



Contribution of Organic Agriculture towards Achieving Sustainable Development in Samrong, Kampong Cham, Cambodia

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Abstract Sustainable development is one of the most important achievements in developing countries. Organic agriculture is one of the factors contribute to achieve sustainable development. However, implementation rates of organic agriculture are low in South East Asia. Several international organizations have been intervening in the agricultural sector in Cambodia. Interventions conducted by non-profit organization play a key role in the implementation of organic agriculture by farmers. However, previous studies have not thoroughly described the economic contribution of these interventions regarding organic agriculture in Cambodia. In Samrong Commune, Kampong Cham Province, a five-year longitudinal project was conducted to reduce financial losses in agriculture through interventions including implementation of organic agriculture and improving the agricultural skills of farmers. This study is aimed to determine the economic contribution of the interventions. Sample data from 64 farmers were collected through a questionnaire survey during the harvest season. Moreover, the amount of *E. coli*, which is an environmental indicator, was measured in compost boxes and vegetables in a farmland. The results showed a significant correlation ($P < 0.05$) between the interventions and household income. This study provides evidence that the implementing of organic agriculture resulted in increased rural household income. However, *E. coli* from immature compost was found in 90% over their compost boxes and farmland. It implies that knowledge and proper techniques for increasing quality of organic fertilizer are needed to be emphasized.

Keywords sustainable development, sustainable agriculture, organic agriculture, household income

INTRODUCTION

With regard to food supply and economic growth, sustainable development will be a major global concern in the coming decades (Research Institute of Organic Agriculture FiBL, 2016). Organic agriculture is defined by the Food and Agriculture Organization (FAO) as a production management system for promoting and enhancing agro-ecosystem health through the reduction of chemical inputs and modified seeds (FAOa, 2016). Organic agriculture is necessary to achieve sustainable development in the agricultural sector and can benefit both developed and developing countries (Research Institute of Organic Agriculture FiBL, 2016). Studies have indicated that organic agriculture has positive environmental effects, and its implementation has therefore become an urgent task (Pimentel et.al.2005). Furthermore, organic agriculture reduces expenditure costs of agriculture (i.e. fuel cost, chemical fertilizer, etc.) in local households (FAOb, 2001; United Nations, 2009). It also contributes to an increased profit margin for farmers (Kilcher, 2007). However, implementation rates of organic agriculture are low in Asia, especially in some developing countries in Southeast Asia (Will & Youssefi, 2004). On the situation, nonprofit organizations (NPOs) or other

international organizations play an important role in introducing organic agriculture to local farmers (Bebbington, 2004). For example, in Cambodia, international organizations have been intervening more in the agricultural sector than in any other sector (Chanrith, 2002). Limited studies focusing on the relationship between organic agriculture and local household income have been carried out, while many studies focusing only on the relationship between organic agriculture and their effect on the environment in Cambodia (Bunthan & Siriwattananon, 2009, Vathana et.al.,2002). Therefore, this study aims to determine the economic contribution of organic agriculture in Cambodia.

OBJECTIVE

The objective was to determine of the relationship between organic agriculture and farmer's household income. In Cambodia, non-profit organizations (NPOs) encourage farmers to conduct organic agriculture and improving agriculture skills. In this study, the intervention of one NPO was focused on.

METHODOLOGY

Study Site and Characteristics

This study was conducted in October 2016 in Samrong Commune, Prey Chhor District, Kampong Cham Province (Fig. 1). Prey Chhor district is located around 90 km from Phnom Penh, the capital of Cambodia. Rainy season in Kampong Cham starts from April to November. The average rainfall was 22.1mm. The mean minimum and maximum temperatures were 23 and 30 degree Celsius respectively. The total population is 1,673,390 in 2011, according to economic census (Statistics Japan).

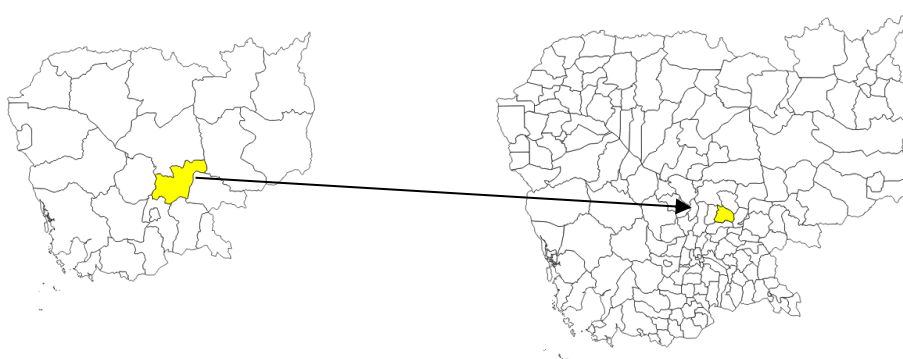


Fig. 1 Location of Kampong Cham Province (left) and Prey Chhor District (right)

Intervention Methods

The NPO conducted a five-year project supported by the Japan International Cooperative Agency (JICA) from April 2011 to March 2016. The goal of this project was to persuade local farmers in Province to practice sustainable, recycling-based agriculture. The project area conducted in 11 villages in Prey Chhor District, Samrong Commune. The five-year long interventions involved the implementation of organic agriculture and the impartment of agricultural knowledge related to the use of organic fertilizer such as compost, recommendation of seeds, etc. (Fig. 2).



Fig. 2 The interventions of NPO (left: compost box, right: liquid fertilizer)

Qualitative Survey (Questionnaire Survey and *E. coli* Survey)

A Questionnaire survey was conducted in Khmer (Cambodia’s official language) by Cambodian staff working at the Institute of Environmental Rehabilitation and Conversation (ERECON) as shown in Fig. 3. The data were collected from 64 participants in intervention and non-intervention groups (Fig. 4). Most of the participants were men, as Cambodian women tend to be involved in other activities (Meinzen-Dick et. al., 2011). The objective was to ascertain whether farmers perceived an increased income over the course of five years. The questionnaire was based on a publication in the Independent Evaluation Group of the World Bank (2011). The indexes of the questionnaire included basic demographic information (sex, age, and location), agricultural style (labor involved, crop type, and number of crops), and participant income. Moreover, the conditions of organic materials (compost box) were checked directly. Organic agriculture should have the advantage of environment (Meinzen-Dick et. al., 2011). However the making organic compost requires proper way (Taiwo, 2011). In this study, organic compost in the compost box was target for the measurement of organic agriculture. Subsequently, Petan Check 25 was applied in compost boxes, and on the farmland and crops of the participants to help detect and measure *E. coli*, an indicator of prevailing environmental conditions.



Fig. 3 Questionnaire survey

Data Analysis

A generalized linear model (GLM) was used to examine the measurements organic agriculture contributes to the increased household income. In the analysis, the response variable was whether farmer felt that there was increased income in five years. The accurate income was difficult to be measured because of the answers are all approximations made by the farmers. The criteria of P value were under 0.05. The explanatory variables were shown as Table 1. All statistical analysis was done using R (R project 3.2.3).

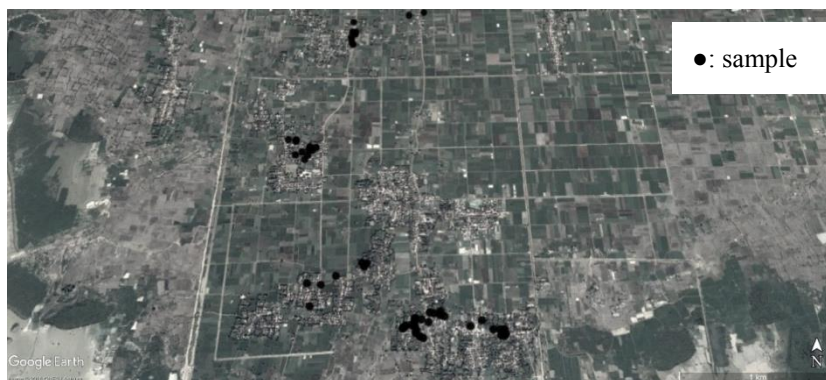


Fig. 4 Black dots as the location of respondent with Google Earth

Table 1 Index of questionnaire

	Index
Response variable	Whether you perceived an increased income over the course of five years
Explanatory variables	Are you a member of the intervention group
	Personal information (age)
	Is your family working only in agriculture
	What kind and how many amount of vegetable for sell
	Do you use organic fertilizers and how many times in one term
	How large is your land (total, rice, vegetable)
	How many cattle do you have
	How many people support your work
	How much is your income (total, only agriculture, non-agriculture)
	Do you talk about ERECON in daily conversation

RESULTS AND DISCUSSION

Characteristics of the Respondents

In this study, 41 or respondents are men (64%) and 23 are women (36%). The numbers of participant from treatment group are 40 (62.5%) and from non-treatment group are 24 (37.5%). Minimum age is 29, and maximum age is 70. Subsequently, median age is 52. Total annual income is 170 USD as minimum, 6000 USD as maximum. Median income is 875 USD. Average income is 1137 USD. Before this intervention, the average income was 943 USD from baseline data.

Result of a Generalized Linear Model

A generalized linear model (GLM) analysis is shown as Table 2. The relation between ERECON’s interventions and their increased income in five years has significant. Moreover, the relation between the number of crops in a year and their increased income in five years has significant. According to the GLM, the co-efficient of ERECON’s interventions and the number of crops is positive. It means that people will feel there will be increased income when people involve in the intervention group and have a opportunity to cultivate more the number of crops as before. Recommendation of seeds for cultivation and sell is one of the interventions conducted in five long years projects. From that intervention, farmers know the type of vegetables that have market demand.

Table 2 GLM of whether farmers perceived an increased income over the course of five years

	Coefficient	P value
Intercept (whether farmers perceived an increased income over the course of five years)	-0.238600	0.662390
Are you a member of the intervention group	0.563400	0.01309*
Personal information (age)	0.000113	0.984330
Is your family working only in agriculture	0.023630	0.881900
What kind of vegetable for sell	0.193900	0.00552*
How many amount vegetables for sell	-0.000024	0.367320
Do you use organic fertilizers	0.382900	0.153380
How many times do you use organic fertilizers in one term	0.032080	0.773790
How large is your land (Total)	-2.392000	0.619190
How large is your land (Rice)	2.407000	0.617430
How large is your land (Vegetables)	1.906000	0.681770
How many cattle do you have	0.059860	0.084020
How many people support your work	-0.003814	0.136000
How much is your income (Total)	-0.005797	0.071710
How much is your income (only agriculture)	0.005408	0.076660
How much is your income (non-agriculture)	0.005939	0.068400
Do you talk about ERECON in daily conversation	-0.867400	0.056620
Are you a member of the intervention group×talk about ERECON	0.571800	0.237480

* $P < 0.05$

Quality of the Compost

From the investigation, *E. coli* exists in 39 compost boxes and farmer's land belong to treatment group (n=40). The detection using Petan Check 25 is shown (Fig. 5). *E. coli* is green colony found on the medium. If farmers make compost properly, *E. coli* will not be found in compost box and land. However, a result of Petan Check 25 is shown farmers do not conduct proper method to make compost.

**Fig. 5 Detection using Petan Check 25**

DISCUSSIONS

This study confirmed the economic contribution of organic agriculture in Cambodia, which can help toward the sustainable development. The results showed that both the interventions and the type of vegetables have the contribution of farmer's household income. However, according to a report of the independent evaluation group of World Bank (2011), the number of labors and cultivated acreage, and some indexes have the relationship with farmer's household income (Taiwo, 2011). These variables did not have significant in this study. Given the possibility that the number of the collecting data was quit few, as there were only 64 respondents in this study. Therefore, these

variables did not have significant. Moreover, the other interventions were not confirmed whether it have positive effect. The results of quality check of the compost box showed that farmers did not clearly replicate the proper way to make organic compost. Because of this, next intervention should focus on the long term education of making organic compost.

CONCLUSION

This study finds there is the economic contribution of organic agriculture in Cambodia. From this finding, organic agriculture have the advantages both environmental (Bunthan & Siri wattananon, 2009, Vathana et.al.,2002) and economic aspects (Ibrahim, 2008). In conclusion, organic agriculture achieves sustainable development in Cambodia.

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