การเรียนรู้ของเกษตรกรเพื่อพัฒนาความรู้และทักษะในการปฏิบัติตามการเกษตรที่ดี

Farmers Learning to Improve Knowledge and Skills on Good Agricultural Practices

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Abstract: The participatory action research (PAR) using a farmer field school (FFS) project aimed to develop farmer's knowledge and skills on conventional rice practices according to good agricultural practices (GAP) standards. Thirty conventional farmer households were interviewed on the factors affecting traditional production. Ten volunteers participated in the project to develop the farmer's knowledge and skills on rice cultivation in accordance with GAP standards. Data were collected by assessing farmers' knowledge and practices, the ecology of paddy and farmers' practices based on the GAP-02 form, using an observation method. The results showed, the traditional rice cultivation used a high amount of seeds per area without soil fertility management, and used chemical fertilizers and herbicides. Farmers who had participated in the FFS project had their knowledge and practice skills increased by 7.24% and 26.70%, respectively. They were adapted to the GAP standard consisting of plantation area, application of pesticides, quality management in pre-harvest production, harvesting and post-harvest practices, and recording and record keeping. Water resources and transportation storage, and product collection were satisfactory under the conventional rice practices.

Keywords: Farmer field school, participatory development, farmers' knowledge and practices, rice cultivation

บทคัดย่อ: การศึกษากระบวนการแบบมีส่วนร่วมโดยกระบวนการโรงเรียนเกษตรกรเพื่อพัฒนาองค์ความรู้และทักษะการปฏิบัติการปลูกข้าวแบบทั่วไปให้เป็นแบบตามมาตรฐานการปฏิบัติทางการเกษตรที่ดี ทำการสัมภาษณ์เกษตรกรจำนวน 30 ครัวเรือน เกี่ยวกับข้อจำกัดในการทำนาและรับสมัครเกษตรกรเข้าร่วมโครงการ มีอาสมัครเข้าร่วมโครงการ จำนวน 10 ราย เก็บข้อมูลโดยการประเมินความรู้และการปฏิบัติของเกษตรกร ใช้แบบสังเกต

นิเวศวิทยาของนาข้าวและประเมินการปฏิบัติจากการจดบันทึกในแบบฟอร์ม GAP-02 ผลการศึกษาพบว่า การปลูกข้าวแบบทั่วไปมีการใช้เมล็ดพันธุ์ข้าวต่อพื้นที่สูงและไม่มีการจัดการความอุดมสมบูรณ์ของดิน ใช้ปุ๋ยเคมีและสารเคมีกำจัดวัชพืช จากการเข้าร่วมโครงการพบว่า เกษตรกรมีความรู้และทักษะการปฏิบัติการปลูกข้าวเพิ่มขึ้นร้อยละ 7.24 และ ร้อยละ 26.70 และสามารถนำมาตรฐาน GAP ปรับใช้ในการปลูกข้าวคือ การจัดการพื้นที่, การใช้วัตถุอันตรายทางการเกษตร, ระบบการผลิตก่อนการเก็บเกี่ยว, การเก็บเกี่ยวและการปฏิบัติหลังการเก็บเกี่ยว และการบันทึกข้อมูล แต่การจัดการน้ำ การพักผลผลิต การขนย้ายในบริเวณแปลงเพาะปลูก และการเก็บรักษา ยังปฏิบัติตามการปลูกข้าวแบบทั่วไป

คำสำคัญ: โรงเรียนเกษตรกร การพัฒนาแบบมีส่วนร่วม ความรู้และการปฏิบัติของเกษตรกร การปลูกข้าว

Introduction

Thailand has learned the effect of the Green Revolution from the increasing use of agricultural chemicals that have had impacts on ecosystems and the long-term productivity of the land. In 2014, the Ministry of Agriculture and Cooperatives (MAOC) implemented the Green Agricultural City (GAC) pilot project by implementing a Good Agricultural Practice (GAP) in six provinces, namely Chiang Mai, Ratchaburi, Phatthalung, Nong Khai, Si Saket, and Chanthaburi to be green agricultural cities. This was the flagship project of the MAOC, consistent with the government's national strategy. The project focuses on the production of environmental-friendly agricultural products throughout the production and consumption chain and encourage these provinces to be models in each region for GAP (Land Development Department, 2015). Then, the National Organic Agriculture Development Strategy 2017-2021 was implemented in Phatthalung province as it was the main source of rice production that is an important agricultural product and the area required a flagship project (National Organic Agriculture Development Committee, 2017). Nevertheless, rice is mostly cultivated using traditional ways and for domestic consumption. The data for the production year 2017/2018 showed planted areas of conventional rice of 20,915 ha, GAP of 557 ha, and organic of 427 ha (Phatthalung Provincial, Agricultural Extension Office, 2016a). Therefore, the development of rice growers from conventional to organic methods was slow, so that GAP production was used as the first step to achieve the organic rice policy. In Thailand, GAP is a production method that covers good practice for food crops such as vegetables, fruit crops, field crops, herbs, and spices in every stage of the production at the farm level. The GAP standard is used to control the production process in order to obtain safe products from chemicals, microorganisms, and pests by taking into account the efficient use of production factors, production cost reduction, the health, safety, and welfare of workers, while being environmental-friendly for sustainability in production (Department of Agricultural Extension, 2016).

Participatory action research (PAR) is a variety of participatory approaches, action-oriented research involving participation, action, and research. Defined most simply PAR involves researchers and participants working together to examine a problem requiring action to change for the better (Wadsworth, 1998). Some researchers have considered that action research is relevant and valid for the discipline of operations management due to its ability to address the operational realities experienced by practicing managers while simultaneously contributing to knowledge (Coughlan and Coghlan, 2002), while participatory research is action-oriented research activity in which ordinary people address common needs arising in their daily lives and in the process generate knowledge (Park, 2006). Therefore, any development program initiative can be fine-tuned by combining it with action research and participatory research which then is considered PAR. This help to take actions which are relevant to the program as well as for the betterment of program participants as per their community requirements, prospects, and sustainability. The program participants can help in changing the livelihoods of the participants in a positive and sustainable manner (Islam *et al*., 2016). FFS in Thailand is a process of mutual learning by farmers starting from planning, surveying, analyzing, and experimenting from planting to harvesting. This process can be used for farmer development particularly rice growers (Phatthalung Provincial, Agricultural Extension Office, 2016b). Therefore, PAR using the FFS method represents a counter-hegemonic approach to knowledge production.

The current study hypothesized that the PAR approach is one way that can be applied to convert farmers using traditional rice production methods to the GAP system. The paper proposes that the PAR-by-FFS process is important as it is in accordance with the targets of the green agricultural project in Phatthalung province.

Materials and Methods

Study scope: Using the purposive sampling method, the study area was selected in Moo 2, Phang Dan village, Na

Khayat subdistrict, Khuan Khanun district, Phatthalung province because, Phang Dan village is a pilot area for the GAC project of Khuan Khanun district with the goal of converting traditional rice farmers to growing rice according to the GAP standard (Khuan Khanun District, Agricultural Extension Office, 2016). The study was divided into two steps: 1) study of traditional rice production and voluntary participation in the FFS project and 2) study of participatory farmer development through FFS and 10 voluntary farmers participating in the project. Throughout the production season (production year 2017/2018), three training courses were conducted: preparation, activities according to the growth stage of rice, and achievement processing. The training courses were integrated with CIALs (the CIALs were consisting of staff from Thaksin University, the Phatthalung Agricultural Extension Office). The CIALs provide integrated knowledge through training and workshops for the farmer participants. Then, the farmers implemented the methods obtained from the FFS on their own farms. The sample population was farmers who grew the Leb Nok Pattani variety of rice in Moo 2, Phang Dan village, Na Khayat subdistrict, Khuan Khanun district, Phatthalung province. The project duration was from January 15, 2017, to March 30, 2018.

Population sampling: There were 30 households of traditional rice growers in the study area in the production year 2016/2017 who were growing Leb Nok Pattani rice variety. They were selected by purposive sampling from the 56 households of farmers in the village (23 farmers of Sangyod rice varieties and 3 farmers of other varieties) (Khuan Khanun District, Agricultural Extension Office, 2016).

Data collection: Data on traditional rice growing were collected by interview using a semi-structured questionnaire, and by inquiring about voluntary participation in the FFS project. Data collection on participatory farmer development by FFS involved: 1) farmers who participated in the learning process at FFS using a content understanding test that was developed for knowledge evaluation form and to assess the skills of the farmers; 2) farmers' paddy fields by survey and in-depth-interview, such as ecosystems in the rice fields and 3) data from the GAP-02 form that farmers used to record rice quality management for their own paddy fields

Data analysis: Quantitative data on understanding of GAP for rice production at the FFS were analyzed using a computer program to calculate means and percentages. The contents were divided into: 1) knowledge from lectures (out of a score of

30) and practical skills developed (out of a score of 70) based on the GAP standard. Qualitative data from the traditional rice production mentioned by the farmers and the implementation of their knowledge and skills in their own rice fields according to the GAP standard were analyzed and synthesized using content analysis.

Results

1. Rice conventional production and limitation

The season for paddy rice in Phatthalung province is August to February. Rice production can be by two methods (sowing or transplanting). If sowing, the farmers first prepared the land by plowing in July. Replowing occurred before sowing for about 3 days and then replowing again with sowing in August. With the transplanting method, farmers prepared the land for seeding at the same time as sowing the seed in a nursery for growing at the end of July and then transplanted the seedlings 1 month later around early August. The rice seed was collected by the farmers themselves and was storage for more than one to three seasons. A large amount of seed was used (on average 62-156 kg/ha by sowing and 62-93 kg/ha by transplanting). One reason for the high rates was that some rice plants in the tillering stage were destroyed by crabs and shellfish. The shellfish were destroyed by using Saponin pesticide from the end of August and into September at the tillering stage. Other chemicals were often used to control pest outbreaks though sometimes natural pests were not controlled. Weed control was commonly undertaken using herbicides in post-rice germination. The common herbicides in rice fields were 2,4-D sodium sulfate to control broadleaf and narrowleaf weeds by spraying after there were 2-4 sprouts of weeds in October. Some farmers grew rice without fertilizing or applied only a small amount, while others focused on chemical fertilizers rather than organic fertilizers. There were usually two fertilizer applications, mostly chemical-based. The first application was 15 days after planting at the seedling stage (August-September) using NPK 16-20-0 at a rate of 162 kg/ha, together with urea (46-0-0) at a rate of 162 kg/ha. The second application was in the flowering stage (November), using NPK 16-20-0. However, the rice plant health determined the amount of fertilization, though 162 kg/ha was normal. Rice harvesting and threshing of the Leb Nok Pattani rice variety (sensitive to photoperiod) were about 180 days after sowing or during February using a machine harvester jointly with other farms. There were mixed varieties harvested at the same time. The rice machine was not cleaned between harvesting different fields. After harvesting, the soil was not improved in any way, and fields were often left empty after harvesting (data not show).

2. Participation in the farmer field school

The results of the participation of farmers in FFS can be summarized using the improvements in the farmer's knowledge and skills. The knowledge (lecture) items evaluation consisted of production planning throughout the season, soil preparation, rice seedling preparation, IPM management, harvesting and post-harvest management, and knowledge of rice production to the GAP standard. A score out of 30 for before and after training in the classroom was used to evaluate items. The skills (practical) items evaluation consisted of the applied practices on their farms by surveying rice growth, surveying the ecological activity in rice fields, surveying natural enemies, controlling pests, having weeding control and production of Trichoderma and their application in the farmers' own rice fields. A score out of 70 evaluated their practical application on-farm before and after training in the same items. The results showed that participating farmers had 7.24% increased knowledge for all items evaluated (before training = 19.52%, after training = 26.76%) while the skill on-farm increased by 26.69% (before training = 34.77%, after training = 61.47%) (Figure 1).

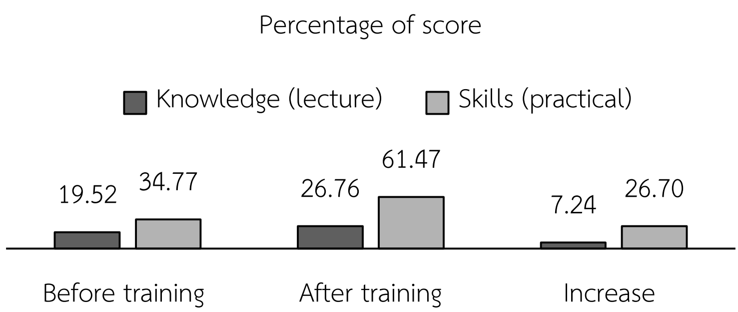

Figure 1. Knowledge and skills score of farmers before and after learning in FFS.

3. Applying farmers' knowledge and practices to the GAP standard

Conventional rice production and GAP production after learning and practicing in school were compared based on the GAP requirements. The results showed adaptation to the GAP practices of plantation area application of pesticides, quality management in pre-harvest production, and recording and record keeping. The soil fertility in paddy fields was improved by plowing in rice stubble and straw, adding green manure (legume), and the application of organic fertilizer. Empty containers of hazardous substances were collected at a particular place for elimination later or for underground burial to prevent reuse. Farmers used IPM instead of using chemicals such as Trichoderma, for pest management. Rice seed was obtained or purchased from specialized centers such as the Phatthalung Rice Department. There was recording of all data practices on the farm and record keeping used the GAP 02 form. However, some farmers could not follow all the GAP requirements such as using herbicides in post-rice germination. Draining water from the rice fields before harvesting could not be applied due to abnormal rains. Comparison of conventional rice (rice production practices before participation in FFS) to GAP production applying of farmers (rice production practices after participation in FFS*)* with the GAP standard requirements 7 item (National Bureau of Agricultural Commodity and Food Standards, 2008) showed in below;

1) Water source

Before FFS: Water for growing rice is precipitation, Surroundings are safe from hazardous substance contamination in normal rain.

After FFS: The practice is no different.

2) Plantation area

Before FFS: The paddy areas are providing an environment, which contributes to contamination of materials that are harmful to the rice product, the soil has low fertility and is particularly low in macronutrients. Rice stubble and straw are not plowed in.

After FFS: The paddy areas are providing an environment which contributes to contamination of materials that are harmful to the rice product, the soil quality is improved by plowing in rice stubble and straw, green manure (legume), application of organic fertilizer, and fertilizer applications according to soil analysis.

3) Application of pesticides

Before FFS: Farmers do not collect various types of agricultural hazardous substances, which in any case are not proportionate and the location is inappropriate. An empty container used for agricultural hazardous substances is re-used incorrectly. Some farmers use these for storage or in cultivating the field. Farmers do not know the details of hazardous substances specified in the registration of agricultural hazardous substances that are prohibited for use.

After FFS: Farmers use IPM instead of using chemicals such as Trichoderma, cultural management. Farmers collect various types of agricultural hazardous substances, which are proportionate and the location is inappropriate. Containers of agricultural hazardous substances used in production practice kept in a particular room, properly closed for safety and prevent exposure to sunlight and rainfall with good ventilation. Farmers understand the hazardous substances identified in the registration of agricultural hazardous substances that are prohibited to use.

4) Quality management in pre-harvest production

Before FFS: The farmer produces his own seed from the past season from an area not isolated from paddy commodity production field. Farmers use herbicides in post-rice germination. Farmers do not inspect according to rice growth phases (tillering stage, flowering stage, and maturing stage). Any practices in rice cultivation not recorded. Farmers do not consider the ecology of rice plots. Farmers use chemicals when encountering problems, which affects the economic return.

After FFS: Rice seed obtained or purchased from official agencies such as the Phatthalung Rice Department. Some farmers are still using herbicides in the post-rice germination but using under GAP standard. Farmers do inspect according to rice growth phases (tillering stage, flowering stage, and maturing stage). Any practices in rice cultivation recorded using the GAP-02 form.

5) Harvesting and post-harvest practices

5.1) Management for good milling quality of rice (harvesting time)

Before FFS: Farmers harvest rice with all the spikes yellow. Farmers cannot drain water from the rice before harvesting.

After FFS: Farmers harvest rice with all spikes in the maturity phase. Farmers still cannot drain water from the rice before harvesting (normally, harvesting period is 28-30 days from the date of flowering and is harvested in dry conditions) due to the time being abnormally rainy.

5.2) Harvesting and threshing

Before FFS: Farmers harvest and thresh using a rice machine harvester and mix varieties at the same time. The machine is not cleaned before harvest in the next paddy field, which affects the quality and mixes the grain.

After FFS: Farmers harvest and thresh with rice machine harvester and separated harvest by rice variety, with the same variety harvested at the same time. The rice machine is cleaned before harvest in the next paddy field.

5.3) The moisture content of paddy and drying practice

Before FFS: Farmers have reduced the moisture of unhusked rice within 24 hours. Farmers have unhusked rice with a height of less than 5 centimeters. Farmers spread rice for airing two times a day.

After FFS: The practice is no different.

6) Transportation and storage and produce collection

Before FFS: Farmers use clean sacks to store rice. Collect in the granary, with clean storage and airy.

After FFS: The practice is no different.

7) Recording and record keeping

Before FFS: Farmers do not have data records.

After FFS: Farmers have recorded data following the requirements on the GAP 02 form. Document or evidence of the analytical results of soil, water, and other production necessities applied for the next season.

Discussion

1. Rice conventional limitation in Phatthalung province

Although rice is the main crop in Phatthalung province and there is a wealth of experience at growing rice conventionally, there remain many challenges currently, which were summarized by the farmers as follow. The rice variety Leb Nok Pattani is popular in Phatthalung due to its widespread consumption by southern Thai people. However, this variety is not resistant to burn disease in the seedling stage. The lowland paddy areas are not more than 10 meters above sea level, and are near Songkhla Lake in the Talay Noi watershed. While it looks suitable land for paddy rice, there has been flooding in some seasons and drought is not uncommon (Dewi and Whitbread, 2017). The outbreak of rice pests is not great but there is no guarantee that there will not be outbreak in the future due to the variable weather conditions. The soil texture is clay that can attract and hold mineral nutrients that are positively charged, water retention is quite high, and results in water-logging that is a positive factor for growing rice. At the same time, it is difficult to drain water in the harvesting stage. Currently, the cost of rice production (machinery, fertilizer, labor, chemicals) is quite high (14,257 baht/ha) combined with low soil fertility (soil analysis of all paddy field plots indicated organic matter 1.48 %; available phosphorus, 16.69 mg kg^{-1}; and available potassium, 161.19 mg kg^{-1}). The proportion of farmers' household income per year from agriculture is relatively low (<100,000 baht) which may affect the decision to use inputs and the provision of soil improvement materials. The number of workers in the household is also a factor in rice production. Family labor in rice farming is mostly around 1-2 persons and they are now from the older generation (>60 years old) and have a low education level (primary 6) and never participate in any meeting or seminar on agriculture aspects (data not shown). From the survey of farmers to determine interest in participating in the farmer field school project found that interest was quite low (10 households from a total of 30 households). Most farmers did not want to join the project because of age restrictions (average age 60.4 years), while farmers with a high income (>100,000 baht/year) didn't wish to join the project either which corresponded to Braun *et al.* (2000) reported that FFS can be community-based and offer non-formal education in small groups. Wilson (1997) who reported that the age of farmers is one factor that affects participation in farmer development. Older farmers perceived barriers and were wary of the side effects of increased operational efficiency. Dolisca *et al.* (2006) found that the income of farmers is an important factor in their participation in a forest management framework.

2. The accomplishment of participatory action research

The participatory action research of researchers (the university) and local extension services (DOAE and LLD) with the rice growers through the FFS process showed that the development of farmers through FFS activities can enhance the knowledge and skills of farmers in converting from conventional rice growing to GAP. Farmers obtained an in-depth understanding of rice production according to the seven requirements in the GAP standard. As Panprom *et al.* (2015) mentioned with regard to participatory behavior in the systematic management within the Tham Phet-Tham Tong forest park, the results produced a means of process and impact because the community members paid attention to and had a good appreciation of the change or development in the forest park. People recognized the coexistence of the forest park and its residents. There were some aspects that were rated at a moderate level: the local people in communities need to be educated more on the correct principles of environmental management. Braun *et al*. (2000) said that FFS and CIALs are participatory platforms for improving decision-making capacity and stimulating local innovation for sustainable agriculture. Discovery-based learning is related to agro ecological principles in a participatory learning process throughout a crop cycle. They found that FFS filled gaps in local knowledge, conducted holistic research on agro ecosystems and increased awareness and understanding of phenomena that were not obvious or easily observable. Their strength lies in increasing farmers' skills as managers of agro ecosystems. The strength of the CIALs lies in their systematic evaluation of technological alternatives and their ability to influence the research agenda of formal research and extension systems. Godtland *et al.* (2004) stated that farmers who participated in the program had significantly more knowledge about IPM practices than a comparable non-participant group. The results showed that farmers passed FFS training and applied the knowledge of rice production in accordance with GAP standards. They adapted to five items requirement of the GAP standard being plantation area, application of pesticides, quality management in pre-harvest production, harvesting and post-harvest practices, and recording and record keeping. However, the two items of water resource, and transportation, storage, and produce collection were not adapted. This study found also that the application of GAP can reduce the amount of chemical use and production costs while increasing the yield. This study was consistent with Godtland *et al.* (2004) who mentioned that the FFS platform can improve knowledge about IPM practices and has the potential to significantly improve productivity in potato production. Davis *et al.* (2012) noted that a farmer development system through FFS had a positive impact on the production and income of women farmers with low knowledge levels. Participation in the farmer school helped increase agricultural income by 61% and overall crop yields increased. The results of this study showed that FFS is a useful way to potentially increase the production and income of small farmers in East Africa and this approach can be applied to target groups of women and producers that have little knowledge while applying GAP to rice growing provides a third alternative for farmers. Conventional rice uses unnatural farming methods such as chemicals, synthetics, and other materials to manage weeds and pests, and to grow and maintain crops. The organic rice techniques prohibit farmers using synthetic pesticides which farmers have to develop another technique for this. (Toyabut, 2019) GAP for rice applies procedures to reduce the risk of contaminating agricultural products with disease-causing microbes or other harmful materials. Therefore, the rice GAP policy could be implemented in the first step to develop organic rice systems. Otieno *et al.* (2017) reported that Global-GAP policy compliance significantly and positively increased the probability of farmers changing the crop variety, water harvesting, finding off-farm jobs, and soil conservation as adaptation strategies to climate change. The policy implication of this study is that government and service providers should mainstream such factors as Global-GAP compliance and regional considerations which enhance the probability of implementing adaptation strategies to climate change-related projects and programs in the smallholder fruits and vegetable farming sector.

Conclusion

The farmer field school can upgrade the conventional rice production methods of farmers to produce rice according to GAP standards. Applying their knowledge and practices resulted in increased rice yields and the on-farm ability of the farmers increased. In addition, the planting management by using more organic substances to improve soil fertility and rice yield and to reduce pest control resulted in an environmental-friendly rice production system. Therefore, the farmers participated in this project can help to develop organic rice according to policy in the National Organic Agriculture Development Strategy 2017 – 2021.

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