



# Farmers' Organic and Inorganic Fertilizers Application and its Effects on Rice Productivity in Prey Chhor District, Kampong Cham Province

**MUY LEANG KIM**

*Graduate School of Agriculture, Tokyo University of Agriculture, Japan  
Email: muyleangkim70@gmail.com*

**MACHITO MIHARA\***

*Faculty of Regional Environment Science, Tokyo University of Agriculture, Japan /  
Institute of Environmental Rehabilitation and Conservation, Tokyo, Japan  
Email: m-mihara@nodai.ac.jp*

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**Abstract** Kampong Cham Province is located in plain region of Cambodia. The major activity of people in the province is agriculture, mainly cultivating rice and vegetables. More than 60% of farmers in Kampong Cham Province applied chemical fertilizers inappropriately without understanding on its impacts. The use of high rates of chemical fertilizers continuously for several years, often lead to unsustainability in production and post harmful to the environment. Recent years, with the support from the government and non-governmental organization (NGOs), many farmers realized and look for a better agricultural practice which could harmonize with natural environment and human health. Several practices were carried to promote the use of organic fertilizers such as green manures, compost, and bio-liquid fertilizer in Kampong Cham Province. The use of organic fertilizers it can reduce the input of chemical fertilizer, improve soil, water, and environment quality. Therefore, the objectives of this study are to describe farmers' practices on fertilization and discuss the effect of fertilization practices on productivity in Samraong and Baray Communes. One hundred farmers were selected for interview with questionnaire surveys on agricultural practices in Samraong and Baray Communes. The results from the questionnaire surveys showed that more than 70% to 80% of farmers in Samraong and Baray Communes applied organic in combination with inorganic fertilizers and less than 20% use only inorganic fertilizers and 10% only organic fertilizer. The amount of rice production in each fertilization practices was different, the rice production in organic fertilizer practices was high compared to other fertilization practices in Baray Commune, however, in Samraong Commune the rice production was high in chemical fertilization practices. As farmers in Samraong Commune used more chemical that is why the production was high compared to other fertilization practices.

**Keywords** organic farming, inorganic fertilizers, compost, sustainable agriculture, Kampong Cham

## INTRODUCTION

Plant nutrients are essential for the growth and productivity of crops. Farmers supply nutrients in the form of organic and inorganic fertilizers. Recently, farmers in Asia have increased the use of inorganic fertilizers over organic fertilizers, however, integration of both organic and inorganic fertilizers helps to increase crop productivity, soil fertility and decreases the damage that can be introduced by inorganic fertilizers. Moreover, farmers in Kampong Cham Province still lack knowledge regarding the advantages and disadvantages of applying organic and inorganic fertilizers.

Kampong Cham Province is located on the plain region of Cambodia. The province consists of 9 districts and 1 municipality, 109 communes and 916 villages. The total population of this

province is about 1.6 million people in 2013 (JICA, 2013), which accounts for 12.5% of the total population of Cambodia. The population is comprised of 80% farmers, 1% craftsmen, 14% service providers and 5% engaged in other businesses. Agriculture activities of people in Kampong Cham Province are changing from subsistence to commercial monoculture with increased use of inorganic fertilizers.

Organic and inorganic fertilizers are important for achieving an increase in crop productivity (Tong, 2010), if there is enough supply of nutrients to the soils, crop will grow well and produce high yields. Application of organic fertilizers, compared to inorganic fertilizers, maintain soil quality by increasing soil organic matter as well as improve soil physical and chemical properties through decomposition of its substances (Mader et al., 2002). Additionally, Farmers in Baray Commune, Prey Chhor District of Kampong Cham Province has been applied organic fertilizers for more than 10 year which results in better soil properties with organic fertilizer application. Compared to that in Samraong Commune, farmers applied organic fertilizer for only 5 years in results there was not clearly shown the influence of organic fertilizer application on soil properties (Kim and Mihara, 2018). Therefore, the study focused on investigating farmers fertilization practices and the effect of fertilization practices on n productivity in Samraong and Baray Communes, Prey Chhor District, Kampong Cham Province.

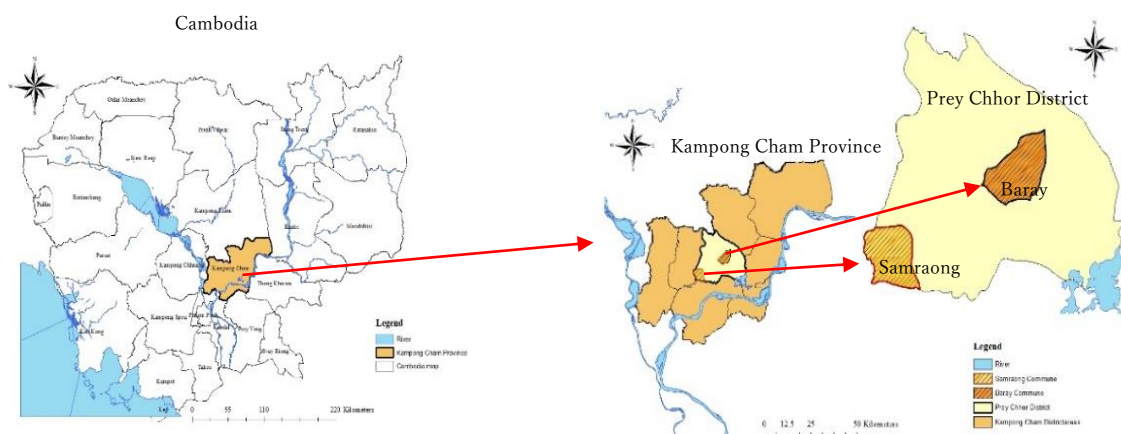
## OBJECTIVE

The objectives of this study are to investigate and describe farmers' fertilization practices and to discuss the effect of different fertilization practices on rice productivity in Samraong and Baray Communes.

## METHODOLOGY

### Study Site

The study is focused in Samraong and Baray Communes in Prey Chhor District, Kampong Cham Province (Fig.1).



**Fig. 1 Maps of the study areas and location of Samraong and Baray Communes, Prey Chhor District, Kampong Cham Province**

Samraong Commune consists of 11 villages and 1,714 households, the farmers in this commune own cultivation land less than 1 ha. The main crops produced are rice and vegetables with main soil types being brown hydromorphics, regurs and cultural hydromorphics. The number of farmers that applied chemical fertilizer or inorganic fertilizers were 1,587 out of 8,123 peoples.

Baray Commune consists of 13 villages, 2,446 households, with average cultivation land less than 1 ha. The main crops cultivated are rice and vegetables. The soil types are the same in both communes, In Bary Commune, 1,479 farmers out of 10,637 people used chemical fertilizer (CDB, 2010).

### Data Collection and Analysis

**Secondary data collection:** Relevant documents were collected from the research institutions journals and reports of the project implement and the experts who had studied in the study areas.

**Primary data collection:** Ones hundred farmers were selected randomly for interview in Samraong and Baray Communes. The contents of the interview and questionnaire surveys mainly focused on the general information of farmers, and agricultural condition, especially on soil fertility management.



**Fig. 2 Conducting questionnaire survey**

**Data analysis:** To describe farmers fertilization practices and amount of fertilizer applied, total nitrogen was used for calculating the amounts of fertilizers used in the study areas. Based on interview and questionnaire surveys the total amounts of nitrogen applied in each fertilizer was calculated with equation (1). Based on total amount of nitrogen applied, the degree of organic and inorganic fertilizers dependency was calculated with Equations (2) and (3).

$$\text{Total N (kg/ha/yr)} = \frac{\text{Amount of fertilizer applied (kg/ha/yr)} \times n \% (\text{nitrogen of the fertilizer})}{100} \quad (1)$$

$$\text{Organic Fertilizer Dependence (OFD\%)} = \frac{\sum N \text{ in Organic fertilizer (kg/ha/yr)}}{\sum \text{Total N ((kg/ha/yr))}} \times 100 \quad (2)$$

$$\text{Inorganic Fertilize Dependence (IFD\%)} = 100 - \text{OFD\%} \quad (3)$$

## RESULTS AND DISCUSSION

### Types of Fertilizers Uses among Responded Farmers

Based on the interview and questionnaire survey on fertilizers practices of farmers in Samraong and Baray Communes showed that farmers applied Urea and Diammonium phosphate (DAP) as inorganic fertilizers and manures and composts as organic fertilizer. The Urea, DAP and manure or compost fertilizer all contained nitrogen content. The commercial rate of nitrogen content in Urea is 46% and DAP is 18%. However, Kim and Mihara in 2018 analyzed the nitrogen content in Urea, DAP and manure used by farmers in Samraong and Baray Communes showed that the nitrogen in inorganic fertilizers were low compared to the commercial rates (Table 1).

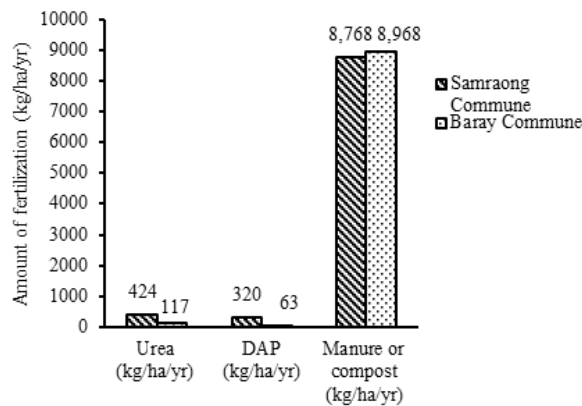
**Table 1 Common types of fertilizers applied and the nitrogen content of fertilizers**

Name	Chemical formulae	N%	N% *
Urea	$\text{CO}(\text{NH}_2)_2$	46	43.37
Diammonium phosphate (DAP)	$(\text{NH}_4)_2 \text{HPO}_4$	18	15.43
Manure or compost			0.36

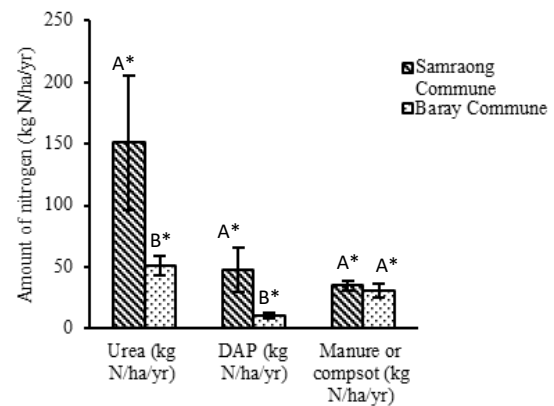
\* Nitrogen content by Kim and Mihara, 2018



**Fig. 3 Chemical fertilizer (left) and compost manure (right)**



**Fig. 4 Amounts of fertilizer applied in Samraong and Baray Communes**

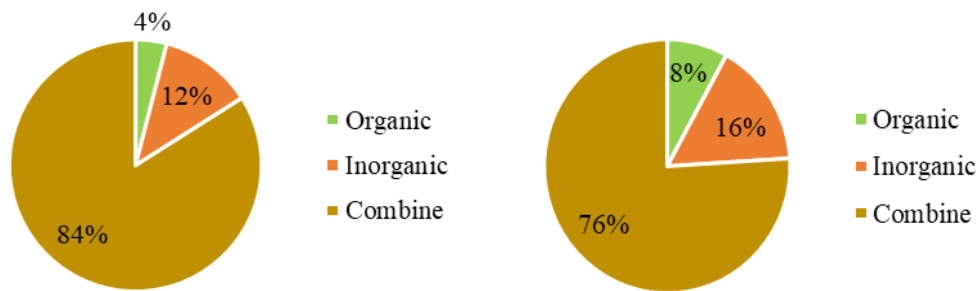


**Fig. 5 Amounts of nitrogen applied in Samraong and Baray Communes**

Farmers in Samraong and Baray Communes applied Urea in average is 424 kg/ha/yr and 117 kg/ha/yr, DAP is 320 kg/ha/yr and 63 kg/year/ha, and manure is 8,768 kg/ha/yr and 8,968 kg/ha/yr, respectively (Fig. 4). The amounts of fertilizers used in each fertilization were converted to the amounts of nitrogen contents (Fig. 5). As the results showed fertilizers applied in both Samraong and Baray Commune were significantly different in 95%, especially in inorganic fertilization practices. Farmers in Samraong Commune applied higher inorganic fertilizers than farmer in Baray Commune.

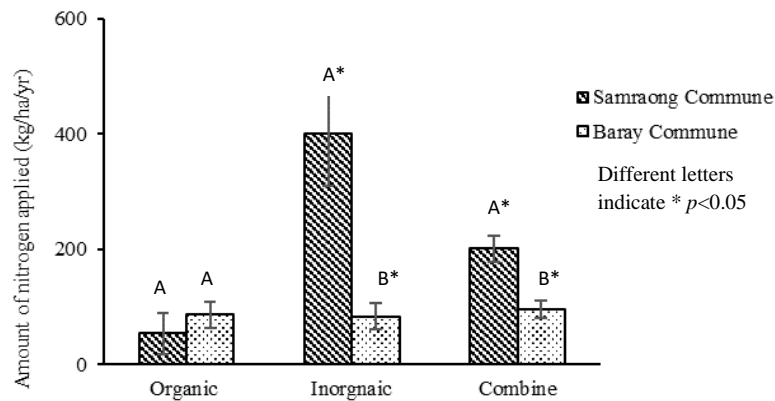
### Farmers' Fertilization Practices

Farmers in Samraong and Baray Communes practiced organic, chemical, and organic in combination with chemical fertilizers. There were 4%, 12% and 84% of farmer household who applied organic, inorganic, and combine in Samraong Commune, respectively. 8%, 16% and 76% of farmer applied only organic, inorganic, and combine in Baray Commune, respectively (Fig. 6). As the result, both communes are likely combining organic and inorganic fertilizers for agricultural production.

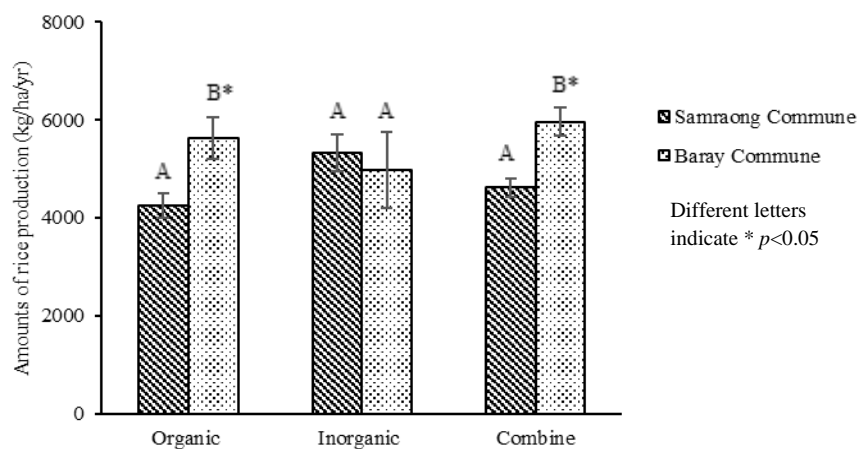


**Fig. 6 Comparison between farmer households who applied different fertilizers in Samraong (left) and Baray Communes (right)**

The amounts of nitrogen used in Samraong and Baray Communes in each fertilization practices were different. In Samraong Commune, nitrogen usage was high in inorganic fertilization practices and combine compared to organic fertilization practices. However, in Baray Commune the amounts of nitrogen use in organic, inorganic, and combine were not different. As comparing the nitrogen use in both communes showed that farmers in Samraong Commune applied more nitrogen in inorganic fertilizers and combine of organic and inorganic fertilization practices.



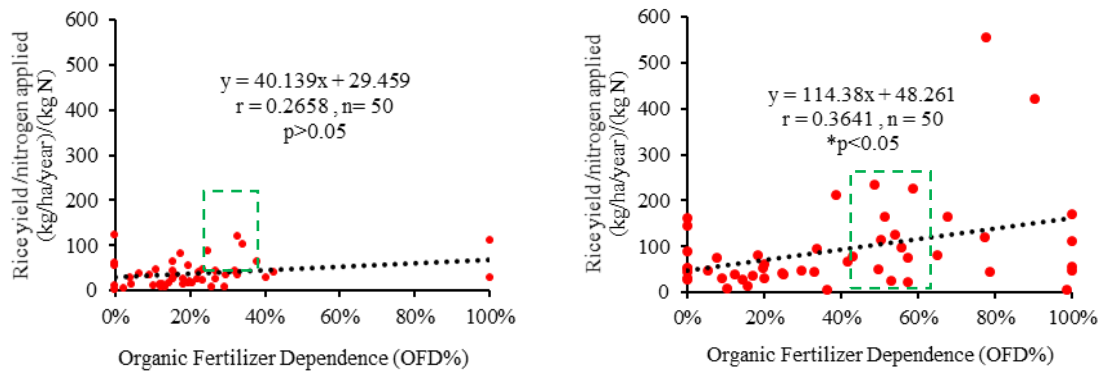
**Fig. 7 Average amounts of nitrogen applied in each fertilization practices (kg/ha/yr) in Samraong and Baray Communes**



**Fig. 8 Amounts of rice production (kg/ha/yr) in Samraong and Baray Communes**

**Effect of Different Fertilizer Practices on Rice Productivity**

The amounts of rice production were significantly different at 95% interval in each fertilization practices in Samraong and Baray Communes. Comparing rice production between Samraong and Baray Communes showed that the rice production shown higher in organic and combine of organic and inorganic fertilizer practices in Baray Commune (Fig. 8). Also, the rice production was not different in inorganic fertilization practices in both communes. It was considered that organic fertilizer application helps to increase the rice productivity in Baray Commune. As farmers in Baray Commune applied less chemical and more organic fertilizer for long term, when organic fertilizer has been applied for long time, the production was high indicating on good soil quality.



**Fig. 9** Amounts of rice production (kg/ha/yr) in Samraong (left) and Baray Communes (right)

There was positive relation between organic fertilizer dependence (OFD%) and rice yields per nitrogen applied at 95% confidence interval in Baray Commune. The combine of organic fertilizer from 50% to 60% with inorganic fertilizers showing good results to increase the productivity in Baray Communes (Fig. 9). However, in Samraong Commune the good rate of organic fertilizer in combination with inorganic fertilizer was from 30% to 40%. As the results the combined application of organic fertilizers such manures or compost and inorganic fertilizer enhanced tiller number, panicle length and yield attribute of rice compared to only inorganic fertilizers application (Kakar et al., 2020).

## CONCLUSION

Farmers in Samraong and Baray Communes combined organic and inorganic fertilizers, there are also a few farmers who applied only organic or only inorganic fertilizers. The main sources of nitrogen for farmers in Samraong Commune are likely from inorganic fertilizer, while in Baray Commune the sources of nitrogen both from organic and inorganic fertilizers. The use of nitrogen in Samraong Commune in inorganic fertilization practice and combine was higher, while the rice production was lower compared to Baray Commune. Farmer in Samraong applied more inorganic fertilizer, but the rice production was not different compared to Baray Commune when farmers applied fewer inorganic fertilizers. Organic fertilizer application helps to increase in rice productivity in Baray Commune, as farmers in Baray has been applied organic fertilizer for more than 10 years and less inorganic fertilizers. It was considered that when organic fertilizer has been applied for many years like Baray Commune, the production was high in organic fertilization and combined. Inconclusion of more organic fertilizer and less inorganic is strongly recommended to farmers in Samraong and Baray as organic fertilizer contributed to increase the rice productivity.

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