Research article

A Model in Promoting Highland Terrace Paddy Cultivation Technology in Northern Thailand

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Abstract This study aimed to investigate the adoption of Highland Terrace Paddy Cultivation Technology (HTPCT) in Northern Thailand. HTPCT was promoted by the Rice Department in 2003 in four provinces of Northern Thailand under the Royal Development Project. Previous studies showed increased yields using HTPCT while cost of converting sloping lands into terrace paddy can be recouped in a few years. However, despite the promotion of the technology, adoption had not been widespread. To understand the limitations in the adoption process, quantitative and qualitative research was conducted in 5 villages of Chiang Mai and Mae Hong Son provinces located in Doi Ompai Mountain. Results show that overall the respondents had high level of adoption but for two practices, namely, soil fertilizer management and sequential cropping system and livestock production, the respondents had moderate level of adoption. Further, the two production practices were only partially practiced by the farmers. This means that even if the adopters converted their upland rice areas to terrace paddy, they still used some traditional technologies and did not follow all recommended HTPCT practices. The common problems mentioned by the respondents in practicing HTPCT were water and labor shortage, difficulty of land preparation, lack of bio-pesticides and green manure seeds, familiarity with traditional cultivation and their superstition which worked against widespread adoption. Thus, a model in promoting HTPCT in Northern Thailand is proposed. The model takes into consideration the necessary policies, roles of various stakeholders and joint learning among farmers, extension workers and researchers in each step of HTPCT promotion.

Keywords adoption, agricultural extension model, highland, innovation, rice terraces

INTRODUCTION

The mountainous regions distinguish themselves from other regions by complex ecological interactions that result to a high variability of land use and production processes (CGIAR Science Council, 2006). Mountain people are typically independent, innovative, resourceful and adaptive; but also identified as poorest, most remote and disadvantaged people in the world (Ives, 1997; Huddleston et al., 2003). In Thailand, mountainous landscape is found in the northern part of the country which share borders with Myanmar and Lao PDR. Northern Thailand covers an area of 17 million hectares comprising 33 percent of the Kingdom's total land area of 51 million hectares. Agricultural practices in the highland are rainfed, characterized by shifting cultivation and subsistence production of specific crops such as rice, maize, and sesame (Mikled et al., 2001). Agricultural production in hilly areas is low and unstable due to erratic rainfall and poor natural resource endowment. Land degradation is one of the key problems causing decline in crop productivity. One potential strategy to address those problems is to promote terraced paddy fields in the hilly areas. Terraced paddy yields have been found to be almost double those of upland rice, and the cost of converting sloping lands into terrace paddy can be recouped in a few years (Linquist

et al., 2007). While terrace paddy cultivation in upland areas had been in existence for centuries, this system was introduced and promoted in Northern Thailand only in 2003 under the Royal Development Project (Naruebal, 2011). The Highland Terrace Paddy Cultivation Technology (HTPCT) was promoted by the Rice Department in Doi Ompai mountain areas since 2003. Currently, there are 48 farmers adopting this technology but there are many more who have not adopted the technology. Because of this, there is a need to investigate why there is low adoption and subsequently, propose a model in promoting HTPCT to farmers in the highlands.

OBJECTIVES

This study aimed to investigate the practices of Highland Terrace Paddy Cultivation Technology (HTPCT) that were adopted, the problems related to the adoption, and propose a model in promoting HTPCT.

METHODOLOGY

Study Sites

The researchers chose Doi-Ompai mountain areas as the site of the study because this is the first place in Thailand that Highland Terrace Paddy Cultivation Technology (HTPCT) was promoted to farmers by the Rice Department. Four villages of Huai Hom sub-district, Mae La Noi district, Mae Hong Son province and one village of Pang Hin Fon sub-districts, Mae Cham district, Chiang Mai province, which are the working area of Doi-Ompai Highland Agricultural Development Station (DOHAD station) were chosen as shown in Table 1. The farm lots and residences of the respondents are situated within the elevation range of 728 meters asl and of 1,465 meters asl. The site has a semi-humid tropical climate with a mean annual rainfall of 1,217.25 millimeters and a mean temperature of 27.18 degree Celsius. Figure 1 shows the study sites.

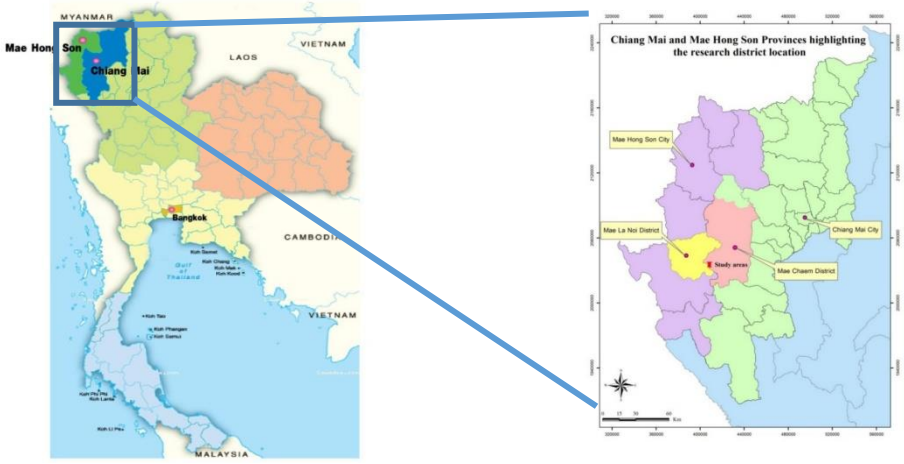

Fig. 1 Chiang Mai and Mae Hong Son Provinces highlighting the research district location
Source: LDD (2014)

Research Design

Survey research was employed to determine the respondent's adopted practices and level of adoption of HTPCT while secondary data review, key informant interviews (KIIs) and Focus Group Discussion (FGDs) were used to gather data about the agencies involved in HTPCT.

Population and Sampling

Stratified random sampling was employed to determine the sample size used for this study. There were 181 households form the 5 villages which are the working areas of the Doi-Ompai highland agricultural development station project, Mae Chaem district, Chiang Mai province, Thailand . All farmers from the 5 villages were separated into adopters and non-adopters groups based on the information from the Rice Department. To determine the number of samples for adopters from each village, a stratified sampling technique was used according to the formula given by Sukhatme (1954) as in Eq. (1) with 10 percent margin of error. Table 1 shows the sample size of the study.

$$N = \frac{NQ}{PC^2 (N-1) + Q} \quad (1)$$

Where: n = sample size
N = population size
P = population of farmers who adopted terrace paddy cultivation technology
C = 10%
Q = 1-P

Table 1 Sample size of adopters

Name of village	Name of sub-district	Number of households	Number of adopters	Sample size of adopters
Baan Sadosa	Pang Hin Fon	60	12	8
Baan Sam	Huai Hom	38	10	7
Baan La-Ang Tai	Huai Hom	7	3	2
Baan Pak Pai	Huai Hom	29	6	4
Baan Mae-Lae	Huai Hom	47	17	12
		181	48	33

Source: DNP (2013) and RD (2013)

Highland Terrace Paddy Cultivation Technology (HTPCT) represents the recommended technologies rice paddy cultivation. It combines indigenous and research based knowledge. Based on survey results, on the basis of the weighted mean ratings of each of the seven recommended HTPTC practices, the respondents had high levels of adoption of five practices, namely, land preparation, seeding and transplanting, pest management, water management, and pre-production practices, while the respondents had moderate level of adoption for two practices, namely, soil fertilizer management and sequential cropping system and livestock. This shows that these two agricultural practices were only partially practiced by the farmers (Table 2).

For the overall adoption or use of recommended HTPCT practices, the weighted mean scores were computed and categorized into three levels which are high, moderate and low levels of adoption. The results showed that the overall adoption of recommended HTPCT practices of the adopters had a mean of 2.37 described as high level of adoption which ranged from 1.94-2.75 (Table 2). Majority of the adopters (60.6%) were described as practicing high level of adoption while the rest (39.4%) were described as practicing moderate level of adoption which means that even if the adopters converted their upland rice areas to terrace paddy, they still used some traditional technologies and did not follow all recommended HTPCT practices. The fact is that most farmers are unable to adopt the whole package of HTPCT at once but, rather, they adopt some of the technology components in a sequential or step-wise manner depending on the agro-ecological characteristics of their terrace paddy field, their knowledge and understanding on the technology and their cultural beliefs. The common problems mentioned by the adopters in adopting HTPCT were water and labor shortage, difficulty in paddy preparation, lack of bio-pesticides and green manure, familiarity with traditional cultivation and their superstition.

Table 2 Rank based on the mean weight of the respondents' adoption level of seven issues of recommended HTPTC practices

HTPTC Practices	Mean	Rank	S.D.
Land preparation	2.48 (HA)	1	0.26
Seeding and transplanting	2.45 (HA)	2	0.51
Pest management	2.42 (HA)	3	0.51
Water management	2.42 (HA)	3	0.60
Pre-production	2.40 (HA)	5	0.29
Soil fertility management	2.15 (MA)	6	1.00
Sequential cropping system and livestock	1.73 (MA)	7	0.98
Overall Mean		2.37 (HA)	
S.D.		0.22	
Range		1.94 - 2.75	

Legend: *Scale Limits* *Descriptive Rating*
2.34 – 3.00 *High level of adoption (HA)*
1.67 – 2.33 *Moderate level of adoption (MA)*
1.00 - 1.66 *Low level of adoption (LA)*

A model to improve adoption of HTPCT is proposed (Fig. 2). The model takes inspiration from Rivera et al (2006).

Policies affecting HTPCT and relevant agencies: Based on KIIs, policies affecting HTPCT are those that promote food security, conserve the forests and promote tourism. These policies promote and facilitate the creation, sharing, and use of HTPCT. These policies have to be in place and should be enforced. The model shows relevant agencies who are working together under the royal project to promote HTPCT. The model outlines the key roles that each of the agencies have to perform in the promotion of HTPCT.

Step 1: Community analysis: The conduct of the community analysis is necessary to understand the biophysical characteristics, resource endowments, farmer characteristics, practices and networks. These are necessary to determine the support that will be given to farmers.

Step 2: HTPCT development and promotion: The royal project stations would serve as learning hubs for farmers, extension workers and researchers. Farmers who volunteer to conduct experiments in their own field will introduce HTPCT to other farmers.

Step 3: Provision of extension and knowledge support: Even though terrace paddy is located in the upstream areas, farmers often encounter water scarcity because they depend mainly on rainfall and do not have good irrigation systems or water storage systems. It is thus important to include technology on constructing small reservoirs or setting gravity irrigation system by providing pipes and other necessary equipment. The government might consider wage subsidies to pay labor wages in converting terraces as the task is very labor intensive and is one of the deterrents in the adoption process. Given moderate adoption, it is important to enhance knowledge in seed selection, transplanting method and pest management. Agricultural extension workers could use the handbook of HTPCT as a guideline and adapt the topics based on farmer's needs.

Step 4: Participation in environmental conservation: Based on KIIs, farmers should have better quality, security of life conditions and ability to protect the environment. People in the highlands must first meet their basic needs through increased yield. The next goal is the enhancement of the security of life by ensuring enough income. The last step of development is creating ideology in environmental conservation. When people have better quality and security of life, they are ready to protect their environment and work for community voluntarily.

Outputs and outcomes: The expected outputs from promoting HTPCT are increased terrace paddy areas and increased reforestation areas. The expansion of new terrace paddy areas which is the first expected output offers opportunities to improve rice security in Northern Thailand. When farmers have enough rice for their household consumption, they tend to reduce shifting cultivation areas and lead to increased reforestation areas. Both expected outputs would contribute to sustainability of highlands development in terms of rice security, environmental sustainability and sufficiency income which are the outcomes of promoting HTPCT.

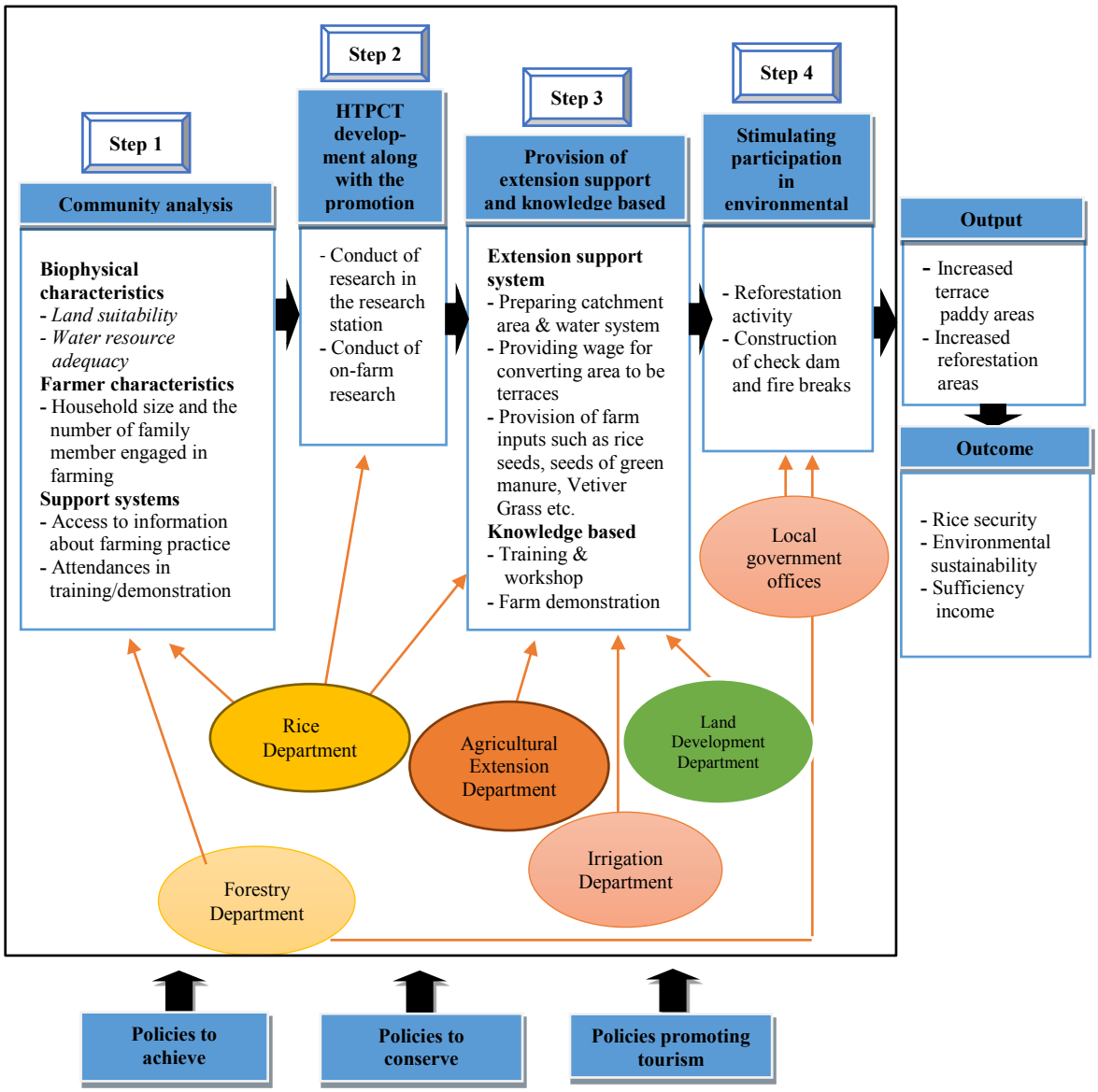

Fig. 2 Proposed model in promoting HTPCT

CONCLUSION

Based on the results of the study, there are very few adopters of HTPCT and those that adopted HTPCT do not fully adopt the recommended practices. The common reasons given by the adopters are water shortage, labor shortage, the difficulty of soil preparation, lack of the source of the bio-pesticides and green manure seeds, familiarity with traditional cultivation and their superstitions. The study presupposes that improvements in the adoption and diffusion of HTPCT can still be improved through the model that had been proposed.

RECOMMENTDATIONS

To the Agricultural Institutions Involved in Promoting HTPCT.

1. Maintain a close link with all involved agencies: In the process of promoting HTPCT, integrated work is needed. The Doi-Ompai Highland Agricultural Development Station can be used as the center of assembly. The meeting among all involved agencies should be held regularly to set

the plan for promoting HTPCT and also to discuss the solutions when the problem or constants have been found in field works.

2. Co-generate knowledge among farmers and researchers: Based on the results, the ethnic groups have their own rice farming wisdom. For example, they have the way to maintain traditional rice variety production for their consumption. The technology that corresponds with their traditional wisdom can be studied and may be useful in the context of highland production. Thus, in the process of research and development on HTPCT, researchers should study and collect the traditional rice farming wisdom from farmers in the fields and combine it with scientific knowledge to improve HTPCT.

3. Providing catchment areas for irrigation purposes: Water shortage may limit the adoption of HTPCT. Thus, the Royal Irrigation Department should provide catchment areas to farmers by constructing small reservoirs such as ponds or tanks for water storage.

4. Providing training course regarding specific areas of technology: Researchers of the Rice Department should provide a training course emphasizing specific topics to enhance skills of farmers in applying HTPCT; for example, System of Rice Intensification (SRI), Alternate Wetting and Drying (AWD) technique, Integrated Pest Management (IPM) etc.

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