Research article

Improving Upland Rice Production for Sustainability of Rice Self-Sufficiency in Ratanakiri Province, Cambodia

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Abstract Rice is the major source of carbohydrate, nutrient and income of poor farmers especially in rural areas in Cambodia, and Ratanakiri Province is one among them. Rice self-sufficiency was threatening while the population dramatically increasing and the rice production trend showed the declining. Given primary result showed that a few families were victims of rice self-insufficiency, notably, who possessed small farm, and large members' family. But none of those families experienced hunger as they superior to buy food aid from the market while the other mechanisms were also held. The linear multiple regression models showed that rice sufficiency of upland rice producer families were strongly depend on rice yield obtained. Traditional practices carried by many farmers resulting poor rice productivity. Thus, to meet and sustain rice self-sufficiency several management practices are needed to improve including increasing seeding rate, wisely select variety and planting method, fertilization while capacity building are more apparent for the rapidly adopt technological and economic environment and increasing income.

Keywords rice self-sufficiency, upland rice, upland community, Ratanakiri, Cambodia

INTRODUCTION

Rice is the staple food, source of carbohydrate and nutrient for Cambodian, especially for rural and poor resource farmers (FAO, 2009; Ros et al., 2011; MAFF, 2012, Work Bank, 2013). By 2012, Cambodia has covered 2.97 million ha for rice production with an average yield of 3.1 t ha^{-1} (MAFF, 2012). Cambodia, upland rice plays a key role in maintaining food security for rural areas, and account for around 20% of total rice production annually (MAFF, 2012). However, upland rice farming still follows traditional practices such as slash and burn for ethnic people while some have already adopted advanced technologies including land preparation, fertilization and pest control. Hence, the country's average upland rice production is only 1.2 t ha^{-1} (MAFF, 2012). Ratanakiri Province, well-known for highland rice producing in Cambodia, has about 30,000 ha potential for upland rice production. In 2012, MAFF reported the decreasing trend of upland rice yield during the last decade and suggested to improve rice production nationwide, not only on lowland but as well as upland rice. There is a reported reduction in wet season rice productivity of rainfed upland rice in Ratanakiri Province, despite the constant of upland rice production while the population is dramatic increasing from about 70,000 ha in 2000 to 191,000 ha in 2012 (NCDD, 2010; RPDA, 2012). Notably, population increasing and low rice

yield would push toward food crisis in the province, particularly rice sufficiency. Thus, the study was aimed to determine the rice consumption status of upland rice farmers in Lum Choar commune, Ou Ya Dav District, Ratanakiri Province, Cambodia, and identified the improvement options.

METHODOLOGY

The study was conducted in the dominantly upland rice production areas of Lum Choar commune, Ou Ya Dav district, Ratanakiri province where the most number of upland rice producers was reported (RPDA, 2012). Farmer respondents of the study were taken from the total families of rice producers in Lum Choar commune. The sampling of respondents was determined based on the Slovin's formula with ten percent (10%) margin of error. A total of 90 respondents out of 265 upland rice families were randomly selected. Direct interview (questionnaire survey) was administered describe the characteristics of farmer, upland rice production and household rice status. A combination of qualitative and quantitative, and Multiple Regression analysis using SPSS version 19.0 (SPSS Inc.) was employed.

RESULTS AND DISCUSSION

Level of Household Requirement

Table 1 show that the respondent have an average of 4 members and all of the respondent families are subsistence rice planting rather than commercial.Weekly plant height (cm) of the plants was taken in all treatments as shown in Table 1. It was found out that there was a difference of height in all treatments compared with the Control. However, based on the analysis of variance, it was found that the difference was insignificant in all treatments over the control plots.

For instant, based on self-sufficiency equation, we had estimation for the household rice requirement as in follow. The household survey showed that the requirement for food grains is fixed at 450 grams per person per day for rural areas. This translates into an annual requirement of:

$$\text{Household requirement} = 450 \text{ g/capita/day} \times 4 \text{ people} \times 365 \text{ days} = 657 \text{ kg} \quad (1)$$

Thus, to meet the rice self-sufficiency, each household has to produce at least 1,000 kg of paddy rice where the conversion ratio from paddy to polished rice was found about 64% (De Datta, 1981), and plus at least 30-40 kg of seed reserve for next planting (Table 1). Hence, rice self-sufficiency would be not the problem in the study area where the average yield of 1.46 ton per ha (0.93 ton polished) was recorded (Table 1).

However, Table 2 showed that about 8 percent of the respondent families were fell into rice insufficiency. Among those who faced rice insufficiency, majority was rice insufficiency for more than 50 days (85%). Difference in farmland size devoted for planting upland rice, yield and household member triggered this phenomenon (Table 1). About 10 percent of the respondent families own less than 1 ha devoted for rice production and about 8.9 percent got yield less than 1 ton per hectare. While production area is small and the rice yield is low, these families would fall into rice self-insufficiency.

In addition, none of the rice insufficiency families experienced hunger since they have coping mechanisms to feed rice to their family and children. All of seven respondents who suffered rice insufficiency resource to purchasing rice (100%), 85.7% asked from neighbours or their relatives, 28.6% said they sometimes milled some portion of their next cultivation seed in case of emergency. The result implied that most of farmers could afford to purchase supplementary food from market, even though majority of them obtained low income (Table 2).

Table 1 Household member, education attainment, rice production area, yield, seeing rate, planting purpose and family income of upland rice producer families

Descriptions	Frequency	Percent	Mean+S.E
Household Member (person)			
• =< 3	50	55.60	
• 4	21	23.30	4 ± 1
• >= 5	19	21.10	
Educational Attainment			
• No formal schooling	50	55.60	
• Primary school	31	34.40	
• Secondary school	9	10.00	
Upland Rice farm areas (ha)			
• <1	9	10.00	
• 1-2.0	76	82.20	1.20 ± 0.50
• 2.1-3.0	5	7.80	
Yield (ton ha^{-1})			
• >1.00	8	8.90	
• 1.00-1.50	49	54.50	1.46 ± 0.37
• 1.51-2.00	30	33.30	
• >2	3	3.30	
Seeding rate (kg ha^{-1})			
• 20-30	66	73.40	
• 31-40	20	22.20	30.10 ± 8. 90
• >40	4	4.40	
Purpose of planting rice*			
• Consumption	90	100.00	
• Income	51	56.70	
Family Income (US$/year)			
- <500	78	86.70	
- 500-800	3	3.30	
- 800-1,000	7	7.80	750 ± 420
- >1,000	2	2.20	

Table 2 Household rice sufficiency in Lum Choar Commune, Ou Ya Dav District, Ratanakiri Province, Cambodia

Descriptions	Frequency	Percent	Mean+S.E
Rice Status			
• Surplus	27	30.0	
• Sufficiency	56	62.2	
• Lacking	7	7.8	
Duration of Rice shortage			
• 50 days	1	14.3	43 ± 9
• > 50	6	85.7	
Coping mechanisms to rice shortage*			
• Purchase from market	7	100.0	
• Ask from neighbor/relative	6	85.7	
• Milled the seed for next cultivation	2	28.6	

** multiple responses*

Factor Affected Households' Rice Sufficiency and Improvement Options

A regression analysis was done on the following selected factors to determine which factor influenced household rice sufficiency: income, household member (social factors), areas of rice production, seed used rate, and rice yield (production factors). The result shows that there was a significant relationship between the availability of rice for household consumption and the selected variables. However, among the selected factors only rice yield had positively significantly affected on the availability of rice for household consumption (Table 3). The result indicates that the level of rice sufficiency for household consumption depend on upland rice yield.

Table 3 Factors affecting household rice sufficiency

Model	Observation number	PR>F	Coefficient value
Seed rate	90	0.361 ^{ns}	-0.111
Area of upland rice production	90	0.327 ^{ns}	0.103
Rice yield	90	0.018 *	0.313
Household member	90	0.082 ^{ns}	-0.182
Income	90	0.906 ^{ns}	0.013

** Significant at 0.05 level. R^2=0.117 (P=0.002)*

Suggesting that increasing rice yield is crucial to meet and sustain rice availability and sufficiency in upland communities, specifically in Lum Choar commune. On the other words, high rice yield would also increase family's income. This is understandable because Cambodia is well known as an agriculture country (MAFF, 2012; OECD, 2013; World Bank; 2013). Agriculture sector stands as third contributor to its GDP (MAFF, 2012). However, the scheme to increase upland rice yield per unit should be in parallel with sustainable development and environment harmony.

Factors Lmiting Rice Production and Options for Yield Improvement

The Linear Regression model was used to represent the effects of selected social factors such as education level, income and management interventions (rice variety, sowing date, seed used history, planting methods, seeding rate, fertilization, and weed management) on rainfed upland rice yield.

Table 4 Factors affecting upland rice yield (Regression Model)

Model	Observation number	PR>F	Coefficient
Sowing Date[a]	90	0.361 ^{ns}	0.065
Planting Method[a]	90	0.020 *	0.241
Variety Use[a]	90	0.001**	0.284
Seed Use Duration[a]	90	0.016 *	-0.213
Seed Rate Use[a]	90	0.000**	0.715
Fertilization[a]	90	0.000**	0.448
Weed Management[a]	76	0.696 ^{ns}	0.077
Education level[b]	90	0.005**	0.215
Income[b]	90	0.000**	0.285

*[a] Management practices factors, [b] Social factors, * Significant at 0.05; **Significant at 0.01*
R^2=0.70 (P=0.000)

Significant affected were observed among selected factors (Table 3). Planting methods, rice variety, seed used history and fertilization were factors limiting productivity while sowing date and

weed management was significantly affected. The results indicated that traditional practices carried by farmers were the major yield' limiting factors which commendable implied from poor education and low income. Thus, to improve upland rice yield, farmers have to select variety and planting method wisely, or change their seed every 3-5 years. This is because after 4-5 years of continued recycling of the seeds, a decline in rice yield often takes place due to the accumulation of seed pathogens, impurity of genetic and mixed with the weed seed which later results to unhealthy crops and low yield (Seshu et al., 1988). Sehnoy et al (1988) reported that 20% of rice's yield decline was due to the use of poor seed quality. Commendably, increasing seeding rate would significantly increase yield.

Over the years, improved rice varieties has been proven to achieve 20% more yield than local varieties in many countries such as China, India, Vietnam, Philippines, Indonesia, Malaysia, Thailand, African nation, Australia, and Cambodia (Longping, 2004; Virmani and Kumar, 2004). In 2004, Longping pointed out that new improved and hybrid rice is a wise and great prospect for commercial production and would play a key role to ensure the world's food security. Self-sufficiency in rice is an important matter as it provides food, income and generates employment opportunities. Additional yield of rice means high economic profitability to farmers and food security. In the same manner, application of additional fertilizer would help to increase rice yield. Results of social profiles both education and income, played an important role in which way management practices were carried, significantly influence upland rice production. In rural areas where farming households invested so little in education contributed to poor production (FAO, 2009; Ros et al., 2011; MAFF, 2012; OCED, 2013 and World Bank, 2013). These authors emphasized that education may enhance productivity directly by improving the quality of management and labour. Education is an important asset to farm production in a rapidly changing technological or economic environment. With the rapid spread of technological innovations, the importance of formal schooling and/or training, workshop and farmer field school to farm production becomes more apparent. On the other hand, increasing upland rice productions with minimum inputs are directly influence the income of the upland rice producer families resulting to enhance rice sufficiency and food security for upland community.

CONCLUSION

Traditional upland rice practices carried by poor and low educated farmers resulting low yield, where rice served as major carbohydrate and nutrient, and seriously threaten rice sufficiency in upland communities. Hence, improvement management practices including wisely select planting method, change seed use, adopt new rice varieties, increasing seeding rate and additional applied fertilizer will help to enhance rice production which notably improve rice sufficiency and directly increase the income. However, increasing family income and knowledge are apparently to improve upland rice production such as technological and climate change adaptation.

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