J. ISSAAS Vol. 15 No. 1: 91-100 (2009)

SUITABLE TIMING OF APPLICATION OF PELLETIZED COMPOST AND FARMERS' ACCEPTANCE IN CAMBODIA

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(Received: March 3, 2009; Accepted: May 26, 2009)

ABSTRACT

The suitable timing for application of pelletized compost and the evaluation of local farmers' acceptance of composting and pelletized compost making was investigated in Wat Chas village, Prey Chhor district, Kampong Cham province, Cambodia. There was no significant difference between the microbial counts in compost and the initial count in pelletized compost. But the microbial count of 12,228 cfu/g dry mass at 7 days was significantly highest at 99% confidence level, then gradually decreased with time. The microbial count at 21 days was lower than that found in the initial pelletized compost. Before the first workshop, 88.4% of the farmers applied chemical fertilizer and 86.0% applied manure or compost. However, after 4 workshops on composting and pelletized compost making, 85.0% of farmers adopted compost making and application while 51.5% made pelletized compost. A better understanding and increased knowledge led to the greater farmer participation, which was directly connected to farmers' acceptance of organic farming.

Key words: participatory, pellet compost

INTRODUCTION

Agriculture is the most important economic sector in Cambodia, both in terms of contribution to income and to employment. Agriculture has contributed 44.8 % of GDP in 1998, and 28.5% as in 2007, and represented the primary form of employment for at least 70% of the population. The agricultural sector also has a significant potential for contributing to poverty reduction in the development of Cambodia. In the agricultural sector, crop production is the largest (52.2%), followed by fisheries (24.8%) animal production (15.6%) and forestry production (7.3%). Rice is the largest crop sector and production increased from 4.0 million metric tons (MMT) in 2000 to 4.7 MMT in 2007. The total cultivated area for rice production in 2007/2008 was 2,585,905 ha, in which 2,241,114 ha was planted in the wet season. The average rice yield in 2007-2008 was 2.621 tons per ha. However, agricultural production in Cambodia is still being developed (MAFF, 2008).

In Cambodia, sandy soils cover a large proportion of the country, on account of the siliceous sedimentary formations that underlie much of the kingdom. Sandy soils are, therefore, the most prevalent in agricultural lands of Cambodia. In rain-fed lowland rice ecosystems, more than half of the rice-growing soils are categorized as having low productivity potential. These soils are strongly to moderately acidic in reaction, very low to low in exchangeable potassium, very low in organic carbon, total nitrogen, and effective cation exchange capacity and very low to moderate in extractable P (Cambodian Government, 2006).

In order to improve the agricultural production, Cambodia needs to import chemical fertilizers from many countries. The importation of chemical fertilizers rapidly increased from 2003 to 2005, decreased in 2006 and increased again from 2007 (Fig. 1). Agricultural chemicals are also imported and increased from year to year (Fig. 2).

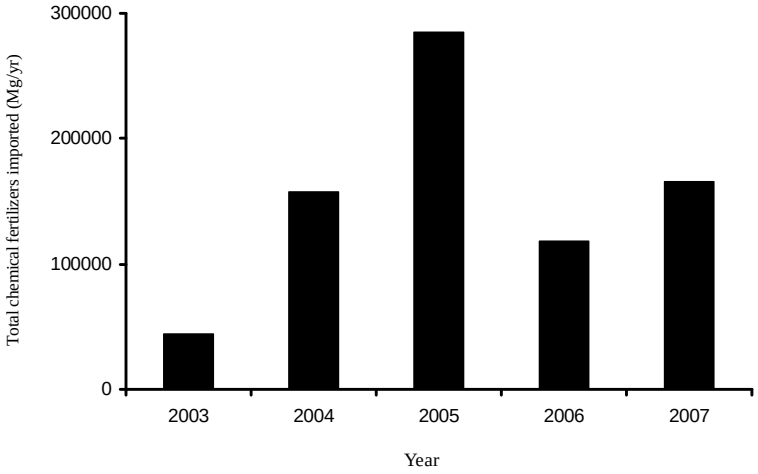


Fig. 1. Chemical fertilizers imported to Cambodia

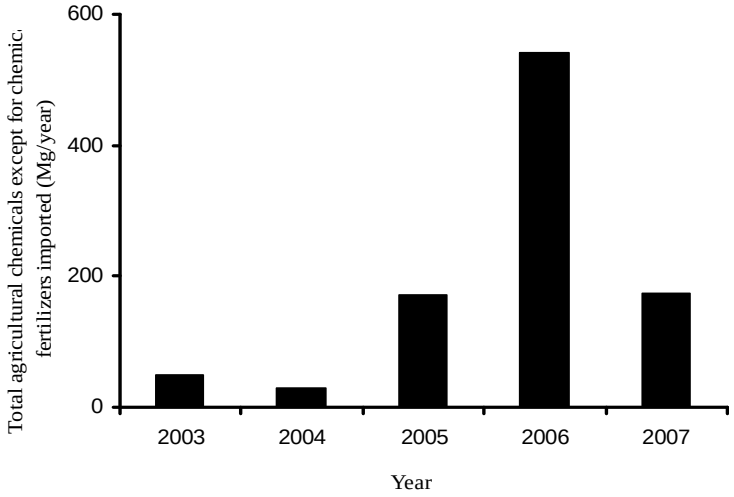


Fig. 2. Agricultural chemicals except for chemical fertilizers imported by Cambodia

Pel (2008) also reported that low rice production in the dry season has increased rapidly in Cambodia. Actually, low rice production increased at the expense of flooded area and flooded forest; and is significantly correlated with the increased use of chemical pesticides and fertilizer. However, farmers still use banned pesticides in the flooded area. Intensive vegetable and low rice production lead to indiscreet and risky application of pesticides with insufficient farmer experience, lack of proper knowledge and information. The overuse of pesticides causes adverse effects in the wetland. The disposal of empty pesticide containers in edges of rice fields and homestead is a big concern.

In Cambodia, many agricultural and environmental problems occur due to the misuse of agricultural chemicals or pesticides. However, these problems affected not only to the environment system but also human health (Alternative Agriculture Forum, 1992). With the support from

government and non governmental organizations (NGOs), many of Cambodian farmers realized and looked for the better practices which can harmonize with the natural environment and health. Organic fertilizers, especially composts are very important and have been introduced to Cambodian farmers.

So, research interest has focused on suitable organic fertilizers in Cambodia. According to a previous study of pelletized formed compost compared with chemical fertilizer or conventional compost from a viewpoint of reducing soil and nutrient loss under various rainfalls. Siriwattananon and Mihara (2008) reported that pelletized compost was effective for decreasing soil and nutrient losses from agricultural fields. But little work has been done in order to evaluate the suitable timing of application of the pelletized compost. Also, attention should be paid to increase the farmers' acceptance through effective capacity building of the farmers to achieve sustainable agriculture which balances economical, social and environmental aspects.

This study sought to investigate the suitable timing of application of pelletized compost and to evaluate local farmers' acceptance of compost and pelletized compost making.

RESEARCH SITE AND METHODS

Research site

The research was conducted in Wat Chas village, Baray commune, Prey Chhor district, Kampong Cham province which is located around 90 km from the capital city of Phnom Penh. It covers 60 ha including 48 ha of rice fields, 5 ha of vegetable orchards and 7 ha for residential purposes. The total population is 484 persons including 152 women. There is no school in this village. As Wat Chas means 'Old Pagoda', this village has a long history and the villagers have preserved their own culture and traditional agriculture methods.

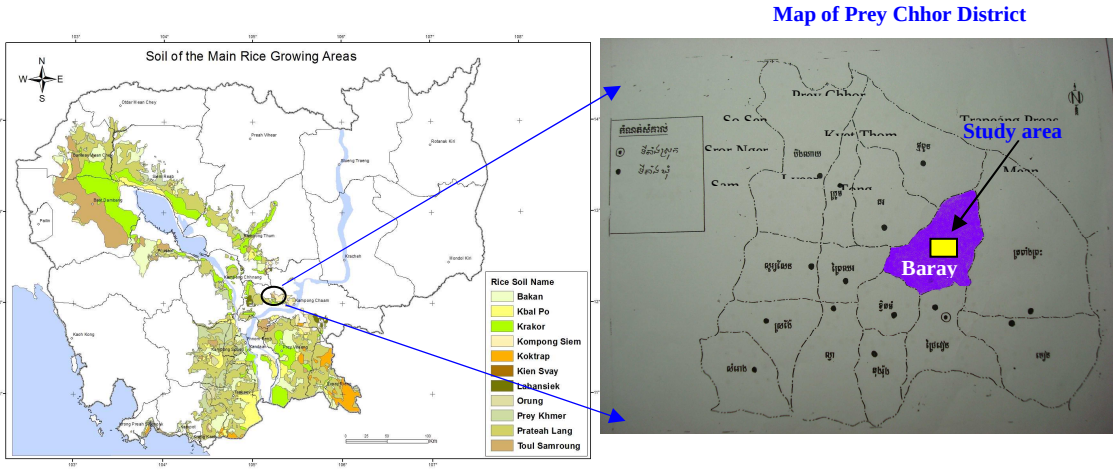


Fig. 3. Location of research site

The climate in Prey Chhor district is tropical monsoons, with a rainy season and a dry season. The rainy season is from April to November and average annual rainfall is 1,549 mm. The daily average maximum and minimum temperatures are 34.7ºC in April and 21.5ºC in January, respectively. Based on topography and land use, this area can be divided into 3 zones: upland, lowland and wetland zone.

Wat Chas village is located in the lowland zone, where rice and vegetables are cultivated. About 95% of the people living in this zone are farmers, 40% are under the poverty line, 30% are living under food security, and 20% look for other extra jobs outside the village. Farmers in this village have several small rice milling machines, a few pumping machines and 2 threshing machines.

The soil at Wat Chas had a pH of 5.1 and an effective cation exchange capacity of 1.9 cmol/kg. The total nitrogen and total carbon concentration of the soil was 5.18 x 10^2 mg/kg or 6.34 x 10^4 mg/kg, respectively. As the soil has very low total nitrogen content and in effective cation exchange capacity, fertilizers should be added to maintain agricultural productivity.

Suitable timing of application of pelletized compost experiment

A previous study reported that pelletized compost was effective in decreasing soil and nutrient losses from agricultural fields (Siriwattananon and Mihara, 2008). But before promoting pelletized compost in Wat Chas village, field trials were conducted to evaluate the suitable timing of applicationof the pelletized compost based on microbial count. The pelletized compost, consisting of conventional compost, clay soil and molasses at the ratio of 10: 1: 0.01, was developed from conventional compost. The mixing ratio was based on a former study (Mihara et al. 2005). Materials were mixed with water and extruded with a mincing machine. The shape of pelletized compost is approximately 0.5 cm in diameter and 1 cm long (Fig. 4).

Conventional compost, having a total nitrogen content of 3.01 x 10^4 mg/kg and total carbon of 44.6 x 10^4 mg/kg, was made from plant and kitchen residues (Table 1). Urea was added in the fermentation process to increase the temperature at around 75 degree Celsius thus eliminating pathogen or bacteria. In addition, total nitrogen or total carbon concentration of pelletized compost was 2.75 x 10^4 mg/kg or 39.6 x 10^4 mg/kg, respectively.

Table 1. Chemical properties of compost, pelletized compost or soil

Sample	Total nitrogen ($x10^{-2}$ kg/kg)	Total carbon ($x10^{-2}$ kg/kg)	C/N
Compost	3.01	44.60	14.8
Pellet compost	2.75	39.60	14.4
Soil	0.29	8.03	27.4

After making pelletized compost, the changes in water content, amount of microorganism, ammonium nitrogen and nitrate nitrogen were observed in the laboratory. Water content was measured by the oven dry method, amount of microorganism by the dilution plate method, ammonium nitrogen by the Nesslar method and nitrate nitrogen by the cadmium reduction method (Buurman et al. 1996, Hach Company 1994). The pelletized compost was kept in the laboratory under the temperature at 25 degrees Celsius and the relative humidity at 70%.

Fig. 4. Pelletized compost made from the experiment

Farmers' acceptance of composting and pelletized compost making

The promotion of organic farming through composting and pelletized compost making was conducted in Wat Chas village. Farmers' acceptance and participation level were discussed through 4 workshops held from August 2007 to December 2008. The questionnaire surveys were carried out to evaluate farmers' perception after every workshop. Four workshops focused on introducing organic farming for sustainable agriculture

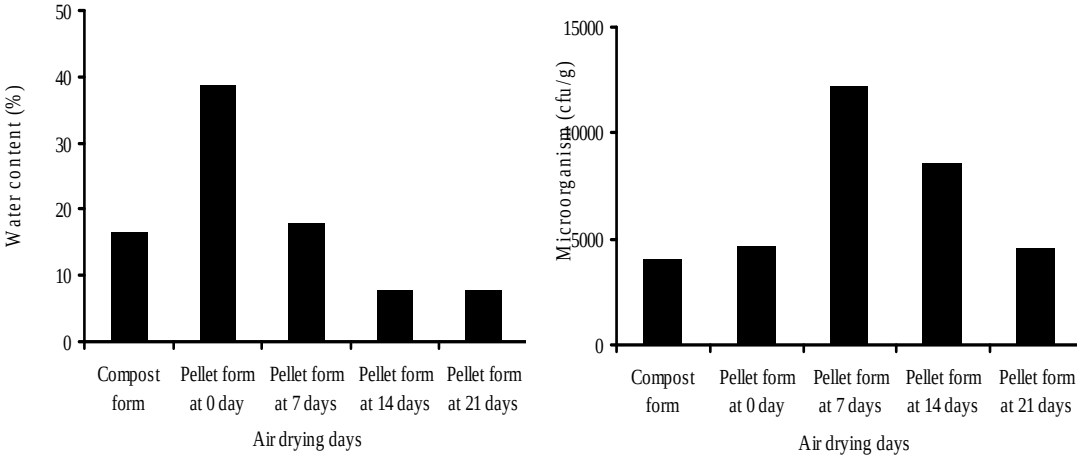
The first workshop in August 2007 focused on introducing concepts of organic farming for sustainable agriculture, the second in December 2007 was on compost making using local materials and applying compost, the third in August 2008 was on making of pelletized compost employing the mincing machine, and the fourth in December 2008 was the farmers' report of composting and pelletized compost making by themselves.

RESULTS AND DISCUSSION

Suitable timing of application of pelletized compost

The changes in water content, amount of microorganism, ammonium nitrogen and nitrate nitrogen after forming pelletized compost are summarized in Fig. 5. As water was added for extruding the mixture, the water content of the initial pelletized compost, at 38.6%, was higher than that of compost. But there was a tendency for the water content to decrease with time. The water content became steady at 7.7% after 14 days. There was no significant difference between the microbial count of compost and that of the initial pelletized compost. But the microbial count was significantly highest at 7 days, increasing to 12,228 cfu/g dry mass, at 99% confidence level. The microbial count gradually decreased with time, and was lower than the initial pelletized compost at 21 days, although there was no significant difference at 99% confidence level.

The microbial counts were not correlated with nitrate nitrogen, but slightly correlated with ammonium nitrogen (Figs. 6 and 7). The suitable timing of application of pelletized compost, therefore, may be around 7 days after preparation of pelletized compost. In cases when this has to be stored, pelletized compost should be applied within 21 days.



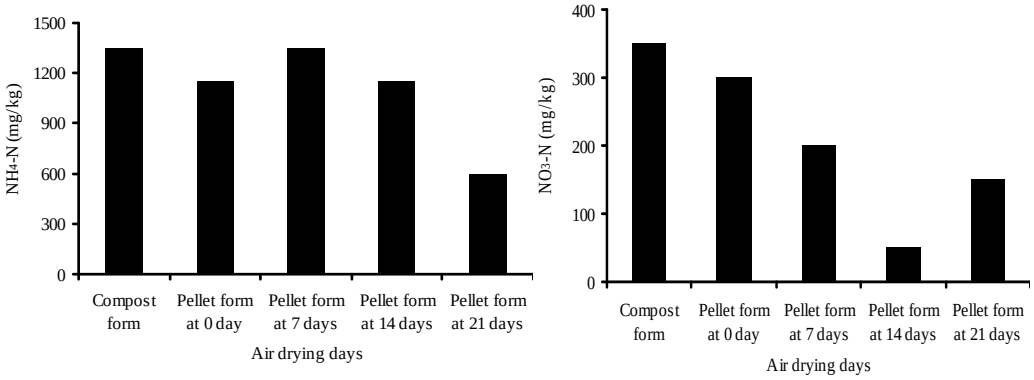


Fig. 5. Changes in water content, amount of microorganism, ammonium nitrogen and nitrate nitrogen after forming pelletized compost

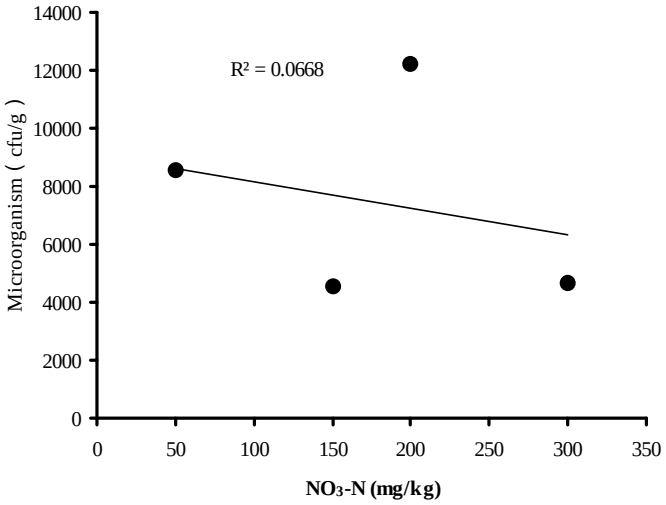


Fig. 6. Relationship between amount of microorganism and nitrate nitrogen

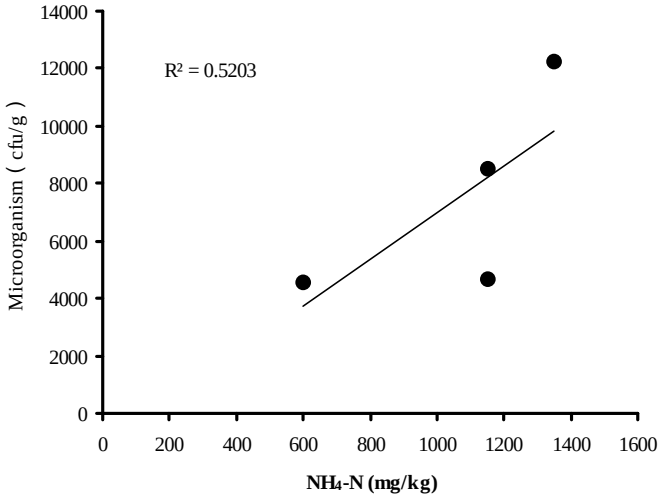


Fig. 7. Relationship between amount of microorganism and ammonium nitrogen.

Farmers' acceptance of composting and pelletized compost making

The results of the questionnaire survey conducted before the first workshop showed that 88.4% of farmers used chemical fertilizers while 86.0% applied manure or compost (Fig. 8). Only 4.6% of the farmers had an experience to apply compost. However, after the first workshop on introducing organic farming for sustainable agriculture, 83.7% of farmers mentioned that they wanted to reduce the expenditure for chemical fertilizer. Also, 95.3% of farmers expressed that they want to join the next workshop on organic farming.

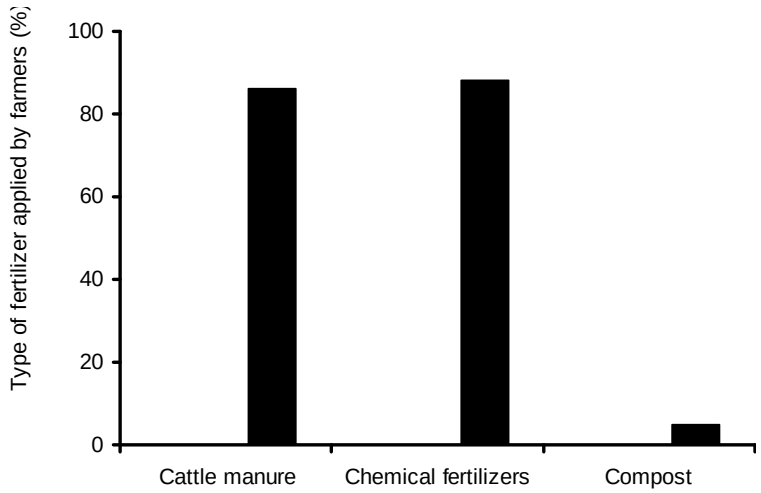


Fig. 8. Types of fertilizers applied by farmers

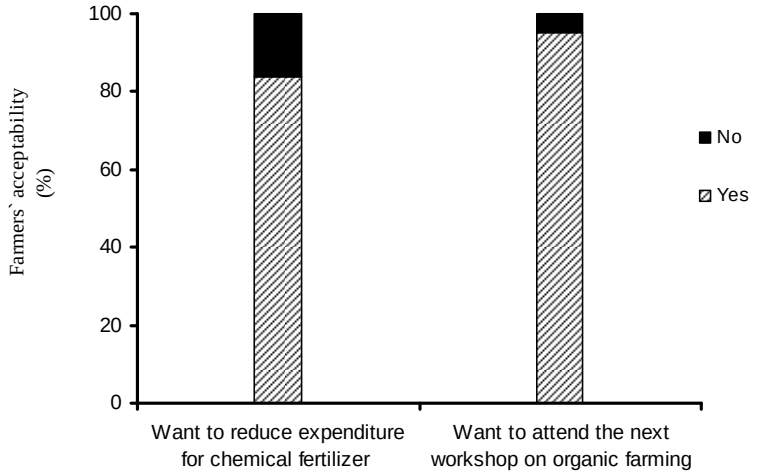


Fig. 9. Farmers' acceptance of organic farming

The second workshop on making and applying compost was held in December 2007, and then pelletized compost making was introduced at the third workshop in August 2008. At the fourth workshop, farmers shared their experiences on pelletized compost in December 2008. About 85.0% of farmers made and applied compost while 51.5% made pelletized compost (Fig. 10).

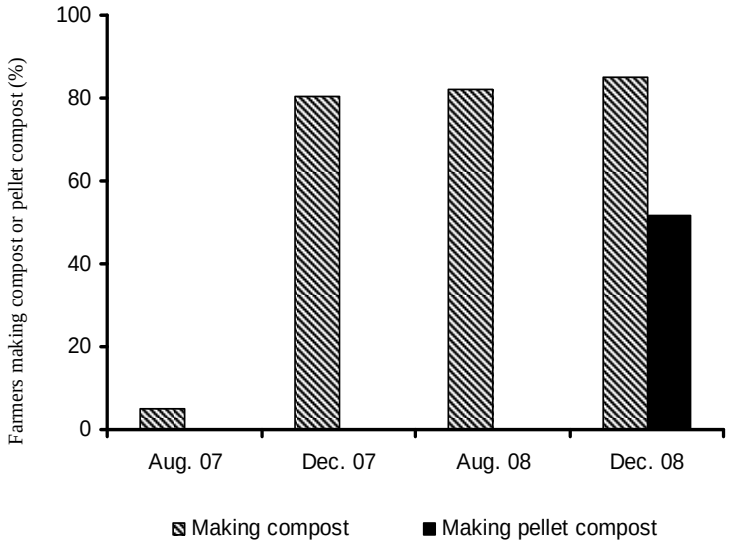


Fig. 10. Changes in farmers of making compost or pelletized compost

The level of participation was evaluated according to the answers in the questionnaire survey and attitudes of farmers in workshops. There are various levels or degrees of farmers' participation as shown in Table 2. The evaluation of level or degree of farmers' participation is important for increasing farmers' acceptance for organic farming. At the beginning of the first workshop, although many farmers attended, it was evaluated as low participation at Level 2 or 3, because most of them participated only in response to the request for attendance. However, farmers became active after understanding the benefits of composting demonstrated in the first and second workshops and pelletized compost making at the third workshop. In the fourth and last workshop, farmers' participation was very high and they were willing to adapt pelletized compost technology. So the degree of farmers' participation was evaluated as interactive participation at Level 6.

It was concluded that the deeper farmers' perception led to the higher farmers' participation. This is directly connected to farmers' acceptance of organic farming.

Table 2. Level of participation

Typology	Characteristics of each type
1. Manipulative participation	People participate by being told what is going to happen or has already happened
2. Passive participation	People participate by answering questions by researcher using questionnaire surveys
3. participation by consultation	People participate by being consulted, and external people listen to views
4. Participation for material incentives	People participate by providing resource, for example labor or other material

Table 2. Level of participation (continued)

Typology	Characteristics of each type
5. Functional participation	People participate by forming groups and objectives related to the workshop
6. Interactive participation	People participate in joint analysis
7. Self-mobilization	People participate by taking initiatives independent of external institutions to change systems

CONCLUSION

Organic fertilizer application through composting of local materials is the easy way which enhances the quality of life for farmers and society, and in the long term it enhances environmental quality and the resource in which agriculture depends. However, there are limits of compost application, so pelletized compost was developed for an alternative fertilization including for soil and nutrient conservation. The recommended timing of applicationof pelletized compost may be around 7 days passed after forming pelletized compost.

Additionally, for achieving sustainable agriculture balancing among economical, social and environmental aspects, it is important to increase the farmers' acceptance through effective capacity building of farmers. In this study, grouping of farmers was also an effective way for facilitating among farmers through exchanging knowledge and experiences related to agricultural practices in sustainable way. The deeper farmers' perception through workshops led to the higher farmers' participation, and directly it connected to farmers' acceptance for organic farming.

ACKNOWLEDGEMENTS

This study has been fully supported by Institute of Environment Rehabilitation and Conservation, Japanese non-profit organization called ERECON, for site surveying and promoting technologies on composting and pelletized compost making to local farmers in Cambodia. Also Royal University of Agriculture, Cambodia kindly supported this extension activity. In addition, special thanks to Ms. Yuko NAKAMURA and Mr. Yuta ISHIKAWA for laboratory works during the experiment of this study.

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