Farm gate price	3.15 bah t /kg
15. Consumption	No
16. Production	17,942kg/year
Fruit (Mango)	
1. Fruit planting area	3.6 rai
2. Fertilizing	Use fertilizers
3. Pest control	Use pesticides, insecticides and fungicides
4. Weed control	Use herbicides (92.9%)
5. Market	Local merchants (50.0%),
	Local markets (47.5%),
	Provincial markets (2.5%)
6. Farm gate price	24.2 baht/kg (13.5-40 baht/kg)
7. Consumption	Yes (75.0%)
8. Production	860kg/year (50-2,600kg/year)

Source: Survey, 2002

organizations' membership, extension services, financial sources, information exposure and rice marketing systems were set as the independent variables. Farm household income was set as the dependent variable. Table 3 presents Chi-square value and probability representing these relationships. Statistical analyses of data by Chi-square test indicated that in the bio-physical factors, there existed a significant relationship between rice varieties and farm household income. In socio-economic factors, age, occupational experience, farmer organizations' membership, financial sources had a significant relationship with farm households hold income.

CONCLUSIONS AND RECOMMENDATIONS

The findings of this study can be concluded that integrated farming was practiced in the study site considering that rice-based farming systems were classified into 10 distinct combinations of rice, livestock, fruit, vegetable and fish production. Rice-livestock farming systems had derived higher profit from non-traditional crops such as frog raising, however, rice-fruit farming systems identified did not significantly augment household income due to problems of production costs and technological know-how. Selection of high yield rice varieties effected higher household income. Maturity and experience in farming influenced farm household income as well. Moreover, membership to relevant organizations and availability of financial sources contributed to high farm household income. In order to improve rice-based farming systems, the following recommendations are proposed;

i) While national agricultural policies in the 7th and 8th National Economic and Social Development Plan on agricultural diversification program and sustainable programs are in place, implementation seems to be lacking as evidenced by the problems met by farm households. Specific implementation guidelines should be developed in the provincial level and monitoring and evaluation

Table 3 Relationship between bio-physical factors and socio-economic factors, and farm household income.

Variables	Farm household income	
	$\overline{X}$	Prob.
Rice varieties	32.405	0.000***
Age	28.393	0.028*
Occupational experience	38.124	0.009**
Farmer organizations' membership	19.924	0.001**
Financial sources	28.293	0.029*

* $p < .05$
** $p < .01$
*** $p < .001$

of the alternatives should be regularly conducted and documented for further analysis and adjustment of implementation plans for a continuing improvement of rice-based farming systems.

ii) It has been noted that there were available farmer organizations, but the farm households did not take full advantage of membership. These organizations are powerful management resources. The available organizations are adequate, however, they need to be activated with the leadership of the District Agricultural Office. Efforts should be made to make these organizations attractive to be able to encourage memberships among farm households. Participatory management approaches can be practiced through the different activities. This will not only produce results for the organization but can build democratic leadership among individual members as well.

iii) Sustainability is based primary on resource management. Huay Khan Lean Sub-district is endowed with a favorable environment that are supportive to enhanced production such as the availability of irrigation, loan, technical services and the farmers' extensive experience. To maintain balance of usage and sustainability, farm households need to be informed through workshops, discussions and demonstrations especially on the harmful effects of excessive use of chemicals that harm the people and environment.

iv) Successful management depends on a well-organized system with clear guidelines and procedures for farm households to follow. A network of the different existing organizations should be developed. Improvement of farming processes should be the main agenda in these organizations and there should be no overlapping or competition between organizations. Each organization should have a specific role in the whole structure. Areas of roles can be divided into management aspects such as finance, marketing, technology transfer, fund raising and other concerns. A cluster of 3 or 4 organizations may be assigned in each role. The farmers' groups should take leadership in the activities and the district agricultural office and the agricultural technology transfer center should provide an enabling environment in the formation and functioning of these organizations.

v) The types of activities in capacity building should be based on the farmers' needs. Model farmers should be used to encourage farm households to adapt new practices. Award can be given to outstanding producers with criteria set considering maximum utilization of resources through integrated farming systems and environmental protection. Focuses on women farmers should be encouraged to fully participate in these activities.

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