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Social-ecological Factors Influencing the Adoption of the Khok Nong Na Model of Farmers in Kut Chum District, Yasothon Province

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ABSTRACT— Khok Nong Na model (KNNM) is currently introduced to farmers in Thailand as an efficient farm practice to operate agriculture, through maximizing land use and water conservation, to improve livelihood. This study focuses on farmers' social-ecological factors influencing the adoption of KNNM. A questionnaire was systematically built based on bottom-up approach with elements of related literature. This was an attempt to formulate the fine-tuned questionnaire for the quantitative examination. Data collected from 200 farmers in Kut Chum district, Yasothon Province were used to study the social, economic, and environmental factors that determine the adoption of KNNM. The results showed that the most significant factor bolstering farmers' adoption intention was environmental benefits such as adjusting the land use for being more suitable for agricultural activities. Also, the influence of social factors contributed positively to the adoption of KNNM was observed. Most notably, participating in KNNM to evolve farms to learning centers to earn respect from the community and the comprehensiveness of resources facilitated by organizations. These findings shed light on how to establish strategies to encourage farmers to embrace KNNM.

KEYWORDS: Khok Nong Na, sustainable development, land management, farmer; Yasothon.

1. INTRODUCTION

In Thailand, the climate variation has been increasingly existing [6]. Extreme weather incidences such as droughts, floods, and storms are reported to have radical effects on rural households across the country [23]. This is proven by droughts have been more frequent, while floods and storms have intermittently occurred, however, it becomes more intense compared to the past [26]. These conditions are unfavorable to all stakeholders, especially farmers and labors in agriculture [11]. According to the Intergovernmental Panel on Climate Change, most Thai farmers are marginal. They are also categorized as low or lower-middle income class who are highly vulnerable to all kinds of change because they are none of the support of social security [14]. This means their household resources to combat climate shocks and its negative consequences are inadequate [2]. Besides, their occupation has considerably been dependent on the suitability of weather conditions. If weather conditions are detrimental, they are difficult to make their livelihood even more precarious [12].

In response to the climate change in the country, public programs had been arranged constantly by the government. They launched warning systems for providing information against extreme weather events. However, its efficacy was often seen as the measurement of climate shocks is exogenous based on many uncontrollable variables [17], [26].

To achieve more stability beyond climate change's threats, an exclusive set of adaptations to accommodate climate change is being distributed. It is short-term plans to nurture farm productivity and management capabilities of farmers [16]. The adaptations are simultaneously delivered with long-term plans that were designed meticulously. For instance, the mega investment in irrigation systems is approved to allow farmers to do agriculture all year. The encouragement to restructure farmers' land uses is also implemented. This is an attempt to foster the balance of sustainable development through the management of land and water conservation to mitigate the vulnerability caused by natural disasters [2], [8]. Agricultural techniques about integrated land management (ILM) to maximize the economic and ecological benefits from the land resource are introduced for replacing monoculture [28]. Theoretically and pragmatically, this implementation is praised as the best strategy due to two reasons. First, it is well-suited to the country's topography features to fully support resilience because it provides an abundance of food security and natural diversity for farmers [10]. Second, many experts agree that such agricultural techniques are related to Sustainable Development Goals (SDGs). Specifically, their fundamental addresses are SDG1 (alleviating poverty), SDGG2 (related to hunger), SDG3 (related to good health and wellbeing), and SDG12 (regarding consumption and production) [14].

Currently, one of the remarkable integrated land managements is "Khok Nong Na model" (KNNM). This model is a way of land structure that is expanded from the Majesty King Bhumibol Adulyadej RAMA IX's New Theory and the Philosophy of Sufficiency Economy to maximize both land use and water conservation, both on the surface and underground, for agricultural production [5]. KNNM's concept essentially calls dividing the area into the proportion 30:30:30:10. The first 30 is reserved for water sources. Constructing a small marsh that performs as a reservoir to protect not only from floods during rainy seasons but also retains a source of water during dry seasons [9]. The second and third 30 are for rice farming and many varieties of trees (fruit trees, usable trees) on the high land to get the benefit of food security. The rest is a residential zone available for human and livestock such as chickens, fish, and cattle [10]. In essence, KNNM is to ensure food and financial security from the smallest units by becoming self-dependent based on indigenous knowledge and local resources to minimize susceptibility to externalities. These underlying capacities have been productive for smallholder farmers to deal with the adverse effects of climate change [28].

Governmental organizations such as the Department of Community Development and the Department of Agricultural Extension are currently trying to encourage farmers to adopt KNNM [4]. Many regions across the country are selected as piloted areas, especially provinces in the Northeastern region [27]. This selection is not done without purposeful contemplation but a strategic decision. Given the historical context, Northeastern Thailand or Isan has had the long challenges of severe droughts and floods mixed with acidic and low fertility soil that often compel local farmers to repeatedly grow low profitable cropping such as sugarcanes and cassava [21]. Besides, most of them are smallholder farmers, whose resources are limited to deal with climate change's effects [22]. These constraints are workable to be solved by KNNM. This model is friendly to the environment restoration and respectful to indigenous wisdom. Smallholder farmers, who embrace this model, are therefore dependent on themselves and can retain food system in a way of resilience [19], [20].

Despite the benefits tied with KNNM, including the enthusiastic support from organizations, the rate of adoption remains low [28]. This is because, like other types of adoption, the successful rate is not only determined by the individual desire of farmers but also their social-ecological factors explicit to the setting within KNNM is being taken [16]. For instance, the extent of farmers, whose land is less than wealthy ones, is unlikely to accept, apply, and adopt KNNM. Dividing an area into three zones of mound, marsh, and rice field is difficult to obtain enough productivity, leading to financial pressure for sustaining their welfare [4].

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Besides, KNNM requires a considerable amount of money to invest in digging marshes, in which Northeastern Thailand tends to be higher than other regions. Trilling marshes in this region are more expensive because the ground is caked dry and extremely low moisture. These conditions are required to be dug about 300 meters deep to ensure the availability of months-long water in dry seasons [25]. This financially differs to Thailand's other regions that are usually dug to a depth of 80 to 100 meters. Explicitly, these statements show how the opportunity of adoption is evidently challenged by social-ecological factors. Farmers' financial status determines the possibility of marsh undertakings [4]. Meanwhile, the environmental factor, all types of soil is not approved to dig marshes. Apparently, sand soil is not pleased to do that. Its physical qualities are burdensome to store sufficient water for use all year-round, while providing moisture through the breadth of the land [24].

This study sought to speed up the rate of the KNNM adoption to make adopters given with food security and its advantages. To achieve that, however, the social-ecological factors that encourage such an adoption should be identified. This type of study is vital for extension agents and stakeholders. Many experts have unanimously said if the adoption is propelled by groundless contemplations, it may arrange farmers, especially poor people, negative consequences rather than positive ones [9], [10]. Therefore, this study's findings can be used to generate more specific recommendations to facilitate a large-scale adoption of KNNM.

The remainder of this study is structured as follows. First, the authors provide background information about the study area to indicate that why it is chosen as a strategic area of the development of agriculture. Then, we present processes of data collection used for the analysis, followed by the results and noteworthy discussions. Finally, the conclusion is summarized.

2. Research Objectives

The specific objectives of this study were: (1) to study farmers' socio-demographic contents; (2) to investigate farmers' social-ecological factors influencing the adoption of KNNM.

3. Material and Methods

Research methods are sorted into 4 sections as follows.

3.1 Study site

Kut Chum is one of the districts of Yasothon Province in the Northeastern, Thailand. This district was selected as the study site as it is an important strategic area of agricultural development [4]. Rice, especially organic rice varieties, has been growing continuously since 2000 to generate the main income, with the facilitation of the Yasothon Alternative Agriculture Network [15]. Most farmers have cultivated rice together with integrated farming to establish propitious surroundings to achieve the sustainability of organic rice production. This condition is therefore approved to adopt KNNM. The farmers not only have basic knowledge of appropriate land and water management, but their integrated farming is also KNNM's central concept [18].

3.2 Population and sample size

Deliberately, the sampling method was none because the study was designed at first to reach a census survey for estimating the whole population's data [1]. Household-level data was collected from 200 farmers, during January to March 2021. All of them were farmers who had registered with the Community Development Office of Kut Chum District, showing their intention to adopt KNNM [15].

3.3 Data collection

This study conducted a two-stage qualitative-quantitative survey. The first stage was a qualitative survey done

in January to February 2021. We applied semi-structured interviews with the 50 farmers to obtain social-ecological factors, such as motivations, social norms, and environmental and financial threats. They were randomly selected to provide a thorough understanding of the social-ecological factors in the context of Kun Chum District, which significantly influence the uptake of KNNM. We also used data retrieved from related studies to augment more meaningful details [9], [10], [27]. Then, we used the resulting data to construct the framework and formulate a questionnaire that was satisfactory for the quantitative investigation [1].

The second stage was quantitative processes and conducted through face-to-face interviews using the questionnaire that consisted of two parts. The first part was intended to gather farmers' socio-demographic characteristics. The second part included the measurement of social-ecological factors stipulating the adoption of KNNM. These factors, which were constructed based on the farmers' insights and the pieces of literature [9], [10], [27], comprised of 12 items sorted in 3 key assets (economics, society, and environment), with Likert scales ranging from 1 to 5 (1 = strongly disagree, 5 = fully agree) [1].

To be noted, the farmers were informed with a detailed explanation of each item's description to ensure consistency with the study objectives. They were also told about no conflict of interest and guaranteed their anonymity.

3.4 Data analyze

Obtainable data was analyzed using Microsoft Excel software for computing descriptive statistics in outlining the farmers' socio-demographic characteristics. Additionally, the measurement of social-ecological factors associated to the adoption of KNNM was calculated, using the five-point scale measuring the degree of those factors. The following criteria of scale interpretation were: 4.50 - 5.00 (very high), 3.50 – 4.49 (high), 2.50 – 3.49 (moderate), 1.50 – 2.49 (low), and 1.00 – 1.49 (very low). Again, descriptive statistics was applied to compute means and standard deviations [1].

4. Results and Discussions

4.1 Socio-economic statistics of the farmers

Table 1 shows the farmers' socio-demographic characteristics. Most were men (55.50 %) and in primary school as the highest formal achievement (55.00 %). These findings are accordant to a previous study, although the human sex ratio in Thailand was 94.79 males per 100 females, men have been traditionally leaders in the culture and involved considerably in the family's key decisions [3]. Therefore, the gender role in the society anticipates men to perform as informants in surveys, including key members of organized groups [13]. In other words, this suggests that men play a vital role in farming and adoption preferences. Meanwhile, the data of educational achievement was easily guessed. Although Thai farmers are now more educated than in the past, however, most were below high school level that is the country's compulsory education [29]. The difference from the country's whole picture was their age range. Around 47.00 percent of the farmers were in the range of 40 to 49 years old. This is dissimilar from most other farmers, whose ages are reportedly found to be more than 60 years [22].

Not surprisingly, the biggest group of the farmers (58.00%) averagely had the total of annual income higher than most domestic farmers at 1,545.54USD [3]. Farmers, who going to participate in KNNM, should be wealthy moderately. In many cases, digging marshes and restructuring land at the beginning of the project often require expenses paid by farmers [25].

Table 1. Socio-demographic characteristics of the farmers (n=200)

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Socio-demographic characteristics	Percentage
Gender	
Male	55.50
Female	45.50
Age (years old)	
From 30 to 39	4.50
From 40 to 49	47.00
From 50 to 59	29.00
60 and above	19.50
Educational achievement	
Illiteracy	2.00
Primary school	55.00
High school	40.00
College and higher	3.00
Number of household labor (person)	
0 to 5	37.00
3 to 5	61.00
5 and above	2.00
Total average of annual income (USD)	
Below 1,718	36.50
1,718 to 3,436	58.00
3,437 to 5,155	5.50

4.2 Determinants of the farmers' Khok Nong Na Model adoption

Table 2 displays the social-ecological factors and its twelve relevant items. These provide a key insight into what incentives are required in adopting KNNM among the farmers.

According to Table 2, the results indicate that the adoption of KNNM was mostly influenced by the environmental factors. It is evident that all factors were scored as very high as adoption incentives. This finding is according to previous studies, participating in KNNM to reach the positivity of environmental aspects i.e., fostering balance of the land management and water conservation is topmost priority [9], [10], [28]. This quality is critical for farmers especially in Northeastern Thailand. As mentioned earlier, this region is low fertility soil and a long hot season, plus with the presence of soil erosion problems caused by the primitive forests, especially in uplands, had been converted into crop fields since 1960s [15]. These conditions are unfavored agriculturally [5]. Engaging in KNNM, which comes with agricultural activities in a farm, is meticulously seen as one of the feasible alternatives to do agriculture in a sustainable fashion. When agriculture is allowed to do, the room of economic opportunities such as income will be following as an outgrowth [24].

Regarding social factors, every item of adoption incentives was graded high except participating in KNNM to establish the learning center within the community. This state might be prospective. In Thailand, if ordinary farmers can elevate their farm to a learning center that is workable for site visits, they will be supported regularly with finance, seminars, and essential inputs by external organizations such as the Department of Agricultural Extension [7]. It is because of the operation and potential of that farm are efficient to perform as change agents to help agents of the Department of Agricultural Extension in contributing knowledge to the community and interested parties [16]. In other words, participating in KNNM is considered as a fast short-cut to prosper in agriculture. Not only inputs are obtainable but respect and honor from people are also evident [7]. In some case, if such a leaning center is well designed to include both of agricultural and recreation activities, farmers can earn more income from that learning center as agrotourism [13].

The findings about economic factors show its all items of adoption incentive were graded high equally. Indeed,

reaching high income status is most global farmers' destination [22]. Nevetheless, the fundamental concept of KNNM emphasizes on to ensure food security and self-dependence through scalable best practices in agriculture to avoid poverty, meanwhile the growth of economy is secondary [27]. Therefore, rapidly becoming wealthy to solve economic cries and COVID-19's negative consequences is not a goal to participate KNNM [9].

Table 2. Summary of social-ecological factors influencing the adoption of the Khok Nong Na Model

Social-ecological factors	Adoption incentive with percentage					Mean	S.D.	Interpretation
	Very high	High	Moderate	Low	Very low			
Economic factors								
1. Solving constraints caused by the current economic situation.	49.0	36.50	14.50	0.00	0.00	4.34	0.720	High
2. Adopting the Sufficiency Economy Philosophy to apply in the daily life	50.50	44.00	5.50	0.00	0.00	4.45	0.599	High
3. Revitalizing the community's economic affected by the COVID-19 outbreak	53.50	39.00	7.50	0.00	0.00	4.46	0.633	High
4. Earning more income and economic opportunities	55.00	37.00	8.00	0.00	0.00	4.48	0.642	High
Environmental factors								
1. Adjusting the land use to cope with ongoing droughts	55.50	38.50	6.00	0.00	0.00	4.50	0.610	Very high
2. Adjusting the land use to meet its maximum benefits	56.50	39.00	4.50	0.00	0.00	4.52	0.584	Very high
3. Protecting land erosion	60.50	32.00	7.50	0.00	0.00	4.53	0.633	Very high
4. Improving the land more suitable for agricultural activities	60.50	30.50	9.00	0.00	0.00	4.51	0.657	Very high
5. Increasing the capacity of water storage of the land	61.50	30.00	8.50	0.00	0.00	4.53	0.649	Very high
Social factors								
1. Participating the model to please family members	60.00	27.50	12.50	0.00	0.00	4.48	0.708	High
2. Creating more agricultural jobs available for migrant workers influenced by COVID-19	54.00	34.50	11.50	0.00	0.00	4.43	0.690	High
3. Establishing the learning center within the community	62.50	28.00	9.50	0.00	0.00	4.53	0.664	Very high

Note. 4.50 - 5.00 (very high), 3.50 – 4.49 (high), 2.50 – 3.49 (moderate), 1.50 – 2.49 (low), 1.00 – 1.49 (very low) [1].

4. Conclusions and Recommendations

The findings demonstrate that the adoption of KNNM is influenced by many incentives, ranging from economic to environmental to social factors. However, environmental factors are more dominant than the

others. This is because of KNNM's key concept focuses on fostering resilience and food security through the appropriate management of land and water based on the country's topographic feature.

There are three significant recommendations to make KNNM sustainable. First, farmers must be confident in integrated farming systems rather than monoculture. Integrated farming systems do not require heavy investment in external inputs such as fertilizers and chemical inputs which often forces farmers into a vicious cycle of debt. Besides, integrated farming systems' vital outputs are food and nutritional security for enhancing farmers' welfare, while continuous learning processes in learning and increasing the number of wildlife to enhance the farm operation are its outgrowths. These qualities provide farmers with self-sufficiency which is approved enthusiastically by KNNM and its settings. Second, as long as agriculture is an open system, whose operation is often distorted by uncertainties in social-ecological systems, the management of KNNM to be successful is therefore dynamic processes. Farmers must be upscaled and rescaled in a manner of lifelong learning. Knowledge provided by upskilling and rescaling provides a creative framework for management to fulfill their desires. For examples, if farmers' total farm area is less, most land area more than 50% should be allocated to grown rice rather than fruit trees as rice is a staple food of Thai people. When that area is more extended, for whatever reason, pursuing more advanced levels of economic development such as newly introducing fruit trees and timber woods are followed next. These are strategic practices to make farmers relatively self-reliant.

Third, the duty of extension agents and relevant organizations must be extended from being facilitators at the early stage of adopting KNNM. Their duty should go further in the development of decision support systems for designing specific formats of KNNM that meet each farmer's needs. This recommendation is indispensable, particularly in Thailand whose agriculture is being running by smallholder farmers as key actors. The terminology of smallholder farmers means marginal people who have limited resources to sacrifice in trade-off [18]. Therefore, their risks must be done based on concrete data and information rather than the government's willingness to promote farmers to adopt KNNM.

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