Rainfed Lowland Rice Cultivation Systems in Vientiane Plain, Lao P D R
ระบบการปลูกข้าวอาศัยน้ำฝนในที่ราบลุ่มเวียงจันทน์ สปป ลาว

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บทคัดย่อ

การวิจัยนี้จึงมีวัตถุประสงค์เพื่อทำความเข้าใจระบบการผลิตข้าวในที่ราบลุ่มโดยอาศัยน้ำฝนเป็นหลัก ได้เลือกหมู่บ้านซึ่งเป็นตัวแทนตามลักษณะทางกายภาพของพื้นที่ราบลุ่มเวียงจันทน์ คือ หมู่บ้านหนองพระยา หมู่บ้านลาดควาย และหมู่บ้านบ่อเหล็ก โดยใช้แบบสอบถาม (Questionnaires) กับกลุ่มตัวอย่าง จำนวน 89 ราย จากทั้งสามหมู่บ้านเพื่อทำความเข้าใจระบบการปลูกข้าว ส่วนใหญ่เกษตรกรมีกระบวนการปลูกข้าวที่คล้ายคลึงกัน คือ ปลูกข้าวครั้งเดียวในฤดูฝน และมีการจัดการนำโดยการทำคันนา เกษตรกรเริ่มปลูกข้าวในเดือนพฤษภาคมถึงมิถุนายนขึ้นอยู่กับปริมาณน้ำฝนในแต่ละปี มีการเตรียมดินเมื่อความชื้นในดินเหมาะสม หลังจากนั้นมีการเตรียมแปลงกล้า และปักดำเมื่อต้นกล้าอายุ 3-4 สัปดาห์ มีการใส่ปุ๋ยรวมถึงการกำจัดวัชพืช ศัตรูพืช และอื่นๆ จนกระทั่งเก็บเกี่ยวในช่วงเดือนตุลาคมถึงเดือนต้นเดือนธันวาคม (ระยะเวลาขึ้นอยู่กับชนิดของพันธุ์ข้าวและวันปลูก) ทั้งสามหมู่บ้านมีผลผลิตข้าวตั้งแต่ 1.04–3.85 ตันต่อเฮคตาร์ มีค่าเฉลี่ย 2.5 ตันต่อเฮคตาร์ (ค่าเบี่ยงเบนมาตราฐาน ± 0.59) ผลผลิตเฉลี่ยของแต่ละหมู่บ้านไม่มีความแตกต่างกันมาก (2.53, 2.48 และ 2.47 ตันต่อเฮคตาร์ ตามลำดับ) แต่ผลผลิตส่วนใหญ่ยังอยู่ในระดับต่ำ ในขณที่ผลผลิตข้าวสูงสุดอยู่ที่ 3.85 ตันต่อเฮคตาร์ ดังนั้น จึงยังมีศักยภาพในการเพิ่มผลผลิตข้าวต่อพื้นที่ด้วยการจัดการที่เหมาะสม เช่น การจัดการปุ๋ย การลดความเสียหายจากการทำลายของหอยเชอรี่ และอื่นๆ

คำสำคัญ : ข้าว / พื้นที่ราบลุ่มอาศัยน้ำฝน / ผลผลิต / ระบบการปลูก / เวียงจันทน์

ABSTRACT

This paper aimed to investigate rice production systems in rainfed lowland. Three villages namely Nongphaya, Latkouy and Borlex were selected as representatives of the lowland in Vientiane plain, according to physical characteristics. A total of 89 households from three villages were selected for interview by using questionnaires to obtain information on rice cultivation system. Almost all farmers interviewed practice similar rice production process. Most of rainfed rice is grown in bunded paddy fields only in rainy season, beginning in May or June depending on timing of rainfall. Land preparation starts when soil moisture is favorable. Then seedbed is prepared and ready for seedling transplantation after three to four weeks. Fertilizer application, weeding and snail controlling, etc… are practiced by most of the farmers. Harvesting and threshing usually occurred during October to early December (depending on varieties of rice and transplanting date). The rice yield from all of three villages varied from 1.04 to 3.85 t ha^{-1}, with an overall average of 2.50 t ha^{-1} (SD = ± 0.59). The average rice yield from each village does not differ much in village (2.53, 2.48 and 2.47 t ha^{-1}), but considered to be as lower yield. However, the highest yield was 3.85 t ha^{-1}. Therefore, there is much potential to increase the yield through proper management such as fertilizers application which is still much lower than the recommend level, reduction from golden apple snail damage, etc.

Keywords : Rice / Rainfed Lowland / Production / Cultivation System / Vientiane Plain

Introduction

Lao PDR is primarily based on agriculture for her economy. The development policy, the government has been aiming to eradicate poverty and move beyond the category of least development country by the year 2020 (NPEP. 2003). To achieve this, the government has adopted the National Growth and Poverty Eradication Strategy. The first period of current strategic objectives of agricultural development are to improve rural livelihoods, reduce vulnerability of poor households, and create opportunities for diversifying livelihoods through market orientation. On the other hand, agricultural sector has changed rapidly because farmers are making a transition from subsistence to commercial farming as the results of this strategy. (Sithong et al. 2006). At present, the change of this rice policy helps farmers' adoption and expansion of intensive agriculture practices. They grow various economic crops, including maize, cassava, sugarcane, etc., for sale to increase their family's income (NAFRI. 2009).

Moreover, rice is the one of most important indicators determining the welfare status of the Lao people. In the past, rice was commonly grown mainly for domestic consumption only (Schiller et al. 2006). Presently, rice is becoming the most households' security crop, which can ensure food security and improve cash income for the rural households. (Basnayake et al. 2006). Thus, it is considered as the core staple food and as economic crop in Lao. Beside this, rice is major crop grown in all regions of the country, its cultivation covers more than 80% of the total cropped area and approximately 80% of the rice is grown on the seven lowland plains adjacent to the Mekong River. Moreover, the rice production in Laos can be divided into 3 systems, including the rainfed lowland, irrigated lowland and upland rice, 76%, 11% and 13% respectively (MAF. 2009). Thus, rainfed lowland rice production is a key strategy of agricultural planning. Therefore, to achieving full self-sufficiency in rice at the national level with increasing of population and to generate exportable surplus by 2015 (MAF. 2010). and to respond to the government policy by achieving increase rice productivities it is necessary to understand the exiting production in a key area of the country.

Research Method

Information related to general feature of the Vientiane plain was obtained for secondary data. The study was conducted in three villages namely Nongphaya, Latkouy and Borlex, in Xaithani district, Vientiane plain. Village selection was based on large planted area of rice and soil texture characteristics. In each village with 3 Key Informants (Village headman, long experience and local knowledgeable farmers) were selected for semi-structured interview in other to understand the village system. A total 89 households form all three villages were selected by stratify sampling (high and low yield households as identified by village headmen) for interview by questionnaires to obtain information on rice production system. Data from SSI were analyzed by content analysis. Quantitative data were processed by computer using MS Excel program such as percentages, mean, maximum-minimum values, etc.

Results and Discussion

Characterization of Vientiane plain

The Vientiane plain is located between latitude 17°47'00"–18°39'00" N and between longitude 102°22'00" –103°22'00" E. with 150 to 200 meter elevation above sea level (SCCL. 1997). Most of the rainfed lowland rice areas are in two provinces i.e., Vientiane province and Vientiane capital with twelve districts. Xaithani district is represents of Vientiane plain, due to largest area of rice planting and covers three main soil textures; the major soil texture is sandy with small amount of clay. There are three classification of paddy fields; 1) Upper terrace rice field, is facing frequent drought, uncertain rainfall, having sandy soil covering about 61.8% of the rice area, 2) Middle terrace rice field, facing frequent shot duration flood and drought, having sandy loam soil texture, covering about

31% of the total rice field. And 3) Lower terrace paddy rice, facing frequent wet season flood covering quite high heavy clay of content, covering 6.2% of the total paddy field. (Table 1)

Rice yield from each village

According to the farmers interview, rice yield from all of three villages varied from 1.04 to 3.85 t ha^{-1}, with an overall average of 2.50 t ha^{-1} (SD = ± 0.59) (Table 2). However, the highest yield was 3.85 t ha^{-1}. Therefore, there is potential to increase the yield through proper management.

Rice cultivation systems

There are two rice cultivation systems in this area, rainfed and irrigated rice system. Rainfed rice is cultivated in the wet season while irrigated rice is cultivated in dry season. In both systems, rice field is flooded at least part of the growing season. Cropping cycle of wet season rice begins at end of May or June depending on rainfall, with the preparation of the nursery seedbed. After a month, young seedlings are transplanted. However, transplanting may be delayed if the wet season rain is late. Harvesting is starting from October to early December (depending on the varieties of rice and planting date). During the dry season, rice fields are often grazed by livestock. (Table 3)

Rice management practices

Almost all farmers interviewed practice similar rice production process. Almost all the farmers plow their main fields when there is sufficient moisture in the soil, usually 2 to 4 weeks before transplanting. The field is plowed again to make soil puddle by harrowing. Farmers apply cow manure with chemical fertilizers; the amount of fertilizer used and frequency of application often depend on individual farmers' financial resources.

Rice cultivar

There are several varieties of rice, used for cultivation. However, it can be classified into three different types, early, medium and late mature varieties, within each type of variety there are traditional and improved varieties. Many farmers grow more than two different varieties in a cropping year, to match the land types and water availability. Usually early-maturing varieties (flowering in middle to late September) are traditionally grown in upper terrace where water supply is limited and uncertain. Medium and late-maturing varieties (flowering in middle to late October) are also typically grown in the lower terrace where water supply is more available. Table 4 shows that only two farmer in two villages (Latkouy, Borlex) can grow early and medium varieties due to the topographical condition.

Land preparation

Normally land preparation starts in May with favorable rainfall. The farmers used hand tractors for plowing, usually at about 15-20 cm depth with two time of plowing. Pand and Bhan9 found that rice yields were higher and weed dry matter was lower with deep tillage (21-28 cm) than with shallow tillage (7-14 cm). According to Boling10 rainfed lowland rice yield can be increased by the deep tillage because deep plowing conserves moisture and kill weeds. The first plowing is done to incorporate rice straw and other plants residues into the soil to hasten decomposition of plant materials, then they flood the field for two to three weeks to kill the insect pests and weeds. The second plowing is done to turn and mix the soil with water and to harrow at the same time to produce soil puddling and land levelling. Thus, timely of land preparation is important to avoid delay in crop establishment and to enable decomposition of organic material such as rice straw, crop residues.

Nursery management

The lowland rice in this area is transplanted, usually nursery is done in small area (about 5-10% of total area to be planted) the average quantity of rice seed sown in ricebed is about 60-90 kg ha^{-1}, seedlings are allowed to grow for 24 to 30 days before

transplantation depending on the rain. Cattle manure is applied before or at the same time of land preparation. Moreover, chemical fertilizer application is done 1 or 2 days before young seedlings are removed for transplanting, in order to easily pull off the seedlings.

Transplantation

Very few farmers have been trying to plant rice by broadcasting due to labor shortage. Usually transplantation is done from the middle to late July with proper stage of seedling growth (30 days) is preferred. Three to five of seedlings per hill are transplanted at about 15 x 15 cm or 20 x 20 cm spacing under normal condition with average population density of 20 to 25 hills per m^2. Seedling is transplanted manually by using household or hire labor within the villages.

Fertilizer application

The most common fertilizers available commercially in the villages are N:P:K 16:20:00 and 46:00:00 (ureas). Based on the farmers interview, about 66% of farmers use only chemical fertilizer, 28% use chemical fertilizer with cattle manure and 17% use only cattle manure in their rice field (Table 5). In their seedbed they use rice husks or cattle manure.

Initially, 1-2 bags (1 bag = 50 kg) of chemical fertilizer (16-20-00) is applied about 10-15 days after transplanting (DAT), Then around 75 DAT 46-00-00 fertilizer is applied. However, some farmers mix different types of chemical fertilizer with different timing. However, according to Table 6, average of nutrient inputs in all three villages amounted 25.65 kg N, 6.09 kg P and 1.49 kg K ha^{-1}, illustrates that most of farmers in three villages apply N at the rate less than recommendation rate (60 kg N ha^{-1}) for the rainfed lowland rice production of the central part of Laos (Linquist and Sengxua. 2011). This practice might contribute to low yielding.

Pests' management

The Golden apple snail *(Pomacea canaliculata)* is the most recent and common rice pest influencing yield in this area (Basilio R. 1991) reported that at 30 days after transplanting, medium-sizes nails (2-3 cm shell height) at a density of one and eight snails/m^2 had reduced the number of tillers by 19% and 98%, respectively. Furthermore, 0.5 snails/m^2 cause 6.5% and 8.0 snails/m^2 cause 93% missing rice hills. In order to avoid the damage from the golden apple snail most of the farmers use more than 30 days old seedlings and transplant with higher number of plants per hill. This might provide some protection or reduce damage from the snail and also increase rice yield. However, 40% of farmers reduce snail damage by traditional practice (handpicking), 16% applied insecticide, 4% applied herbicide and 41% do not control the snail (Table 7). (Halwart M. 1994) summarized that crop establishment with different ages of seedlings and different numbers of seedlings per hill are considered as one of the major cultural methods for controlling snails. Moreover, (Sanico et al. 2001) founded that transplanting the of old seedlings (4-5 weeks) at increase number of seedling per hill could reduce snail damage in terms of missing hills and minimized yield losses.

Harvesting

Proper management and timing of harvesting can reduce rice yield loss. The farmers always observe when 80-85% of rice grains reach mature stage. Usually rainfed rice harvesting starts from October to early December (depending on varieties and planting date) and most farmers harvest their rice manually (using sickle) using household or hire labor within their villages. Harvested rice is dry by the sun in the rice field for a few days before threshing. And usually threshing is done by machine, but seed for the next season planting is threshed manually. After threshing, rice grains with 12-14% of moisture content are usually stored in small rice barns to protect rodent damage.

Conclusion

Management practices of rainfed lowland rice in Asian countries; Cambodia, Thailand, Nepal (Fujisaka. 1990)

are not differ much from the ones in Vientiane plain of Laos. However, this paper show that a combination of physical, methodological, biological and technological factors influence rice cultivation practices and yield of the Vientiane plain. Moreover, changed of rice management practices are observed. Farmers quickly adapted their farming systems according to the changes such as mechanizations.

The average yield of lowland rainfed rice (2.5 t ha^{-1}) is still low as compared to the neighboring countries such as Vietnam (5.5 t ha^{-1}), China (6.5 t ha^{-1}), etc. (FAOSTAT. 2010) and the yield from each village is not much different (2.53, 2.48 and 2.47 t ha^{-1}), this may be related to the fact that most farmers apply cattle manure or other fertilizers less than recommendation. Moreover, soil fertility in these villages is low. There have a potential to increase the rice yield through proper soil management, pest management and fertilizers application.

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Table 1 Soil distribution of Vientiane p

Soil texture	Area	
	Hectare (ha)	Percentage (%)
High sand Soil texture (SL, LS)	238.39	62
Medium of clay Soil texture (LL,CL,LC)	122.28	31.8
Heavy clay Soil texture (HC)	23.83	6.2
Total	384.44	100

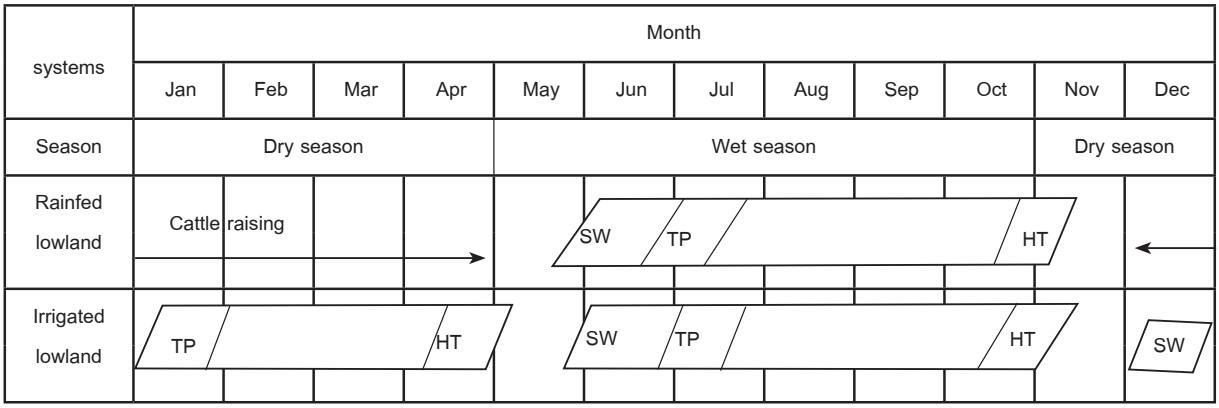
Note: SL= Sandy Loam, LS= Loamy Sand, LL= Loamy loam, CL= Clay Loam, LC= Loamy Clay, HC= Heavy Clay

Table 2 Rice yield in three villages

Villages	Yield t ha^{-1}			No. of HH	SD
	average	Min	Max		
I	2.53	3.85	1.04	27	0.70
II	2.48	3.43	1.60	32	0.47
III	2.47	3.75	1.04	30	0.62
Total	2.5	3.85	1.04	89	0.59

Note: Village I, II, III = Nongphaya, Latkouy and Borlex village respectively

Table 3 Seasonal land-use calendar of lowland paddy field



Note: TP = Transplanting, SW= sowing rice, HT = Harvesting

Table 4 Varieties using in three different villages

Characteristics	Nongphaya village	Latkouy village	Borlex village
Physical	Low terrace	Low terrace & flat	Medium terrace
Water resources	Rain & semi-irrigation	Rain & Irrigation	Rain & semi-irrigation
Varieties	Early, medium & Late varieties	Early & medium varieties	Early & medium varieties

Table 5 Number farmers' type fertilizer application in main paddy field

Practices	Nongphaya village		Latkouy village		Borlex village		Total	
	No. of HH	Percentage (%)	No. of HH	Percentage (%)	No. of HH	Percentage (%)	No. of HH	Percentage (%)
None	0	0	2	6	1	3	3	3.4
CM only	0	0	1	3	0	0	1	1.1
CF	19	70	5	78	15	50	59	66.3
CM+CF	7	26	4	13	14	47	25	28.1
SN+CF	1	4	0	0	0	0	1	1.1
total	27	100	32	100	30	100	89	100

Note: HH= Households, CM= Cattle Manure, CF= Chemical Fertilizer, SN= Soil Night

Table 6 Average nutrient inputs in each village

village	Yield t ha^{-1}	Organic fertilizer (kg ha^{-1})			Chemical fertilizer (kg ha^{-1})				Total (kg ha^{-1})		
					First period		Second period				
		N	P	K	N	P	K	N	N	P	K
I	2.53	0.90	0.41	0.82	17.59	4.32	0.64	11.45	29.93	8.60	1.47
II	2.48	1.35	0.61	1.24	19.22	3.62	0.00	13.92	34.49	7.41	1.34
III	2.47	1.28	0.58	1.18	5.89	0.81	0.27	5.37	12.54	2.28	1.66
Mean	2.50	1.17	0.53	1.08	14.23	2.91	0.30	10.25	25.65	6.094	1.48

Note: Village I, II, III = Nongphaya, Latkouy and Borlex village respectively
First period = 1-30 DAT, Second period = 31-90 DAT transplanting

Table 7 golden apple snail control by farmers

Nongphaya village	Category		Latkouy village		Borlex village		Total	
	No. of HH	Percentage (%)	No. of HH	Percentage %	No. of HH	Percentage %	No. of HH	Percentage %
None	5	19	18	56	14	47	37	41.57
Hands catching	12	44	9	28	14	47	35	39.33
Insecticide	8	30	5	16	1	3	14	15.73
Herbicide	2	7	0	0	1	3	3	3.37
Total	27	100	32	100	30	100	89	100