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Assessment of Agricultural Input Uses and Rice Productivity in Cambodia: A Case Study in Battambang and Svay Rieng Provinces

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Abstract: Rice is the main crop grown in Cambodia and in many parts of the world. In Cambodia, people use rice as a main dish for their daily food and for income generation. Therefore, farmers employ different farming strategies (e.g., pest and disease treatments) and inputs (e.g., fertilizers) to optimize rice productivity. This study aims to 1) assess the farming input uses and rice productivity in Battambang and Svay Rieng provinces, Cambodia; 2) determine the factors that affect rice productivity; and 3) predict rice productivity based on farming inputs. As methodology, a survey was conducted by selecting 148 samples from 7 villages, 2 communes, and 2 districts in Battambang and Svay Rieng provinces. Data were collected and analyzed using quantitative and qualitative methods such as frequency, descriptive, cross-table, chi-square, one-sample t-test, and p-value probability. The results found that the average number of farmer family members involved in agricultural production was 2 people, or 70%. Farmers' land sizes range from 2-4 ha, or 40%. The type of chemical fertilizer farmers used to grow their rice the most is DAP (66%). The farmers' land size used in rice productivity affects each family's rice productivity by almost 93%. The quality of rice seed is most affected by rice productivity by increasing rice yields by about 86%. Pesticides have the greatest impact on rice productivity, increasing rice yields by 91%. Rice productivity is almost entirely affected by chemical fertilizer. Farmers should reduce chemical fertilizers and start using organic and natural fertilizers because they provide good quality and safe rice. The government and NGOs should be more active in setting up the agricultural policy of the government mandate on rice production by providing technical support to farmers. Researchers and the next study may deeply conduct research by gaining experience about rice production by using Good Agricultural Practice (GAP) with farmers to find out the impact on rice yield and quality for consumers.

Keywords: Rice variety, natural fertilizer, herbicide, pesticide, and rice yield.

INTRODUCTION

Rice is a major crop that is significant and diverse, like paddy, wheat, and broccoli, which most people in the world commonly use as daily food and processed food. Fodder as well as business Many countries in the world, as well as in the region, are increasing yields, growing crops to support human needs, and ensuring food security for humans on the planet. To obtain rice yields, people have the technical idea to grow rice based on soil selection, crop cultivation, tillage, soil conservation, storage, maintenance, and harvesting of agricultural inputs (Tabibian et al., 2012). Rice grown under rain-fed lowland ecosystems accounts for approximately 29% of the 140 M ha of rice globally, and over 90% of the rain-fed lowland area is located in South and Southeast Asia (Zeigler & Puckridge, 2016). Cambodia is a country with the potential for agriculture through rice cultivation. Our country is naturally favored by the tropical, hot, and humid tropical monsoon to have a six-month dry season and a six-month rainy season. Particularly in the lower plains, there is fertile land with natural reservoirs such as Tonle Sap, Tonle Bassac, and the Mekong River. Battambang and Svay Rieng Provinces are provinces in the central lowlands of Cambodia, including Battambang Province to the west and Svay Rieng Province to the east. Battambang is one of Cambodia's largest rice fields, rich in nutritious soil compared to the topography and soil conditions of Svay Rieng Province, a rice-growing area that is suffering from poor nutrition due to its use.

Farmers' fertilizer year after year, which decreases yields if farmers do not use fertilizers and chemicals to sustain growth. This study aims to 1) assess the farming input uses and rice productivity in Battambang and Svay Rieng provinces, Cambodia; 2) determine the factors that affect rice productivity; and 3) predict rice productivity based on farming inputs.

METHODOLOGY

As methodology, this study was survey research which conducted by selecting 148 samples from 7 villages, 2 communes, and 2 districts in Battambang (BTB) and Svay Rieng (SVR) provinces. All data needs to be collected by interview the target farmers who are involved in rice productivity in both dry and rainy seasons. The purpose of collecting data is to assess the farming inputs used and rice productivity in BTB and SVR, to determine the factors that affect rice productivity, and to predict rice productivity based on farming inputs. Data were analyzed by using quantitative and qualitative methods such as frequency, descriptive, cross-table, chi-square, one-sample t-test, and p-value probability.

RESULT AND DISCUSSION

Assessment of the farming input uses and rice productivity in BTB and SVR provinces

The results found that the average number of farmer family members involved in agricultural production was 2 people, or 70%. Analysis by the one-sample t-test has illustrated that the land size of farmers in each family used in rice production every year showed that the biggest land size from 2-4 ha is 40%, followed by from 4-6 ha is 34%, and from 0.5-2 ha is 9%, while the land size greater than 6 ha is only 8%. This could be explained that the biggest land size farmers per family used for rice production was 2-4 ha as well as 4-6 ha. Based on this result, it can be seen that most farmers in BTB and SVR have their own land, and every family uses their land for rice productivity. Instead, if farmers have their personal land for agriculture, they do not waste money renting other farmers' land to produce rice and ensure sustainable rice production in their families, as they grow rice for food and income. Similar to FAO (1998), which explained that land for agriculture could justifiably be viewed as the most important natural asset and the most important resource for the enhancement of peasant production, it also mentioned land as the most fundamental productive resource in the rural economy. Kassambara & Mundt (2017) has stated that it has not been possible to increase production as land for cultivation is becoming increasingly scarce. This, according to Chinaware, is aggravated by the fact that most lands have lost their productive capacity in a situation where the cost of bringing new lands under cultivation is also high and rising.

The quantity of rice seed farmers preferred to use per hectare was about 200 kg, or 63%. About the price of rice seed per kg, the highest price of rice seed was 1,600–2,000 riels per kg, or 75%, while the lowest price was 2,000–2,500 riels per kg, or 25%. Based on this result, it can be discussed that in rice productivity, farmers need rice seed to cultivate; however, it is noted that generally, farmers use rice seed of about 150–200 kg to grow per hectare both in BTB and SVR. As agree to by Martin et al. (2016), rice was established by direct seeded rice (DSR) using manual broadcasting by 100% of the farmers, with an average seeding rate of 181 kg/ha. In their survey study conducted in BTB and Takeo provinces of Cambodia, they also found that 97% of farmers were practicing DSR using a similar seed rate. The majority of the farmers used their own saved seeds or seeds purchased from neighboring farmers (82–83%) for planting rice in both dry and wet seasons, and only 8–13% bought seeds from a seed company. These results are similar to the previous findings. However, Clarke & Warwick (2001) and Chhun et al. (2019) have reported a similar situation in Vietnam, where 81% of farmers use their own saved seeds for rice sowing and only < 5% buy certified seeds.

The types of fertilizer farmers use to grow their rice every year shows that the most chemical fertilizer is 87%, while the most natural fertilizer is only 13%. In addition, due to the results, it could be explained that the most common fertilizer farmers use to grow rice is chemical fertilizer, which they prefer to natural fertilizer because it is easier and improves growth very quickly. As agree to Chhun et al. (2019) reported that 95% of farmers used fertilizer on rice in the wet season. Urea (82%) was the most commonly used fertilizer, followed by diammonium phosphate (DAP, 52%), ammonium phosphate (27%), NPK fertilizers (12%), and muriate of potash (8%). Overall, 91% of farmers applied N, 86% applied P, and only 30% applied K. In the dry season, only 53% of farmers planted rice, and among them, 96% used fertilizer. Urea (75%) was the most commonly used fertilizer in the dry season, followed by DAP (42%, NPK fertilizers (32%), ammonium phosphate (30%), and muriate of potash (9%). Overall, 96% of farmers applied N, 94% applied P, and 35% applied K.

The farmers who currently use herbicides in their rice productivity the most are 91%, while some farmers do not use them at all, at only 9%. The types of herbicides farmers currently use in their rice productivity are: the most chemical herbicide is 91%, while some farmers use natural herbicides at only 9%. Based on this result, it can be discussed that very farmers wanted to get higher rice yields after harvesting. To achieve this, farmers needed to use herbicides to control all kinds of weeds. Similar to Bodruzzaman (2010) have stated that an effective herbicide for desiccation of live vegetation (cover crop, previous crop, rice, or weeds) prior to planting is necessary to establish a growth advantage of the crop over weeds. The herbicide must provide a complete shoot kill and prevent regrowth of the previous crop or weeds. It should be capable of controlling all emerging plant species present but should have no residual activity on the crop being planted.

The water resources that farmers use in rice productivity the most from rainwater are 87%, while some farmers use water from rivers, lakes, and canals at only 13%. The fuel that farmers use in rice productivity the most from 50–75 Litres is 66%, while some farmers use fuel from 25–50 Litres is only 34%. The amount of money that farmers used to pay for fuel in rice productivity per year was the highest at 240,000–480,000 Riels, while some farmers paid only 43%. Based on the results, it can be concluded that in rice production in both BTB and SVR, farmers exactly need water resources and irrigation from rainwater, rivers, canals, or lakes to grow rice; however, without water, farmers cannot grow rice, whether in the wet or dry seasons. Similar to what Coolman & Hoyt (1993) presented, the use of wastewater in agriculture is growing due to water scarcity, population growth, and urbanization, which all lead to the generation of yet more wastewater in urban areas. With the increasing scarcity of freshwater resources that are available to agriculture, the use of urban wastewater in agriculture will increase, especially in arid and semi-arid countries.

Determining the factors that affect rice productivity

The results found that the amount of farmers' land size used in rice productivity by each family almost affects rice productivity at 93%, while some farmers say farmers' land size does not at only 7%. Most farmers think that the quality of rice seed affects rice productivity by 80%, while some farmers say it is not affected by only 20%. In the below chi-square test (table 4-11), it is indicated by non-significant (n/s) that there is no relationship because the sign or p-value = 0.247 is greater than 0.05, which implies a null hypothesis that can be rejected. So that, there is a relationship between quality and quantity of rice seed farmers use, which exactly affects rice productivity. That means if farmers use high-quality rice seed to grow, they will receive higher rice yields after harvesting.

H0: There is no relationship between the quality and quantity of rice seed and farmers' rice productivity (Null Hypothesis).

H1: There is a relationship between the quality and quantity of rice seed and farmers' rice productivity (alternative hypothesis).

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.414[a]	4	.247
Likelihood Ratio	4.887	4	.299
Linear-by-Linear Association	1.066	1	.302
N of Valid Cases	148		

a. 5 cells (50.0%) have an expected count of less than 5. The minimum expected count is .20

The quality of rice seeds used in rice productivity has shown that the quality of rice seeds is all most affected by rice productivity by increasing rice yields by about 86%, while some farmers do not think that the quality of rice seeds is not affected by rice yield by only 14%. It could be explained that the quality of rice seed affected the rice yield. meaning that if farmers use quality rice seed to grow, they will get a higher rice yield.

The pesticides that farmers use to improve rice productivity, it shows that pesticides almost completely affect rice productivity by increasing rice yield by 100%, while farmers use pesticides to control all kinds of pests and insects by reducing damage to rice during growing until it has been harvested. The pesticides that affected rice productivity that farmers used, it shows pesticides are the most affected by increasing rice yields by about 91%, while some farmers did not think that using pesticides was not affected by rice yield by only 9%. This could be explained by the fact that using pesticides affected the rice yield. meaning that if farmers do not use pesticides when growing rice, they will get a low rice yield.

Herbicides almost completely affect rice productivity by increasing rice yield by 100%, while farmers use pesticides to control all kinds of weeds or grass by reducing damage to rice during growing until it has been harvested. The herbicides that farmers used affected rice productivity the most. It shows that most herbicides affected rice productivity by increasing rice yields by about 98%, while some farmers did not think that using herbicides affected rice yield by only 2%. This could be explained by the fact that the use of herbicides had a significant impact on rice yield, meaning that if farmers do not use pesticides during rice growing, they will get a low rice yield.

Chemical fertilizers, which farmers use to improve rice productivity, it shows that chemical fertilizer almost affects rice productivity by increasing rice yield by 100%, while farmers use chemical fertilizer to improve rice growing at very fast rates and with higher yields. The chemical fertilizer most affected rice productivity by increasing rice yields is about 95%, while some farmers did not think that using chemical fertilizer would affect rice yields by only 5%. This could be explained by the fact that the use of chemical fertilizer had a significant impact on rice yield. means that farmers use chemical fertilizer to improve growing rice in a short time and get a higher rice yield.

Natural fertilizer almost affected rice productivity by increasing rice yield by 100%; meanwhile, farmers used natural fertilizer to improve rice growing during very fast and high yields. Furthermore, rice yields are derived from natural fertilizer, which people can consume safely and in high quality. The price of selling rice yield per kg after harvesting, which farmers sell rice yields, showed that the most price-affected rice productivity is from 800-1,100 Riel/kg, followed by 500-800 Riel/kg, which is 24%, and from 1,100-1,400 Riel/Kg is 14%, while some farmers sell their rice yield at 1,400-1,700 Riel/kg, which is 5%. Meanwhile, most farmers sell their rice yield at an agreed price of 500–800 Riel/kg, which is a bit low compared to the price of inputs for rice productivity.

Predicting rice productivity based on farming inputs

Analysis by the One-Sample T-Test has indicated the quantity of rice yields that farmers get after harvesting per hectare. It shows that the amount of rice yields farmers generally gets from 2,000–400 kg/ha is about 84%, while some farmers get higher rice yields from 4,000–6,000 kg/ha, which is only 16%. This could be explained by the fact that most farmers get rice yields of 2,000–400 kg/ha, while some farmers get higher rice yields of 4,000–6,000 kg/ha. The season, during which farmers always like to grow rice, has a strong relationship with the rice yield.

H0: There is no relationship between the seasons and the quality of rice seed with which farmers cultivate rice and rice yields (Null Hypothesis).

H1: There is a relationship between the seasons and the quantity of rice seed with which farmers cultivate rice that affects rice yields (alternative hypothesis).

Chi-Square Tests

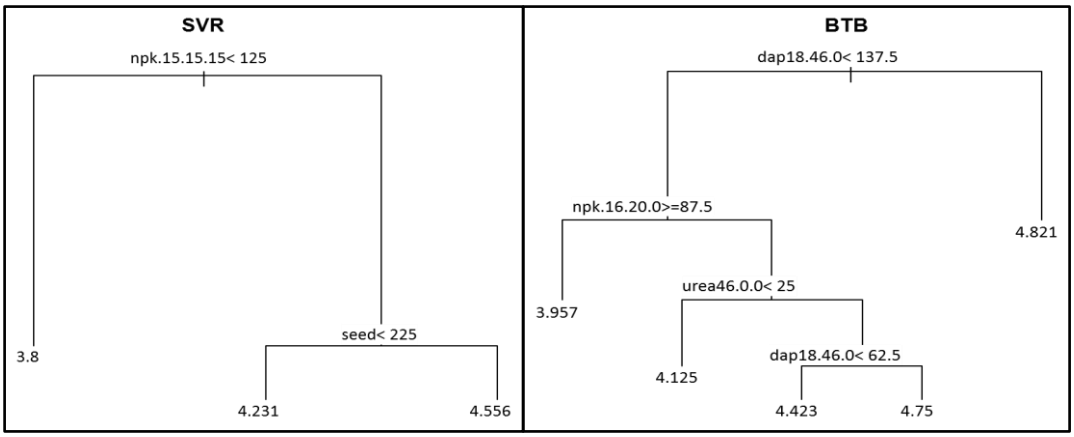
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	30.313[a]	1	.000		
Continuity Correction[b]	28.459	1	.000		
Likelihood Ratio	30.943	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	30.108	1	.000		
N of Valid Cases	148				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.91.
b. Computed only for a 2x2 table.

Comparing between the chemical and natural fertilizers with which farmers grow rice every year. It shows that the most fertilizers applied to rice yields are chemical fertilizer (about 78%), followed by natural fertilizer (about 21%), while some farmers mix chemical and natural fertilizer (only 1%). This could be explained by the fact that most farmers use chemical fertilizer to grow rice, and they get higher rice yields than with natural fertilizer. Only a few mixed fertilizers. The rainy season rice yield per hectare, which farmers grow in rainy seasons. It shows that the most generally high rainy season rice yields are about 2,000–4,000 kg/ha, or 70%, while some farmers get rice yields of about 4,000–6,000 kg/ha after harvesting per hectare, or only 30%. This could be explained by the fact that most rainy season rice is higher than 2,000–4,000 kg/ha, and some farmers get 4,000–6,000 kg/ha. It shows that the most generally high dry season rice yields are about 2,000–4,000 kg, or 86%, while some farmers get rice yields of about 4,000–6,000 kg after harvesting per hectare, or only 14%. This could be explained by the fact that most dry season rice yields are higher at 2,000–4,000 kg/ha, and some farmers get 4,000–6,000 kg/ha.

The coefficient of determination describing the correlation between rice productivity and the predicted value was 0.566. Pesticide level appeared to have the highest influence on rice production, followed by natural fertilizer and chemical fertilizer factors, respectively (Figures 4–53). With regard to productivity prediction, high rice productivity of 5 tons/ha was correlated with a pesticide cost >= $13,000. The medium volume of rice production, 4.276, was discovered. Furthermore, the lowest level of rice production, 3.8 Ton/ha, was discovered when chemical fertilizer was used less than 125Kgs/ha. If farmers use rice seed less than 225 kg/ha, they will probably get rice production of 4.231–4.556 kg/ha in Svay Rieng province (Figure 4-53). In contrast, the rice productivity in Battambang province requires farmers to use more chemical fertilizers if they want to get higher rice production, as follows: If rice production was 4.841 kg/ha, they applied DAP 18:46:00 less than 137.5 kg/ha, while N.P.K. 16:20.00 was about 87.5 kg/ha and rice yield was 3.957 kg/ha. If they applied UREA 46.0.0 less than 25 kg/ha, rice yield was 4.125 kg/ha, and if they applied DAP 18.46.0 less than 62.5 kg/ha, they would get rice production of 4.423–4.75 kg/ha.

- The coefficient of determination describing the correlation between rice productivity in Svay Rieng (SVR) and the predicted value was 0.572.
- The coefficient of determination describing the correlation between rice productivity in Battambang (BTB) and the predicted value was 0.481



Svay Rieng Province Battambang Province

Conclusion

Based on the result of the study, we can conclude that rice productivity is almost entirely affected by chemical fertilizer. The quantity of rice yields, which farmers get after harvesting per hectare the most from 2,000–400 kg/ha, is 84%. Rainy season rice yields, which most farmers get higher, are from 2,000 to 4,000 kg, or 70%. The average dry season rice yield from 2,000 to 4,000 kg is 86%. Farmers should reduce chemical fertilizers and start using organic and natural fertilizers because they provide good quality and safe rice. The government and NGOs should be more active in setting up the agricultural policy of the government mandate on rice production by providing technical support to farmers. Researchers and the next study may deeply conduct research by gaining experience about rice production by using Good Agricultural Practice (GAP) with farmers to find out the impact on rice yield and quality for consumers.

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