



## Effects of Eri-Culture on Promoting Environmental Awareness in Greater Phnom Penh of Cambodia

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**Abstract** Currently in Greater Phnom Penh of Cambodia, the majority of farmers apply agricultural chemicals such as chemical fertilizers or pesticide to maintain high levels of crop yield. However, agricultural chemicals released from farmlands are causing severe problems, such as the health damage of farmers or the degradation of soil and water environment. So, an attention has been paid to approach sustainable rural development as regional challenges in the Education for Sustainable Development, ESD. This research dealt with the evaluation of the effects of eri-culture on promoting environmental awareness of local farmers, especially regarding the reduction of chemical pesticide applied. As eri silkworm is sensitive to agricultural chemicals, research interests have been focused on how eri-culture affects the environmental awareness of local farmers who rear eri silkworm. Eri silkworm, a kind of wild silkworms that inhabit south Asia, has been introduced to local villages in Kampong Cham province since October 2010 for a part of the activities of Regional Centre of Expertise in Greater Phnom Penh. The workshops have been organized 2 times for local farmers including the demonstration of eri-culture in November and December 2010. Also, the training on eri-culture was conducted to each local farmer who has started rearing eri silkworms. After 6 months from introducing eri-culture in Kampong Cham province, the questionnaire survey was conducted in March 2011 to evaluate the effects of eri-culture on promoting environmental awareness of local farmers. The results showed that rearing farmers wanted to reduce 92.5% of chemical pesticide compared to the conventional way. While local farmers who just participated or who have never participated in the workshops showed only 72.3% or 66.9% of chemical pesticide to be reduced. So, there was a tendency the expected percentage of chemical pesticide to be reduced for rearing farmers was remarkably higher than that for local farmers who just participated in the workshop or who have never participated in the workshops. Accordingly, it was considered that eri-culture has educational function for local farmers regarding the reduction of chemical pesticide application. However, other trainings such as sustainable farming practices may be indispensable to reduce the amounts of chemical pesticide applied with minimizing the insect damage to agricultural products.

**Keywords:** eri-culture, sustainable rural development, ESD, environmental awareness

## INTRODUCTION

Greater Phnom Penh is composed of Phnom Penh city and six surrounding provinces of Kampong Cham, Kandal, Prey Veng, Kampong Speu, Kampong Chhang and Takeo provinces. The total population of those areas is 7,250,881 and the area of Greater Phnom Penh is 34,641 km<sup>2</sup> (Source:

General Population Census of Cambodia 2008). More than 70 % of population is engaged in agriculture and related sectors.

Population increases rapidly in Cambodia, which causes many problems in environment, quality of life, education and human health. Education is always the key to develop human resources that is necessary for the country's development. However, there are many obstacles that make things difficult in Cambodia, for examples, lacking teachers, lacking school facilities, low income of the people and lacking of educational awareness. According to the statistics 2010/2011 of Ministry of Education, Youth and Sport, Cambodia (MoEYS), while the net enrollment ratio for primary school in Kampong Cham province is 96.8 %, the ratio for lower secondary school is 28.3% and for higher secondary school only 14.4%. As a whole, the situation in rural area is much worse than that in urban area. After the enrollment to school, the statistic shows that the severe situation for children to continue their study. The percentage of dropout in primary school (grade1-6) is 10.1%, in lower secondary level (grade7-9) is 22.4% and in upper secondary level (grade10-12) is 13% (Education Indicators, 2010/2011) in Kampong Cham province, and the situation is quite same in other areas of Cambodia.

Also the majority of farmers apply agricultural chemicals, such as chemical fertilizers or pesticides to achieve and maintain high levels of yield. However, the overuse of agricultural chemicals caused the degradation of water regime that is released from farmlands to downstream. Therefore, the education for sustainable development (ESD) is necessary to approach sustainable rural development.

Regional Centres of Expertise (RCE) is a network for existing formal and non-formal organizations to deliver ESD to local communities in respective countries. RCE Greater Phnom Penh (RCE-GPP) has been established to promote ESD through the food, agriculture and environment education for sustainable development in the area of Greater Phnom Penh and was officially acknowledged by the Global RCE Centre of the United Nations University, Institute of Advanced Studies (UNU-IAS) on December 26, 2009. RCE-GPP aims to enhance the food, agriculture and environment education not only for primary schools but also for local communities through organic farming activities under the cooperation of government, universities, local NGOs and local communities in Greater Phnom Penh.

So, in above activities, cultivating eri silkworms called "eri-culture" has been introduced to local villages in Kampong Cham province since October 2010 for a part of the activities of RCE-GPP, which is aiming to promote the Education for Sustainable Development (ESD).

## OBJECTIVE

The objective of this paper is to evaluate the effects of eri-culture on promoting environmental awareness, especially the environmental awareness in terms of the reduction of chemical pesticide application in local villages in Kampong Cham province, which is located in Greater Phnom Penh, Cambodia. Due to the characteristic of eri silkworm, the usage of chemical pesticide should be concerned. Through the introduction and implementation of eri-culture in local villages, it was discussed how eri-culture affect to the local people for changing and improving their environmental awareness.

## METHODOLOGY

### Eri-culture

Eri silkworm, *Samia Cynthia ricini*, is one kind of wild silkworms that inhabit south Asia (Photos. 1-3), and it is said that its origin is Assam province, India. Now not only in India, eri-culture has been conducted in various countries, such as Thailand, Vietnam, China, Philippines, Ethiopia and Cambodia. Wild silkworms inhabit all over the world with more than 500 varieties, and each has very different unique characters.

Not only eri silkworm but also other kinds of wild silkworms have a very unique characteristic

with cocoon, so called ‘nano-tube structure’ (Akai and Nagashima, 2001, 2002). This nano-tube structure makes eri silkworm very unique with high functionalities as material, such as high ultraviolet protection and high moisture absorbency.

Specializing about eri silkworm, it has very high potential to be used as hybrid yarn with other materials, such as silk, cotton and others. As the fiber of eri silkworm is very soft like wool or cashmere, an attention has been paid on cocoon of eri silkworm by private sectors around the world.



**Photo. 1 Eri silkworm    Photo. 2 Castor leaves as host plant    Photo. 3 Eri cocoon**

Eri silkworm is multivoltine and it hatches around 6 times per year (Kawabe, 2010). One lifecycle is about 45 to 50 days. One female moth produces more than 200 eggs per time. Host plants of eri silkworm are leaves of castor (*Ricinus communis*), cassava (*Manihot esculenta*), papaya and a few kinds of leaves which can be found in rural areas of south Asia, and actually considered as “just leaves” with no utilization. Without any input or special care, those leaves are grown naturally, especially near rivers or damping sites. So, farmers can easily start eri-culture without any change of their land use. While using the natural resources in villages, farmers find themselves to acknowledge their farming practice gradually change to sustainable agricultural way. Eri-culture is one of the possibilities to promote sustainable agriculture, due to the sensitivity of eri silkworm to any kind of chemical substances so that farmers started to realize the harm of chemical pesticides, smoke of cigarette, smoke of burning plastics and so on. To conduct eri-culture, farmers need to quit using chemical substances or at least reducing the amount of usage. That is a reason why eri-culture could be one of educational materials for sustainable rural development and also a solution to reduce chemical pesticide, which has been causing severe illness to farmers and strain their living.

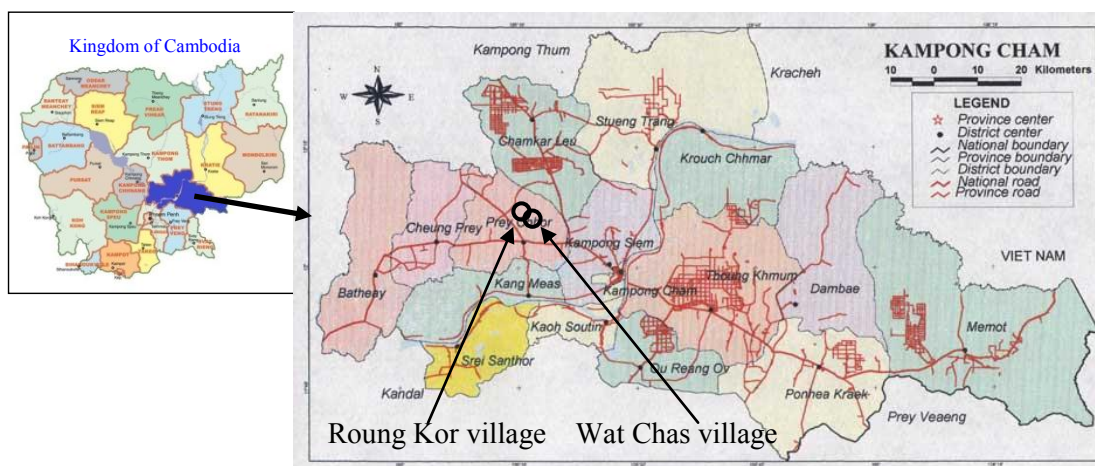
However, to promote sustainable agriculture on ESD, it is necessary to provide something as incentive for local farmers, as their poverty level is quite high and they are eager to do another work for income generation except farming, especially during the dry season, farmers go to urban areas to look for a job for living. So, not only providing workshops or seminars regarding sustainable rural development but also providing opportunity for income generation is the essential factor to motivate farmers and it leads to promoting sustainable rural development in their daily life and initiative could be taken by local farmers.

### **Research sites**

The research sites to conduct eri-culture are located at Wat Chas village and ROUNG KOR village in Baray commune, Prey Chhor district in Kampong Cham province, Cambodia (Fig. 1). Since October 2010, eri-culture has been introduced and promoted in Wat Chas village and a little after in ROUNG KOR village.

In Wat Chas and ROUNG KOR villages, main economic activity of farmers is rice cultivation, and some amounts of vegetables in upland fields are also cultivated. There are some serious problems related to the agricultural situation. Average area of farmland is around 0.45 ha in Wat Chas village and ROUNG KOR village, which is below the average of other areas of Kampong Cham province, thus the amount of agro-production is very limited in the small land and poverty level is higher than other province of Cambodia (Table 1). To yield the large amount of crops, it is common to apply chemical fertilizer and chemical pesticides into farmlands, although it causes severe

degradation of soil and water environment in farmlands and serious health problems for farmers (Mihara and Fujimoto, 2007).



**Fig. 1 Location of Wat Chas and Rong Kor villages in Baray commune, Prey Chhor district in Kampong Cham province**

**Table 1 Agricultural land per rural household in Kampong Cham**

Agricultural land per rural household (a)	Cambodia	Kampong Cham	Wat Chas	Rong Kor
No agricultural land (landless)	15%	17%	7%	3%
$0.01 \text{ ha} \leq a < 1.0 \text{ ha}$	49%	55%	80%	82%
$1.0 \text{ ha} \leq a < 3.0 \text{ ha}$	30%	23%	13%	15%
$a \geq 3.0 \text{ ha}$	6%	5%	0%	0%

Source: MAFF 2004

For the first trial, two farmers have selected and started conducting eri-culture in October 2010, and then four more farmers in Wat Chas village and two farmers in Rong Kor have started to conduct eri-culture since January 2011. Its activity has been expanded in those villages, and the number of farmers who have already started conducting eri-culture is increasing in each village (Photo. 4).



#### Workshops and questionnaire survey

**Photo. 4 Rearers in Wat Chas village**

Eri silkworm, a kind of wild silkworms that inhabit in south Asia, has been introduced to local villages in Kampong Cham province since October 2010 for a part of the activities of Regional Centre of Expertise in Greater Phnom Penh. As shown in Photo. 5, the workshops have been organized 3 times for local farmers including the demonstration of eri-culture in October, November and December 2010. Also, the training on eri-culture was conducted to each local farmer who has started rearing eri silkworms. After 6 months passed from introducing eri-culture in Kampong Cham province of Cambodia, the questionnaire survey was conducted in March 2011 to evaluate the effects of eri-culture on promoting environmental awareness of local farmers. The questionnaire includes the following questions:



- Whether you have already initiated eri-culture.
- Whether you have ever participated in the workshop on eri-culture.
- How much you want to reduce chemical pesticide compared to conventional way.
- How much you enhanced communication compared to before starting eri-culture.
- How much you expect that eri-culture contributes to income generation per year.



**Photo. 5 Eri-culture demonstrations in workshop held at Wat Chas in November, 2010**

## **RESULTS AND DISCUSSION**

### **Local acceptability of eri-culture**

The first workshop conducted in October 2010 was a very small one where only two farmers have participated in. By showing and touching eri-silkworms in effect, farmers understood the process of rearing and active discussion was made naturally.

The second workshop conducted in November 2010 was much bigger than the first one, because more farmers were motivated by the first trial farmers and many came to see their rearing way. Since one farmer for the first trial succeeded, she was acknowledged as “Good Practice” in the village. Although another farmer failed to rear, due to smoke of cigarette and feeding wrong plant such as *Jatropha*, the farmer took this as an opportunity to understand how chemical substances affected eri silkworm that led to fatal event.

Totally, 45 farmers participated in the second workshop and among the participants, other four farmers started eri-culture. Most of them failed to rear for their first time and many worms have died because of the chemical pesticide that was contaminated in the rearing net. New rearers tried to figure out the reason of their sudden death. Naturally, communication among farmers became more active than before to exchange and share knowledge and experiences on eri-culture, and it seemed their awareness to chemical substances has improved. They asked whether perfume is acceptable to worms or not, because young women wear perfume a lot in daily life in Cambodia.

Farmers implement ESD (education for sustainable development) by themselves without being ordered to do so. Moreover, many other farmers from other villages in Kampong Cham province showed their strong interest to start eri-culture since they consider it as a high potential work which can be conducted easily in their villages. After second and third workshops, communication level became high in the network formed naturally and the information and knowledge were spread. Even no support by providing necessary materials, there were many farmers who wanted to start eri-culture.

Table 2 shows the typology of participation. According to attitude of local participants or way to be related or involved in the project, the degree of participation can be evaluated. Based on Table 2, the change in participation level from October 2010 to March 2011 for 6 months was discussed.

When the first workshop was conducted in October 2010, only two farmers participated in it. It was a unilateral announcement without any listening to local responses. So, it could be evaluated as Level 1, passive participation, at the initial stage in October 2010. However, through the second and third workshops including demonstration on eri-culture, many farmers were motivated. Also, they showed their strong and positive passion to start eri-culture. Based on attitude of local participants and way to be related to eri-culture, it could be evaluated as Level 6, interactive participation, as local people participated in eri-culture with forming local network to enhance eri-culture with systemic learning processes based on the local communication.

**Table 2 A typology of participation**

Typology	Characteristics of Each Type
1. <i>Passive participation</i>	People participate by being told what is going to happen or has already happened. It is a unilateral announcement by an administration or project management without any listening to people's responses. The information being shared belongs only to external professionals.
2. <i>Participation in information giving</i>	People participate by answering questions posed by extractive researches using questionnaire surveys or similar approaches. People do not have the opportunity to influence proceedings, as the findings of the research are neither shared nor checked for accuracy.
3. <i>Participation by consultation</i>	People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions and may modify these in the light of people's responses. Such a consultative process does not concede any share in decision making, and professionals are under no obligation to take on board people's views.
4. <i>Participation for material incentive</i>	People participate by providing resources, for example labor, in return for food, cash, or other material incentives. Much on-farm research falls in this category, as farmers provide the fields but are not involved in the experimentation or the process of learning. It is very common to see this called participation, yet people have no stake in prolonging activities when the incentives end.
5. <i>Functional participation</i>	People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organization. Such involvement does not tend to be at early stages of project cycles or planning, but rather after major decisions have been made. These instructions tend to be dependent on external initiators and facilitators, but may become self-dependent.
6. <i>Interactive participation</i>	People participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. These groups take control over local decisions, and so people have a stake in maintaining structures or practices.
7. <i>Self-mobilization</i>	People participate by taking initiative independent of external institution to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used. Such self-initiated mobilization and collective action may or may not challenge existing inequitable distribution of wealth and power.

Source: Pretty (1994), adapted from Adnan et al. (1992)

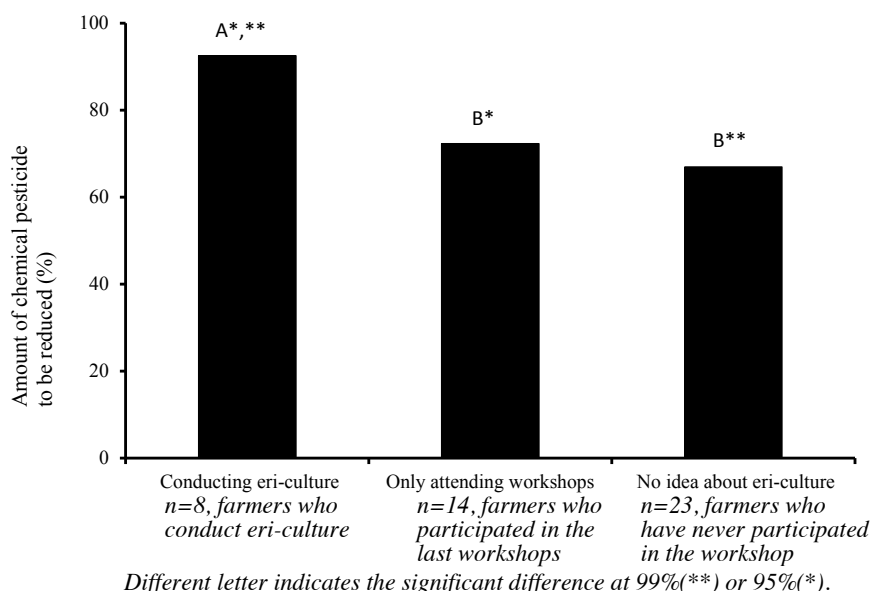
### **Evaluation on the effects of eri-culture on promoting environmental awareness**

The workshops have been organized 3 times for local farmers including the demonstration of eri-culture in October, November and December 2010. Also, the training on eri-culture was conducted to each local farmer who has started rearing eri silkworms. After 6 months passed from introducing eri-culture in Kampong Cham province of Cambodia, the questionnaire survey was conducted in March 2011 to evaluate the effects of eri-culture on promoting environmental awareness of local farmers.

The results of the questionnaire survey showed that local farmers who rear eri silkworms wanted to reduce 92.5% of chemical pesticide compared to the conventional way (Fig. 2). While local farmers who just participated in the workshop or who have never participated in the workshops showed only 72.3% or 66.9% of chemical pesticide to be reduced. So, the expected percentage of chemical pesticide to be reduced for local farmers who rear eri silkworms was

significantly higher than that for local farmers who just participated in the workshop or who have never participated in the workshops.

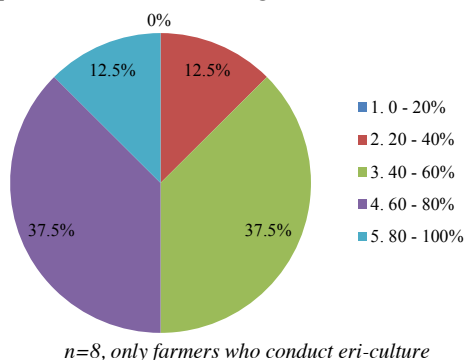
Accordingly, it was considered that eri-culture has educational function for local farmers regarding the reduction of chemical pesticide application. However, other trainings such as sustainable farming practices may be indispensable to reduce the amounts of chemical pesticide applied with minimizing the insect damage to agricultural products.



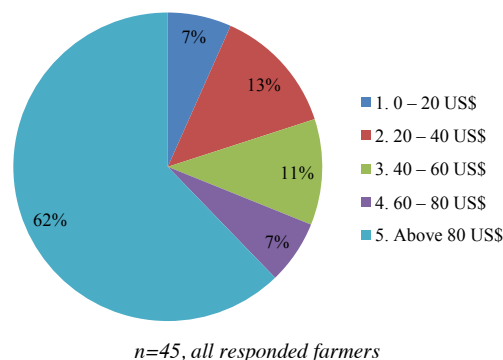
**Fig. 2 Difference in expected percentage of chemical pesticide to be reduced between rearers and others**

#### Evaluation on the effects of eri-culture on rural development

Through the second and the third workshops in November and December 2010, including demonstration on eri-culture, many farmers were motivated. Also, they showed their strong and positive passion to start eri-culture and participated in eri-culture with forming local network to enhance eri-culture with systemic learning processes based on local communication. Corresponding to forming local network to enhance eri-culture, they deepened communication compared to before starting eri-culture.



**Fig. 3 Increase of communication comparing to before starting eri-culture**



**Fig. 4 Expected income generation through eri-culture per year**

As shown in Fig. 3, 38% of rearers acknowledged that the communication increased 40 to 60% compared to that before starting eri-culture, and other 38% of rearers responded increasing up to 60 to 80%, while only 13% acknowledged 20-40%. Accordingly, it was evaluated that the communication in the network has been increased through eri-culture. In addition, Fig. 4 shows the

expectation of income generation through eri-culture. Over 62% of rearers expect more than 80 US\$ of income increase per year. It means local farmers expected that their income would increase through eri-culture in the village.

## **CONCLUSION**

Eri silkworm, a kind of wild silkworms that inhabit in south Asia, has been introduced to local villages in Kampong Cham province since October 2010 for a part of the activities of Regional Centre of Expertise in Greater Phnom Penh. Because of the characteristics of eri silkworm, eri-culture was considered that it has an educational function for local farmers regarding the reduction of chemical pesticide application. This paper dealt with the effects of eri-culture on promoting environmental awareness of local farmers, in terms of the reduction of chemical pesticide application. After 6 months passed from the introduction of eri-culture, the questionnaire survey was conducted for evaluating local awareness on the reduction of chemical pesticide application. In the results, the farmers who rear eri silkworms wanted to reduce 92.5% of chemical pesticide compared to the conventional way. On the other hand, farmers who only participated in the workshops or who never participated in the workshops wanted to reduce only 72.3% or 66.9%. The results of the survey clearly showed that the environmental awareness of the local farmers who reared eri silkworm was significantly higher than that of rest farmers. Accordingly, it was considered that eri-culture could be one of solutions for reduction of chemical input in agricultural land that leads to conservation of natural resources and farmlands, but also poverty reduction to create job opportunity in the village. However, other trainings such as sustainable farming practices may be indispensable to reduce the amounts of chemical pesticide applied with minimizing the insect damage to agricultural products.

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