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Progressing Towards a Sufficiency Economy in Small Rice Farming Households in Northern Thailand

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Abstract

This study's purposes are to evaluate and search for ways to progress towards a Sufficiency Economy (SE) in small farming households. The data were taken from farmer self-evaluations by assigning scores to their practices and activities to reflect whether and how far they follow the concept of a sufficiency economy, in both the production and the personal life domains. A total of 447 samples of small rice-based farming households in Chiang Mai Province covered in this study are categorized into those pursuing three different production systems. The investigation reveals that the households in the alternative farming system have a higher degree of a SE than those in the conventional and the subsistence farming systems which are almost at the same SE level. From the ordered logit regression, nine factors were identified as being able to contribute to the higher level of farming households in practicing according to the Sufficiency Economy Philosophy (SEP) including; 1) more than 12 years of educational attainment, 2) farming in the irrigated area which enables the farmers to have adequate water for agricultural production and involve a diversity of farming activities and systems, which in turn leads to the next factor, 3) taking up a wide range of economic activities, 4) household savings, 5) positive attitude toward a rice

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farming career, 6) willingness and sharing which includes being satisfied with the external environments comprising the next three factors, 7) good social surroundings, 8) access to financial sources, and 9) availability of good public infrastructure. The presence of all of these nine factors will make the farmers ready to learn and practice the principles of SEP more intensively.

Keywords: sufficiency economy, alternative farming, sustainable livelihoods, Thai agriculture
JEL Classification: A12, D01, D10, Q01, Q12

1. Introduction

The Sufficiency Economy Philosophy (SEP) has been extensively advocated by various entities in all segments of Thai society with the testimony that it is a practical approach for application at every level in society, from the individual, household, and community to the nation. It is the tenet of this study, specifically the notion that fostering the stronger practice of the SE principles at the levels of individual and household to the point these smallest units of Thai society can attain balance and sustainability in life, and is instrumental for social units and organizations at the higher levels to embrace the SEP easily, widely, and effectively in a short time. This study, thus, aims to evaluate the current situations and explore new ways to heighten the practice of SEP within farming households. Small farming households were selected especially for the investigation because the majority of them are rice-based production units in Thailand—a dominant rice-producing country. Rice cultivation, practices, and related cultural heritage have been handed down to present day farmers from the first rice cultivators ever settled on this land. Rice farmers in Thailand are still regarded as the backbone of the country, where 46.5% of the total land is now agricultural with 5.9 million total farming households, more than 60% of which, or 4 million households, cultivate rice (Office of Agricultural Economics, 2018). Nonetheless, a large number of Thai farming households are still economically poor with almost 40% of them living below the national poverty line (Chantarat, Attavanich, & Sa-ngimnet, 2018). Hence, this study aims at finding ways to enhance the practice of principles in the SEP among small farming households, with the hope that their quality of life will eventually be improved.

2. Literature review

The SEP was expounded by the late King Rama IX to the Thai people on the 4th December 1997 (Mongsawad, 2010). It is a philosophy that provides concepts, principles, and guidance on appropriate conduct, emphasizing on the middle path as an overriding doctrine (Thongpakdee, 2011). It is applicable to conduct at the level of the family and community, as well as on a national level (Piboolsravut, 2004). The SEP has long become the framework for the drafting of Thailand's National Economic and Social Development Plans since the 9th Plan onward, considering the 12th Plan for 2017-2021 in use at present. Furthermore, the SEP approach was included as a Thailand Vision for 2037 in the 20-year National Strategy (2018-2037), which is the country's first long term development plan (National Economic and Social Development Board (NESDB), 2018).

The SEP has been recognized internationally, leading the United Nations Development Programme (UNDP) to present the first Human Development Lifetime Achievement Award to His Majesty King Bhumibol Adulyadej in May 2006. The SEP was praised to be useful for Thailand and other nations as it can help develop self-immunity, firstly at the individual level and next at the community and national levels. The United Nations incorporated the principles of the SEP in its Sustainable Development Goals (SDGs) to spread this philosophy to wider international audiences for the realization of the SDGs by 2030 (Ministry of Foreign Affairs, 2017).

Sufficiency contains three elements: moderation, reasonableness, and the need for a good built-in resilience or self-immunity in the face of internal or external changes, and it needs two conditions under which the philosophy can work most effectively, namely knowledge with comprehensive understanding, prudence, and carefulness when applied, and morality with consideration of integrity/honesty, diligence, patience, and sharing in leading one's life (Piboolsravut, 2004). These main features of the SEP can be further elaborated for a better understanding. *Moderation* means to be moderate in relation to one's means or constraints considering that one is living with limited means individually, socially, environmentally, and culturally in each locality. Thus, one should, economically, do anything not too much and not too little but in line with the need and the appropriateness, and one should not do anything that harms oneself and others (NESDB, 2007; the Chaipattana Foundation, 2018). *Reasonableness* is concerned with the use of wisdom or reason in making decisions, for example, through the thorough consideration of technical facts, relevant laws, moral and ethical principles, fine culture, and the potential short-run and long-run impacts on oneself and others (NESDB, 2007). However,

to be truly reasonable, one has to continuously acquire knowledge and experience to enable oneself to properly think and conduct virtuous consideration (NESDB, 2003). *Self-immunity* is one's preparation and readiness to adapt to and cope with the impacts of economic, social, environmental, and cultural changes (NESDB, 2007) after building various scenarios of future possibilities (the Chaipattana Foundation, 2018). Meanwhile, the two essential underlying conditions of the SEP, namely knowledge and morality, have to exist in balance, meaning that one's lack of some attributes in these two domains may cause him to make a wrong decision which can lead to failure to achieve a stable or sustainable improvement. *Knowledge* does not simply mean the stock of facts, information, and skills acquired from experiences and education, but it has to be applied with prudence to prevent unintended adverse effects and avoid failure (NESDB, 2003; Mongsawad, 2010). *Morality* is a mindset that must be built and developed to ensure the traits of integrity/honesty, diligence, patience, and the use of one's knowledge and intelligence in work and life on the basis of such ethics (NESDB, 2007; the Chaipattana Foundation, 2018). However, the practical application of the SEP by government agencies must be first pursued at the individual level with the awareness, confidence, trust, and belief in its value before extending the application to the levels of family, community, society, and nation (NESDB, 2007).

To apply the SEP, there are various ways depending on areas and the environment. On a Micro scale, sufficiency in life is emphasized, which means family and community have sufficiency (Ubonsri & Pannun, 2013). Sufficiency in the individual and family starts from within by practicing their mind, teaching their family members with virtue, adequacy, self-dependence, moderation, consideration, education, and self-improvement for future stability and reliability (Utsahajit, 2014).

In terms of agricultural sufficiency, the example of the SEP is the "New Theory Agriculture" that requires rural households to be self-reliant through holistic land management and living a harmonious life with nature and community, which consists of 3 levels: sufficiency at the household level or the first stage of development according to the New Theory Agriculture that assures even small farming households have enough to subsist and be self-reliant; sufficiency at the community level is when farming households develop their cooperation to build up community strength (middle stage); and sufficiency at the national level or the enlargement of cooperation and mutual help toward the creation of the network's relationship with external organizations and agencies (advancement stage) (Piboolsravut, 2000; Office of the Royal Development Projects Board, 2011). Moreover, there are a number of farmers who have successfully applied the theory, which can be

evaluated in various dimensions, namely the completeness and biodiversity of the ecological system, possessing sufficient food for the family, good quality products, and sufficient products for selling year-round, as well as a reduction of debt or debt payments (Office of the Royal Development Projects Board, 2011). This is in accordance with the study of Janmaimool and Denpaiboon (2016), which revealed that those who apply SEP in their daily life will definitely have a better quality of life.

In early works to assess the practice of the Sufficiency Economy principles, researchers generally considered the three core elements and the two conditions without giving priority to different elements (Puntasen, Premchuen, & Keitdejpunya, 2003; Wiboonpongse et al., 2009). These early works concentrated on developing the indicators of being a sufficiency economy, assessing the level of being a sufficiency economy based on the total score, and discussing the strengths and weaknesses of each element on the grounds of its score. Puntasen et al. (2013), consequently, developed a more refined set of indicators on the tenet that an individual has to fulfill three basic requirements, specifically qualifying, understanding, and reaching, before he/she can be said to be a complete SEP follower. Puntasen (2017) considered that the building of self-immunity only for personal benefit is just the first stage of a sufficiency economy or the “qualifying” level; the building of self-immunity on the grounds of the moderation principle by reducing one’s desire or unnecessary consumption and increasing sharing with others is the middle stage of a sufficiency economy, or the “understanding” level. Additionally, the persistent practice at the middle level will be translated into a sufficiency economy at the high or “reaching” level. This way of measuring the sufficiency economy levels was adopted during a study of the performance of a Buddhist temple (Phrabaidega Supot Tabaselo, 2017) and a local administrative organization (Somyana, Nonthakod, & Khamjai, 2018).

The present study adopted the method using the total score from the measurement of indicators for assessing the level of a sufficiency economy as employed by Wiboonpongse et al., 2009). Leerattanakorn and Wiboonpongse (2015) and Leerattanakorn (2015) because farmers have been measured as practicing strongly or weakly without consistency across different indicators of the elements of self-immunity/moderation/reasonableness.

3. Methods

3.1 Design and sample

The Chiang Mai Province is selected to be the study site as it is the third most important rice-growing area in the Upper North. Over 70 percent of rice farming land is in the irrigated area. With this abundance, rice productivity per rai is very high. Its rice yield per rai is not only high compared to the national average and northern region's average but also close to the productivity level of the Central Plain, which is the most favorable area for rice production for many reasons. Topographically, Chiang Mai features many types of land ranging from lowland basin, upland, highland, to mountainous areas with small and large inter-mountain valleys and catchments. Thus, rice farming systems in Chiang Mai are so diverse that they can represent virtually all rice systems in Northern Thailand. As a result, a total of 447 rice farming household samples from 28 Sub-districts within 11 Districts in Chiang Mai Province can represent cultivators in all rice systems in Northern Thailand, namely lowland, upland, and highland rice farming which are under either irrigated, non-irrigated, or rain-fed conditions. These sampled rice-based farming households can be further distinguished into those farming in the lowland area using agrochemical inputs as typical in the majority of rice farmers in Thailand (Conventional farming systems), those farming in organic or chemical-safe systems (Alternative farming systems), and those farming in the upland or highland areas who are virtually entirely hill-tribe farmers producing rice for household subsistence (Subsistence farming system), although they might get involved in some other economic activities.

Questionnaires and in-depth interviews on the economy and society including characteristics and components of SEP, which was extracted and used as self-evaluation, were used to collect data.

3.2 Variables and measurement

The variables used in the analysis consist of dependent variables which correspond to the SEP values divided into 3 levels; low, middle, and high; and independent variables related to economic, social, and environmental conditions.

Dependent variable

The level of SEP is determined by the self-assessment scores from the 63 indicators in the career aspect (production domain) and the 45 indicators in the personal life domain, making a total of 108 indicators. The self-assessment scores vary from 1-5 (the possible full score is 540). These 108 SEP indicators were referred to and interpreted from a number of papers and academic journals, as well as all related research including Wasi (1999); Piboolsravut (2000); Puntasen

(2001); Wiboonpongse et al., 2009). This evaluation covers self-behavior consisting of validity, moderation, and self-awareness, as well as academic knowledge appliance. Additionally, it includes caution and carefulness in applying knowledge. Last but not least, the practices of morality, integrity, patience, diligence, and generosity are also evaluated.

The 63 indicators of a sufficiency economy in the production domain are classified into 11 categories for reasonableness using such questions as whether *you use exchange labor to reduce production costs*; 6 for moderation asking, for example, *if you have to borrow money for investment, you will borrow only at the amount for which you can make repayments*; 13 for self-immunity like the question of whether *you produce first to ensure food sufficiency for your family, and then sell the domestic surplus for money;* 20 for knowledge conditions asking questions like whether *your household practices integrated/mixed farming methods (multi-farming activities in a farming area or the same season such as field crops – leguminous crop intercropping, poultry and fish raising, free-range poultry raising in paddy fields);* and 13 indicators for the morality condition, for example, by asking whether *you discuss with/give advice to/share knowledge with your neighbors on the matters useful to farming*.

The 45 indicators of a sufficiency economy in the personal life domain comprise 6 for reasonableness asking such questions as whether *you take into consideration the worthiness and the need before spending the money*; 4 for moderation by asking, for example, *in case you have borrowed, you use the loan for farm investment or necessary items only (such as for children's education, for hospitalization, or medical treatments);* 14 for self-immunity like questioning whether *you have enough savings to spend in case of emergencies;* 6 for knowledge condition with such questions as w*hen you get information from any sources, you generally think it over before believing or consult knowledgeable or relevant persons before using the information in practice;* and 15 indicators for morality condition like the question of whether *you are generally keen to acquire knowledge (by attending training sessions organized by government agencies or the local community whenever you have the opportunity)*.

A self-assessment score from each household was collected and later converted to the standard T-score, with a mean of 50 and a standard deviation of 10. The T-score range was then divided by 3 for the purpose of classifying the SEP scores into 3 levels: low, middle, and high (Wannarat, 2016).

Independent variables

The independent variables used in the analysis consist of household information: education, health (mental and physical), and economic situation (income, expenses, savings, and debt). In the production aspect, the selected variables are the household production systems, the size of land including land ownership. All details concerning the independent variables are presented in Table 1.

Table 1: Descriptive statistics of variables and hypothetical effect on the SE level

Variable	Description	General		Expected effect
		Mean	SD	
Independent variables				
EDU>12	Having at least one working-age family member with an education higher than senior high school/vocational school certificate (Dummy) =1	0.36	0.48	+
SFARM	Subsistence farming (Dummy) =1	0.15	0.35	+
CFARM	Conventional farming (Dummy) =1	0.78	0.42	-
AFARM	Alternative farming (Dummy) =1	0.08	0.29	+
LUSE	Farming land area (rai)	10.94	7.74	+
LOWNE	Land ownership (% of land that had ownership of total land that households used)	34.06	41.25	+
IRRIGAT	Agricultural areas are in irrigated areas. (Dummy) =1	0.72	0.45	+
NAC	Number of livelihood activities that generate direct and indirect income for the household	3.66	1.30	+
SAVING	Household savings at the time of the study (baht)	18,836	57,331	+
DEBT	Household debts at the time of the study (baht)	83,051	142,617	-
EXPEND	Household expenditure at the end of 2016 (baht)	92,029.37	53,793.20	-
ATTD	Good attitudes toward rice farming occupation (1-5)	3.65	0.45	+
HEALTH	Healthy, cheerful, helping, sharing, and have freedom of thought (1-5)	4.28	0.50	+
GOODST	Satisfaction with social surroundings (1-5)	4.32	0.43	+

Variable	Description	General		Expected
		Mean	SD	effect
FIN	Access to financial sources (1-5)	3.87	0.95	+
GOODENV	Satisfaction with the richness of the environment (1-5)	4.29	0.49	+
GOODINFR	Satisfaction with public infrastructure (1-5)	4.07	0.59	+
Dependent variables				
Y1	Low Sufficiency Economy level	0.40	0.49	
Y2	Medium Sufficiency Economy level	0.41	0.49	
Y3	High Sufficiency Economy level	0.19	0.39	

Source: Authors' survey

Note: Average SEP scores of AFARM = 3.82, SFARM = 3.39, CFARM = 3.38

4. Data analysis

A five-point Likert scale was applied to self-assessment of the extent of applying the principles of SEP in both the production domain and the personal life domain, in which "1" means the farmers do not practice/not true, "2" = Once in a while, "3" = Moderately/sometimes, "4"= Mainly/frequently, and "5" = Exactly/regularly. The average score retrieved from each criterion was evaluated to detect the SEP correspondence level. The result was ranked and classified into five levels as follows: 4.21 - 5.00 = Very high, 3.41 - 4.20 = High, 2.61 – 3.40 = Moderate, 1.81 – 2.60 = Low, and 1.00 – 1.80 = Very low.

The level of a sufficiency economy, the dependent variable, is in the ordinal scale. The Ordered Logit or the Ordered Probit model is appropriate as both models provide comparable estimated values (Maddala, 1983). In empirical research, the Logit model is commonly used and thus we adopted the Ordered Logit method in this study. To model the outcomes, $y_i = 0$ (Low Sufficiency Economy level), $y_i = 1$ (Moderate Sufficiency Economy level) and $y_i = 2$ (High Sufficiency Economy level); y_i^* is a latent variable, β and x are vectors, and ε is an error term.

We can write an ordered response model as

$$y_i^* = x_i'\beta + \varepsilon_i \quad (1)$$

$$y_i = 0 \text{ if } y_i^* \leq 0$$

$$= 1 \text{ if } 0 < y_i^* \leq \gamma,$$

$$= 2 \text{ if } y_i^* > \gamma ,$$

Equation (1) is estimated using the maximum likelihood method (Greene, 2012).

Partial effects in the ordered choice model are computed using either the derivatives, or first differences for discrete variables (Greene & Hensher, 2009).

It is common in some areas to report the elasticities of probabilities, rather than derivatives, as shown in equation (2)

$$\in_{i,j} = \frac{\partial \ln \text{Prob}\left(y_i = j \mid x_i\right)}{\partial \ln x_{i,k}} = \frac{\partial \text{Prob}\left(y_i = j \mid x_i\right)}{\partial x_{i,k}} \frac{x_{i,k}}{\text{Prob}\left(y_i = j \mid x_i\right)} \quad (2)$$

where j = 0, 1, 2

The elasticities are simple to obtain from the estimated partial effects. However, the elasticity is not likely to be useful for either dummy or discrete variables. Therefore, Greene and Hensher (2009) have suggested a semi-elasticity, [%ΔProb]/Δx, where Δx would equal one. Whether a percentage change in an integer valued x would make sense depends on the context. The relevant semi-elasticity for the change in a dummy variable $e_{i,k}$ (or a unit change in a discrete regressor) would be (Greene & Hensher, 2009, p. 37)

$$e_{i,k} = \frac{\text{Prob}\left(y_i = j \mid x_i d_i = 1\right) - \text{Prob}\left(y_i = j \mid x_i d_i = 0\right)}{\frac{1}{2}\left[\text{Prob}\left(y_i = j \mid x_i d_i = 1\right) + \text{Prob}\left(y_i = j \mid x_i d_i = 0\right)\right]} \quad (3)$$

The denominator computation removes the asymmetry in the computation, which makes it dependent on whether the change is from d_i = 1 to 0 or from 0 to 1.

5. Results and discussion

The level of following the SEP as determined by the total score from the production and the personal life domains reflects the moderately high to high extent of practicing SE principles in rice farming households considering the close SEP scores between the conventional farming group and the subsistence farming group (3.38 and 3.39, on average, out of the 5 full score), which is

lower than the average of the alternative farming group (3.82) at the 0.05 statistically significant level (note of Table 1).

The alternative farming households have attained the highest scores of the SEP in the aspects of production and personal life at 3.74 and 3.93, respectively. Their high scores for the chemical-free production indicators were translated into high levels of reasonableness and morality, as well as being outstanding in production based on technical knowledge. The subsistence farming households have gained higher scores of SEP in agricultural production than conventional farming households due to using labor from family members or hiring only when necessary, which reflects the reasonableness principle. In terms of SEP in the personal life domain, subsistence farming households gained lower scores than conventional farming households, especially in the components of self-immunity and knowledge.

Furthermore, the statistical test shows a positive relationship between the SEP score of the production domain and that of the personal life domain at the .01 statistical significance level, implying that once farmers have SEP as their mindset, they can apply it in their career, livelihood, and gradually the SEP will become a part of their lives, as also found by Leerattanakorn (2015).

To choose the appropriate specification for the Ordered Logit model of SEP levels, five models were proposed, estimated, and evaluated for goodness of fit. In model 1, only the internal factors of the households were considered as the explanatory variables. Model 2 contains two more independent variables related to attitude and physical-spiritual health, in addition to the factors internal to the households. Models 3 to 5 include farming practices defined as subsistence farming, conventional farming, and alternative farming, respectively, with the further inclusion of external factors (satisfaction with social surroundings, the environment, public infrastructure, and access to capital) into the regression equations.

Among the 5 proposed specifications, Models 1 and 2 are outperformed by Models 3-5. The statistical analysis result showed that LR χ^2 and Pseudo R^2 for Model 1 are the lowest but increase substantially in Model 2 in which two other variables (attitude toward farming career and health) were added. This means that Model 1 lacks a significant variable related to SEP description. However, to prove the assumption that the external factors are related to SEP, more independent variables were added. In the aspect of social environment, access to financial capital, resources, and public utility are counted from the self-assessment mentioned in Models 3-5.

The analysis was performed on the calculated result depending on the specifications. Generally, the more variables included in the model, the more potential ability to explain the results. However, unless the increasing number of independent variables influences the dependent variable, the potential to explain is not high. In Models 3-5, the statistical values of LR χ^2 and Pseudo R^2 are almost identical, thus Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values are employed for further evaluation. Both AIC and BIC in Model 3 are slightly lower than those of Models 4 and 5, due to the change in the variables indicating household characteristics and attitude.

Model 3 was selected to represent the SEP level model for three different farming systems, apart from using the AIC, because it captured the strong relationship between the farming system and the level of a sufficiency economy of small farming households at a statistically significant level, which is one of the hypotheses to be tested in this research. Model 3 reveals 11 factors have statistically significant effects on the level of SEP. Since the coefficients in Table 2 are slopes of the odds ratio, partial derivatives and elasticities are presented in Table 3 for the interpretation of the effects of the independent variables.

Table 2: The ordered logit estimates for SEP models

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Coefficients				
EDU>12	0.3641*	0.5231**	0.4191*	0.3637	0.4073*
	(0.1995)	(0.2153)	(0.2296)	(0.2278)	(0.2314)
SFARM	0.4350	0.2364			0.4250
	(0.3109)	(0.3343)			(0.3763)
CFARM			-0.5200*		
			(0.2968)		
AFARM	1.1935***	0.5803		0.6066	0.6502
	(0.3478)	(0.3789)		(0.4344)	(0.4357)
LUSE	-0.0143	-0.0305**	-0.0285**	-0.0277*	-0.0280*
	(0.0127)	(0.0135)	(0.0144)	(0.0144)	(0.0145)
LOWNE	-0.0023	-0.0005	-0.0026	-0.0030	-0.0028
	(0.0024)	(0.0025)	(0.0028)	(0.0028)	(0.0028)
IRRIGAT	0.3810	0.5037**	0.5564**	0.3987	0.5186*
	(0.2337)	(0.2532)	(0.2580)	(0.2509)	(0.2737)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Coefficients				
NAC	0.1576**	0.2021***	0.2614***	0.2696***	0.2606***
	(0.0718)	(0.0784)	(0.0862)	(0.0860)	(0.0863)
SAVING	0.0224*	0.0238*	0.0353**	0.0341**	0.0353**
	(0.0115)	(0.0137)	(0.0159)	(0.0159)	(0.0159)
DEBT	0.0009	0.0063	0.0034	0.0019	0.0031
	(0.0072)	(0.0077)	(0.0084)	(0.0083)	(0.0084)
EXPEND	0.0051	-0.0018	0.0049	0.0040	0.0047
	(0.0062)	(0.0068)	(0.0073)	(0.0073)	(0.0074)
ATTD		0.0876***	0.0911***	0.0933***	0.0910***
		(0.0126)	(0.0141)	(0.0140)	(0.0141)
HEALTH		0.0861***	0.0629***	0.0625***	0.0628***
		(0.0117)	(0.0141)	(0.0142)	(0.0142)
GOODST			0.0426**	0.0389**	0.0423**
			(0.0190)	(0.0187)	(0.0190)
FIN			0.0385***	0.0384***	0.0384***
			(0.0070)	(0.0070)	(0.0070)
GOODENV			0.0026	0.0038	0.0025
			(0.0139)	(0.0139)	(0.0139)
GOODINFR			0.0482***	0.0492***	0.0484***
			(0.0118)	(0.0117)	(0.0118)
Statistical report					
Log likelihood	-451.96853	-374.40452	-312.97541	-313.53224	-312.89162
Pseudo R^2	0.0365	0.2019	0.3328	0.3316	0.3330
LR χ^2	34.26	189.39	312.25	311.13	312.41
Prob > χ^2	0.0002	0.0000	0.0000	0.0000	0.0000
AIC	927.937	776.809	659.951	661.065	661.783
BIC	977.168	834.245	729.694	730.808	735.629

Note: *, **, and *** indicate the level of significance at .1, .05, and .01, respectively.

The standard error is in parenthesis.

The changes in probability with respect to each factor are calculated for the three SEP levels: low, moderate, and high (Table 3). The following interpretations are rested on the elasticity values as the effects can be compared among factors. At the low level of the SEP, only two of the

11 significant variables have positive elasticity, i.e. CFARM and LUSE. This indicates that in the conventional farming system, farming households are 0.34% more likely to have low SEP levels compared to those in the other two systems, and that having a 1% increase in farmland size will increase the probability of the household having low SEP levels by 0.22%. The nine other significant variables serve to elevate the level of SEP as an increase in their values will decrease the probability of a household having a low SEP level, but increase its probability of having a high SEP level. Besides, it is clear that the impact is stronger at the high SEP level than at the moderate SEP level.

Meanwhile, being a household head with more than 12 years of education (EDU>12) (compared to those having less than 12 years of education) has .08% more probability of having a moderate SEP level and contributes to a 0.41% more understanding and practicing the SE principles at the high SEP level.

Table 3: Marginal effects and elasticities of factors affecting SEP level (Model 3)

Variables	(1) Predicted prob. SEP level = 1		(2) Predicted prob. SEP level = 2		(3) Predicted prob. SEP level = 3	
	Marginal effects	Elasticity	Marginal effects	Elasticity	Marginal effects	Elasticity
EDU>12	-0.0837*	-0.2900*	0.0509*	0.0807*	0.0328*	0.4068*
	(0.0447)		(0.0267)		(0.0194)	
CFARM	0.0999*	0.3461*	-0.0562**	-0.0891**	-0.0437	-0.5414
	(0.0526)		(0.0261)		(0.0286)	
LUSE	0.0059**	0.2221**	-0.0037*	-0.0649*	-0.0021*	-0.2870*
	(0.0030)		(0.0020)		(0.0011)	
LOWNE	0.0005	0.0620	-0.0003	-0.0181	-0.0002	-0.0802
	(0.0006)		(0.0004)		(0.0002)	
IRRIGAT	-0.1196**	-0.4144**	0.0822*	0.1303*	0.0374**	0.4636**
	(0.0576)		(0.0428)		(0.0165)	
NAC	-0.0537***	-0.6815***	0.0343***	0.1992***	0.0194***	0.8806***
	(0.0178)		(0.0123)		(0.0068)	
SAVING	-0.0072**	-0.0675**	0.0046**	0.0197**	0.0026**	0.0872**
	(0.0033)		(0.0022)		(0.0012)	
DEBT	-0.0007	-0.0183	0.0004	0.0054	0.0002	0.0236
	(0.0017)		(0.0011)		(0.0006)	

Variables	(1) Predicted prob. SEP level = 1		(2) Predicted prob. SEP level = 2		(3) Predicted prob. SEP level = 3	
	Marginal effects	Elasticity	Marginal effects	Elasticity	Marginal effects	Elasticity
EXPEND	-0.0010	-0.0936	0.0006	0.0274	0.0004	0.1209
	(0.0015)		(0.0010)		(0.0006)	
ATTD	-0.0187***	-4.7242***	0.0119***	1.3807***	0.0068***	6.1049***
	(0.0029)		(0.0024)		(0.0014)	
HEALTH	-0.0129***	-3.8317***	0.0082***	1.1198***	0.0047***	4.9515***
	(0.0029)		(0.0022)		(0.0012)	
GOODST	-0.0088**	-2.6189**	0.0056**	0.7654**	0.0032**	3.3843**
	(0.0039)		(0.0026)		(0.0015)	
FIN	-0.0079***	-2.1194***	0.0050***	0.6194***	0.0029***	2.7388***
	(0.0015)		(0.0011)		(0.0006)	
GOODENV	-0.0005	-0.1574	0.0003	0.0460	0.0002	0.2034
	(0.0029)		(0.0018)		(0.0010)	
GOODINFR	-0.0099***	-2.7947***	0.0063***	0.8168***	0.0036***	3.6114***
	(0.0024)		(0.0018)		(0.0010)	

Note: *, **, *** indicate the level of significance at 0.1, 0.05, and 0.01, respectively. The standard error is in parenthesis.

There are two related and influencing factors in SE improvement. When farmers have sufficient water, they can grow various kinds of plants both during and outside of the rainy season like those practicing New Theory Agriculture. As sufficiency in water depends primarily on irrigation service, having irrigated farmland is significant in improving the chance for the farming households to elevate their SE level from middle to high by 0.46% more than those living out of the irrigated area. Moreover, there is a higher probability of improving SE from a low to middle level (0.13%). In the same way, the diverse economic activities and careers tend to improve SE to the middle level by 0.20% and to the high level by 0.88%.

Having savings is a significant index of practicing SEP, while being in debt is not. In other words, having significant debt may not be beyond their ability to pay back if the household has appropriate capital management and maintains balanced productivity.

Attitude toward farming career and satisfaction with the surrounding environment have a significant relationship with the SE level, except the satisfaction with the environment. When considering the scores from 1 to 5 of these factors, one can see the more influence they have on improving the SE level from middle to high than from low to middle. For example, the attitude toward farming career shows its elasticity impact the most by increasing the probability by 6.105% when the attitude changes 1 score (Greene, 2009, p. 36), whilst pleasure and sharing (HEALTH) has the second strongest influence (4.95%). To have a good society (GOODST), access to financial capital (FIN), and good infrastructure (GOODINFR) can improve the readiness of farmers to study and follow SEP.

6. Conclusion and recommendations

The study result suggested the following recommendations. Firstly, the promotion for farmers to farm according to the principles of New Theory Agriculture, at least at the stage I development, will help enable farmers to manage the use of their land and water resources efficiently as this theory makes the most of existing resources, especially by appropriate soil and water management. A large number of farmers in Thailand have already applied the New Theory Agriculture in practice and realized the benefit from their on-farm water management following the theoretical prescription. One of the successful cases is Mr. Boontaen Laosupa, a farmer in Lei Province who built a farm-pond in his mixed farming area which has served as not only a water storage for dry-season crop irrigation but also an area for fish farming that has generated an extra supplementary income for his family (Office of the Royal Development Projects Board, 2011). Similarly, the alternative farming households in this study have not only a high level of SEP but also possess similar on-farm resource management characteristics to what are advised in the New Theory Agriculture. Therefore, the farming households, especially those in the subsistence and conventional farming systems, can be encouraged to adapt their practices toward alternative farming or environmentally friendly production systems simply by converting the crop residues and animal wastes into the farm production inputs which can help contribute to the attainment of households' sustainable livelihoods. As households in the subsistence farming system invariably face problems with the limited availability of water for farm irrigation, the extension works should it involve the integration of drought-resistant crops into their production system and the take-up of a secondary off-farm occupation to improve their livelihoods. Furthermore, the development and

provision of public infrastructure and services throughout the rural area, particularly the remote villages and the hill-tribe communities, will widen opportunities for under-privileged farming households to obtain access to the livelihood assets. Last but not least, the knowledge and guidelines concerning the sufficiency economy practices should be expeditiously extended to the farming households to enable them to understand and recognize the benefits of SEP to the point that they can change their mindset and take up the SEP as the guiding principles for their livelihoods, especially among farming households in the conventional and subsistence farming systems.

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