

**Comparison of Cost-Benefit Between Rice Production Under Irrigated and Rain-fed Conditions
in the Southern Lao PDR**

**การเปรียบเทียบต้นทุน และ ผลตอบแทน การผลิตข้าวในสภาพนาปี และ นาปรัง
ในภาคใต้ของ สปป ลาว**

Inpong Siliphouthone (อินปง สีริภูธร)* Dr. Yupa Hanboonsong (ดร.ยุพา หาญบุญทรง)**

Krailert Taweekul (ไกรเลิศ ทวีกุล)*** Dr. Supaporn Pongchompu (ดร.สุภาภรณ์ พวงชมพู)****

ABSTRACT

The aim of this study was to investigate cost-benefit of rice production per hectare under irrigated and rain-fed conditions. The target populations were rice growing farmers under irrigated and rain-fed conditions in the lowland areas. A total of 113 farming households in the rice producing areas of Savannakhet and Champasak provinces were surveyed through a structured questionnaire. The study found that the average household income was US\$ 2,581.97/year while the average household expenditure was US\$ 2,421.23/year. The average rice production cost under irrigated and rain-fed conditions were US\$ 631.61/ha and US\$ 521.24/ha while the revenue of rice production was US\$ 783.12/ha and US\$ 1,018.40/ha. Therefore, the net profit of rice production under irrigated and rain-fed conditions was US\$ 151.51 and US\$ 497.16, respectively. The reasons of rice production under rain-fed lowland were more profitable than irrigated lowland due to the price of rice in was higher.

บทคัดย่อ

การศึกษาในครั้งนี้เพื่อศึกษาต้นทุนผลตอบแทนของการผลิตข้าวต่อเฮกตาร์ ในนาปรังและนาปี กลุ่มเป้าหมายคือเกษตรกรผู้ปลูกข้าวนาปรังและนาปีในบริเวณพื้นที่ราบลุ่ม จำนวน 113 ครอบครัวของผู้ปลูกข้าวในจังหวัดสุวรรณเขตและจำปาสัก ดำรงโดยใช้แบบสอบถาม ในการศึกษาครั้งนี้ได้พบว่ารายได้ต่อครัวเรือน 2,581.97 ดอลลาร์สหรัฐต่อปี รายจ่ายครัวเรือน 2,421.23 ดอลลาร์สหรัฐต่อปี ค่าใช้จ่ายในการปลูกข้าวนาปรังและนาปี 631.61 และ 521.24 ดอลลาร์สหรัฐต่อเฮกตาร์ตามลำดับ ผลตอบแทนในการผลิตข้าวนาปรัง 783.12 และ นาปี 1,018.40 ดอลลาร์สหรัฐต่อเฮกตาร์ กำไรสุทธิในการปลูกข้าวนาปรังและนาปี 151.51 และ 497.16 ดอลลาร์สหรัฐต่อเฮกตาร์ ตามลำดับ การปลูกข้าวนาปีได้รับผลตอบแทนมากกว่าการปลูกข้าวนาปรัง เนื่องจากราคาข้าวในช่วงเก็บเกี่ยว ผลผลิตมีราคาสูงขึ้น

Key Words: Rice production, Cost-benefit, Irrigated and Rain-fed

คำสำคัญ: การปลูกข้าว ต้นทุน-ผลตอบแทน นาปรังและนาปี

* Master degree student, Agriculture (International program), Faculty of Agriculture, Khon Kaen University

** Associated Professor, Department of Entomology, Faculty of Agriculture, Khon Kaen University

*** Assistant Professor, Department of Agricultural Extension, Faculty of Agriculture, Khon Kaen University

**** Lecturer, Department of Agricultural Economics, Faculty of Agriculture, Khon Kaen University

Introduction

Lao People Democratic Republic (Lao PDR) is a developing country, located in Southeast Asia and has 6.7 million people. The Lao economy is rapidly increasing, the Gross Domestic Product (GDP) per capita was US\$ 1,087 with growth rate at 8.1 % in 2010 (DOS, 2010). Agriculture is one of the most important sectors in the Lao economy which accounted for 28.4 % of GDP, employing approximately 75 % of the workforce particularly in rural and regional areas (DOS, 2010). Rice is life for Lao people. The areas for planting rice were 870,000 ha which accounted for 80 % of the total crop areas (DOA, 2010) while 20 % were areas for planting maize, starchy roots, vegetables, soy beans, etc. Rice production systems in Laos are classified into three broad ecosystems: irrigated lowland, rain-fed lowland and upland. A 74.25 % of the harvested areas are in the rain-fed lowland, 13.33 % are rain-fed upland and irrigated areas amounted to 12.41 % of the harvested area. The average rice yield for irrigated and rain-fed conditions were 4.73 tonne/ha and 3.56 tonne/ha, respectively (DOA, 2010).

Rice is a staple food and a main source of incomes for Lao farmers as well. Most of the country's agricultural production is produced on small family farms. Although the Lao government has focused on improving food security at the national level in order to improve the livelihood of Lao people. However, farmers still face problems and limited incomes especially farmers in the rural areas. Setboonsarng (2008) reported that the main source of remote rural household incomes in Lao PDR was selling rice products which accounted for 32 %, followed by selling vegetables and fruits, livestock, non-farm employment, forest and other, accounted for 19%, 18%, 10%, 7% and 14%, respectively. However, farmers spend a lot of

money for rice cultivation as well (Sengxue, 2009). Mohammed (2011) made a comparative analysis in Gombe State, Nigeria which found that labor was the major cost components of rice production.

Therefore, a study of economic analysis of rice production under irrigated and rain-fed conditions in Laos is very important for agricultural economists to generate a rice price policy. This study can also be informative for lowland farmers on the main cost components of rice production and help them get more income. Also of interest is data on which method between irrigated and rain-fed condition was more profitable. Thus, this study was carried out with the general objective of investigation of the farmer's income-expenditure and comparison of costs -benefit between rice production under irrigated and rain-fed conditions in the Southern Lao PDR.

Methodology

1. Sample size and sampling procedures

This study was quantitative research which focused on the areas of growing rice under irrigated and rain-fed conditions in the southern Lao PDR. A multi-stage sampling method including purposive and simple random sampling techniques were used. Kor and Phaleng villages in Champhone district, Savannakhet province and Nakham and Tomoh villages in Pathoumpone district, Champasak province were selected as the study areas.

The selected provinces were where the largest area for growing rice in irrigated and rain-fed conditions. One district in each province was selected where there are mostly rice farmers. Interview farmers were selected by using a simple random sampling. 123 farmers were individually surveyed. However, after cleaning data, 113 questionnaires were used for

analysis. The table 1 presents the distribution of respondents across the surveyed areas.

Table 1 The sample size

Province	District	Village	Respondents	Percentage
Savannakhet	Champone	Kor	42	37.7
		Phaleng	26	23.1
Champasak	Pathoum - pone	Nakham	22	19.5
		Tomoh	23	20.4
Total			113	100

2. Data collection and methodology

The household heads were surveyed during March to April 2011 with structured questionnaires which were designed to investigate the farmer's income and expenditure and the net profit of rice production under irrigated and rain-fed conditions, including details of farm and off-farm income as well as expenditure. Data was also collected on the farmer's socioeconomic information, farm characteristics and rice production. These included information on age, household members, household labor, farming experience, farm size as well as the detail of rice varieties grown. The pre-test was conducted ahead of data collection in order to review the questionnaire before conducting baseline survey. Descriptive statistics such as minimum, maximum, mean and percentages analysis were employed in the analysis of the data. A formula to analyze net profit was total revenue subtracting total costs, as shown in below:

$$\text{Net profit} = \text{TR} - \text{TC}$$

Where TR = Total revenue and TC = Total cost

Results and Discussions

1. Socio-economic information

The result found that the majority of respondents were male (67.3 %) and the average age of

farmers was 45 years old. The average number of household members was 6 people and the labor unit in household was 4 people. 34.1 % of respondents had an education level to primary school while 25.2 % lower primary school, 19.5 % secondary school and 14.6 % had no formal education. The average farm size per household (HH) between irrigated and rain-fed areas were 1.49 ha and 0.77 ha, respectively. The maximum farm size was 3.50 ha/HH while the minimum was 0.40 ha/HH. The majority of respondents (89.4 %) owned land while the rest of them rented the land (19.6 %). The soil type was classified into 5 characteristics, loamy sand, loamy soil, clay soil, sandy soil and rocky soil which accounted for 35.8 %, 35.0 %, 19.5 %, 7.3 % and 2.4 %, respectively.

The most popular rice varieties grown in the study areas were Phone Ngam 3 (PNG3) 18.8 %, followed by Tasano 3 (TSN3) 13.4 %, Thadokkham 1 (TDK1) 12.1 %. The rice varieties grown by farmers included TDK4, TDK5, TDK6, TDK7, TDK11, PNG5, PNG6, TSN1, TSN2, TSN4, TSN5, TSN7, RD6, RD10, Homsavanh etc. These improved varieties accounted for 95.9 % of rice grown while some farmers still grown traditional rice varieties such as Khao-teay, E-pa, E-teay, La-nard, E-dengnoi, Damdane etc.

Most of the improved rice varieties are glutinous rice and non photoperiod sensitive and can be grown in both wet and dry seasons. However, TDK4 variety could not grow in irrigated areas due to it is photoperiod sensitivity rice variety. At 5.10% of non-glutinous rice is grown in the wet season rain-fed lowland such as Homsavan, Jaomali and Jao Vieth varieties.

2. Household income and expenditure

The data on household income and expenditure was collected by estimates from the previous year (January – December 2010). The household income has been divided into (1) selling rice and cash crop, (2) selling animal and (3) off-farm income while the household expenditure has been divided into farm and off-farm expenditures.

The study found that the average household's income was US\$ 2,581.97/year (Appendix 1) which major sources were selling rice (28.16 %), followed by trading or service (14.79 %), labors (13.61 %) and remittance from relative outside country (11.73 %). This implied that rice always plays a critical role in household income for lowland farmers which are similar to the study of (Pandy, 1998), they reported that the major sources of household income was selling rice.

The average of household's expenditure was US\$ 2,421.23/year, Rice cultivation was a major components of household's expenditure followed by food for home consumption, diesels and gasoline which accounted for 47.87 %, 16.72 % and 6.38 %, of total household's expenditure that amounted to US\$ 1,519.09 /year, US\$ 404.73/years and US\$ 154.55/year, respectively (Appendix 2). Thus, the net return of household was US\$ 160.74/year. This indicated that farmers in lowland areas earn incomes than they spend.

The rice's quantity for consumption and sale was shown in table 2. The results found that the average paddy rice for home consumption per household under irrigated and rain-fed seasons were 1,354 kg and 2,584 kg which accounted for 59.15 % and 68.11 % of total production, respectively.

Table 2 Rice consumption and sale in irrigated and rain-fed conditions per household (HH)

Item	Irrigated	Rain-fed
Total production	2,319 kg/HH	3,794 kg/HH
For consumption	1,354 kg/HH	2,584 kg/HH
For sale	935 kg/HH	1,210 kg/HH
% for consumption	59.15 %	68.11 %
% for sale	40.85 %	31.89 %

3. Rice Marketing

This study also investigated on rice marketing and the results found that 91.1 % of respondents sold rice while 8.8 % did not sell. The average price of paddy rice between irrigated and rain-fed seasons are quite different which were US\$ 0.26/kg and US\$ 0.40/kg, respectively. The price of rice started to increase in June 2010 and declined with the arrival of new harvest in late of October. However, in November it was high again as central and southern regions were affected by drought after transplanting and flooded before harvesting so the rice production in this year was lower than the previous years. Phommasack (2006) reported that the reason rice sales did not occur during late June to early October was because it is the growing time and risky for droughts and floods so farmers have to retain their paddy and price of rice is also very low.

The majority of respondents sold rice as paddy rice and milled rice which accounted for 85.4 % and 13.6 %, respectively. The marketing channel showed that rice flows from farmers to consumers mainly through the three marketing channels. Marketing channel 1 showed that 46.2 % of respondents sold paddy rice to rice mills, after milled, milled rice was sold to retailers in the markets and finally to consumers. Marketing channel 2 showed that 29.0 % of respondents

sold paddy rice to traders, the traders processed paddy rice to milled rice and then sold to retailers in the markets and directly to consumers and Marketing channel 3 showed that 16.1 % of respondents processed the paddy rice to milled rice and sold directly to consumers. As shown in figure 1.

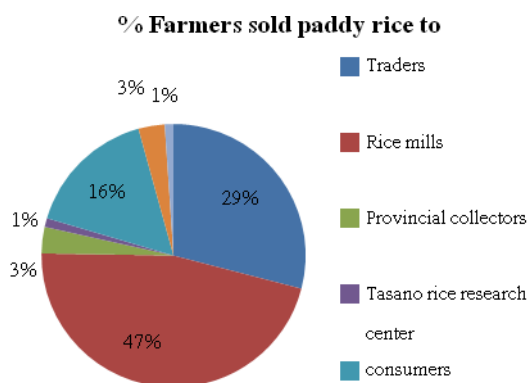


Figure 1: Source of rice selling

4. Cost-Benefit analysis of rice production

Analysis of cost and benefit of rice production under irrigated and rain-fed conditions per hectare (ha) are shown in the appendix 3. The study found that the average rice yield under irrigated and rain-fed areas were 3.012 tonne/ha and 2.546 tonne/ha, respectively. The production costs were classified into two groups; variable costs and fixed costs. The average variable cost for irrigated and rain-fed conditions were US\$ 557.17/ha and US\$ 445.20/ha which accounted for 88.21 % and 87.37 % of total cost of production for the respective systems. The average fixed costs were US\$ 74.44/ha and US\$ 65.82/ha which were 11.79 % and 12.63 %, for irrigated and rain-fed respectively.

Farmers have been spent a lot of money in rice cultivation particularly in the irrigated system where the cost of production was higher than rain-fed system. Chemical fertilizer and labor for transplanting,

were main components of production cost in irrigated condition which accounted for 21.18 % (US\$ 133.75), and 19.94% (US\$ 122.79), respectively. In the rain-fed condition, the main components of rice production cost were transplanting and harvesting which were for 25.85 % (US\$ 134.74) and 18.16 % (US\$ 94.65), respectively.

This indicated that labor is an important resource in rice production which is similar to study of Gailyson (2011) who reported that human labors was the most significant cost item in rice production. Actually, all rice production costs between irrigated and rain-fed were similarly, except the chemical fertilizer costs for irrigated conditions which were higher than rain-fed conditions. Farmers have not applied a lot of chemical fertilizer in wet season due to period heavy raining they cannot control. Therefore, the average total cost of rice production under irrigated and rain-fed conditions was US\$ 631.61/ha and US\$ 521.24/ha, respectively.

On the other hand, the net profit of rice production under irrigated and rain-fed condition per ha was calculated by average yield (kg) multiplied by average price of rice which the total revenue of rice production for irrigated and rain-fed conditions were US\$ 783.12/ha and US\$ 1,108.40/ha, respectively. Therefore, the net profit of rice productions were US\$ 151.51/ha and US\$ 497.16/ha. The reasons the rice production under rain-fed was more profitable than the irrigated systems was because during the period after harvesting of wet season, the price of rice was higher than during dry season due to rice shortages in other parts of the country. In addition traders from neighboring countries come to buy rice in Laos as the price is lower than neighboring countries such as Vietnam and Thailand at the same time.

Conclusion and Recommendation

This study can conclude that the average rice yield in the study areas is below than Ministry of agriculture and forestry (MAF) statistic, the average rice yield under irrigated and rain-fed conditions in the study areas was 3.012 tonne/ha and 2.546 tonne/ha while the MAF statistic was 4.730 tonne/ha and 3.560 tonne/ha, respectively due to some of study areas was affected by drought after transplanting. Although the rice yield under irrigated was higher than rain-fed but the net profit of rice production under irrigated was lower than rain-fed conditions because the total cost of rice production in irrigated was higher than rain-fed conditions and the price of paddy rice after harvesting time in rain-fed was higher than irrigated conditions.

The price of paddy rice in Laos is lower than neighboring country. Agricultural economists should consider on setting up rice price policy help farmers to gain more profit from selling rice. Farmers spend a lot of money for rice cultivation especially chemical fertilizers so they should use manure or organic fertilizers in order to reduce production costs. If farmers used organic or manure fertilizers the yield may be less but the production cost may be a smaller amount thus the net profit may be higher. Therefore it needs to do research on cost-benefit analysis of rice production by using manure or organic fertilizer. Agricultural extension workers should introduce farmers to use new technologies such as drum seeder and mini harvester machine to reduce the labor cost especially in the irrigated lowland

Acknowledgements

The authors gratefully acknowledge the Northern Uplands Rice-based Farm (NURiFaR project), Ministry of Agriculture and Forestry, Lao PDR for financial support in conducting this study. We also thanks

to farmers in Savannakhet and Champasak provinces and staffs in Phonngan Rice Research Station who provided their time for field data collection.

Reference

- DOA. (Department of Agriculture). 2010. Agriculture Statistics: Year Book 2010. Ministry of Agriculture and Forestry, Vientiane, Lao PDR.
- DOS. (Department of Statistic). 2010. Statistical: Year Book 2010. Ministry of Planning and Investment, Vientiane, Lao PDR. Retrieved November 22, 2011, from http://www.nsc.gov.la/index.php?option=com_content&view=frontpage&Itemid=1.
- Gaillyson, YJ., Harana, ES., and Apollos, GT. 2011. Evaluation of factors influencing farmers adoption of irrigated rice production in Famada soil of north eastern Nigeria. *Journal of Development and Agricultural Economics*. 3(2): 75-79.
- Mohammed, S. 2011. Economies of rain-fed and irrigated rice production under the scheme of Upper Benue River Basin Development Authority, Dadinkowa, Gombe State. Nigeria. *Agricultural Economics*. 5(1): 14 – 22.
- Pandey, S., and Minh, DV. 1998. A socio-economic analysis of rice production system in the uplands of northern Vietnam. *Agriculture, Ecosystems and Environment*. 70: 249-258.
- Phommasack, K. 2006. Production and marketing of rice in Champhone district, Savannakhet provinces Lao PDR., MSc. Thesis, Department of Agricultural Economics, Faculty of Agriculture, Khon Kaen University, Thailand.

Setboonsarng, S., Leung, P., and Stefan, A. 2008. Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture. Tokyo. Asian Development Bank Institute.

Sengxua, P., Manivong, V., Xayachacck, S., and Sayavong, S. 2009. Rapid assessment of stocks and marketing system of paddy rice in Lao PDR.

Appendix 1 Household incomes (From 1 January – 31 December 2010)

Incomes items	Amount US\$/Year/HH	Percentage
Rice and cash crop	769.76	29.81
Selling rice	727.1	28.16
Cash crop (sweet corn, lemon, vegetables	42.66	1.65
Selling animals	345.7	13.39
Cattles	160.9	6.23
Poultry	96.26	3.73
Other (Pig, goat, fishpond)	88.54	3.43
Off-farm income	1,466.51	56.80
Salary	182.19	7.06
Labors	351.43	13.61
Remittance from relative within country	56.54	2.19
Remittance from relative without country	302.74	11.73
Fishing	38.73	1.50
Trading and service	381.82	14.79
Selling charcoal	86.43	3.35
Forest production	66.63	2.58
Total income	2,581.97	100.00

Note: 1 US\$ = 8,030 Kip

Appendix 2 Household expenditure (From 1 January – 31 December 2010)

Expenditure items	Amount US\$/Year/HH	Percentage
Farm expenditure	1,165.69	48.14
Rice cultivation	1,159.09	47.87
Growing cash crop	6.60	0.27
Off-farm expenditure	1,255.54	51.85
Rice for consumption	7.22	0.30
Foods	404.73	16.72
Diesels and gasoline	154.55	6.38
Electricity	56.04	2.31
Education	116.06	4.79
Health	125.90	5.20
Cloths	96.39	3.98
House maintaining	133.13	5.50
Festival, event and wedding, etc	102.49	4.23
Cell phone	59.03	2.44
Total expenditure	2,421.23	100.00

Note: 1 US\$ = 8,030 Kip

Appendix 3 Cost and benefit analysis of rice production under irrigated and rain-fed condition

Items	Irrigated conditions		Rain-fed condition	
	Value (US\$/ha)	Percentage	Value (US\$/ha)	Percentage
Variable cost	557.17	88.21	455.42	87.37
Seed cost	32.5	5.15	31.63	6.07
Manure	4.98	0.79	2.37	0.45
Chemical fertilizer	133.75	21.18	67.25	12.90
Insecticide	1.74	0.28	0.37	0.07
Irrigation	9.34	1.48	0	0.00
Land preparation	70.49	11.16	55.92	10.73
Boast casting	2.74	0.43	0	0.00
Transplanting	122.79	19.44	134.74	25.85
Harvesting cost	103.99	16.46	94.65	18.16
Threshing cost	70.86	11.22	64.01	12.28
Transportation	3.99	0.63	4.48	0.86
Fixed cost	74.44	11.79	65.82	12.63
Land tax	-	-	9.09	1.74
Land rent-in cost	22.29	3.53	13.7	2.63
Opportunity cost	52.15	8.26	43.03	8.26
A. Total production cost/ha	631.61	100.00	521.24	100.00
Yields (ha)	3,012	-	2,546	-
Price (US\$/kg)	0.26	-	0.40	-
B. Total revenues	783.12	-	1,018.40	-
C. Net profit	151.51	-	497.16	-

Note: 1 US\$ = 8,030 Kip