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Changes in Land Use and Rural Livelihoods: A Study of Phatthalung Watershed in Southern Thailand

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Abstract

A study was conducted to investigate the change in land use and assess its effects on rural livelihoods of Phatthalung watershed in Southern Thailand. The study examined changes in land use for three time periods using remote sensing data and assessed the livelihood of three groups of households who have or have not performed in land use change, using household data collected from a household survey. The study area has been experiencing considerable changes in land use in the recent past with 37.3 per cent increase in rubber area between 1990 and 2006 on the cost of declining paddy area and others. An increasing rubber price over the years was one of the motivating factors among others for the change. The overall livelihood of the surveyed households is moderate with high social and human asset. However, no statistically significant difference in livelihood was observed between the groups of household; the households who have been cultivating rubber for long period (Group III, 0.591) have relatively better livelihood followed by those who have been cultivating rice paddy for long period (Group II, 0.580) and those who have recently changed their use of land to rubber (Group I, 0.559). Among five livelihood assets, natural asset was observed to be below average in all cases, which hints that market driven land uses not necessarily contribute to the rural livelihood as the land use decisions are not made based on the capacity of the natural resources to support production. Such practices can seriously undermine the ecological functions and eventually rural livelihoods.

1.0 Introduction

The changes in land use are complex processes that start from modifications in land cover to conversion of land cover (Lambin and Geist 2001). Over the last decade, the interest in the impacts of change in land use has been increasing due to its significant link with other important issues, such as carbon stocks, and climate change (Bonino 2006; Cerri et al. 2007; Nogueira et al. 2007; Sharma and Rai 2007), land degradation, and land related disasters, e.g. flooding, landslide, soil erosion (Alcantara-Ayala et al. 2006; Cotler and Ortega-Larrocea 2006).

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Land use change is driven by the interaction in space and time between biophysical and human dimension. Moreover, there are also the potential impacts on physical and social dimensions (Veldkamp and Verburg 2004). Literature shows that attempts to understand land use change, its causes and effects have been made but mostly on biophysical aspect of land use change. Although, there have been increasing number of studies on rural livelihoods, such studies are mostly focused on studying the effects of the policy on livelihoods (Jakobsen et al. 2007), for instance the development of rural livelihoods on transition period (Bouahom et al. 2004), the linkage between demographics and livelihoods (de Sherbinin et al. 2008), the effect of livelihood improvement projects on rural livelihoods (Ashley and Hussein 2000; Koezberski and Curry 2005; Kitula 2006; Njifonjou et al. 2006; Neba 2007), impacts of disasters and climate change on livelihoods (Elasha et al. 2005), as well as the development of assessment tools to assess the situation of rural livelihoods (Bebbington 1999; Cramb et al. 2004; Kienberger and Steinbruch 2005; Kristjanson et al. 2005; Bhandari and Grant 2007). One of the widely used approaches for rural livelihood assessment is the Sustainable Livelihoods Approach (SLA) developed by the Department for International Development (DFID). In using SLA, some studies have mainly focused on coping strategies and adaptation to change of rural livelihoods (Soini 2005; Salisbury and Schmink 2007) while other tried to assess five assets of rural livelihoods. However, the completeness of the assessment depends mostly on the availability of data (Cramb et al. 2004). Rajbhandari (2006) opined SLA as a wider view-based approach for addressing poverty and environment than conventional income-based approach, which recognises the importance of the ability to access to resources. According to SLA, livelihoods resources comprised of five different capitals or assets, namely human asset, natural, financial, social and physical asset (DFID 1999). Each asset can be represented by number of factors affecting livelihoods.

Human asset is skill, literacy, knowledge, ability to labour and health of household members which enable them to achieve their livelihood objectives (DFID 1999; Scoones 1998). Different indicators are in use in livelihood studies to represent human asset indicator, for example health, literacy level, labour as used by (Cramb et al. 2004; Kristjanson et al. 2005; Ahmed and Chowdhury 2006; Westley and Mikhaev 2002; de Sherbinin et al. 2008) whereas Soini (2005) used family structure, education, occupation, link to outside the farm sources of income.

Natural asset is important, especially in case of rural households in which most household activities are resource-based. Natural assets are the natural stocks (soil, water, air, genetic resources, etc.) and environmental services (hydrological cycle, pollution sinks, etc.) from which resource flows and services useful for livelihoods are derived (Scoones 1998; de Sherbinin et al. 2008). Soil and water resources are

important natural asset particularly for agriculture-based households. Land-holding size in one of the most commonly used natural asset indicators by several researchers, such as (Ahmed and Chowdhury 2006; Cramb et al. 2004; Westley and Mikhaev 2002). Some other natural asset indicators in use are rainfall, wildlife density, and likelihood of having tick diseases (Kristjanson et al. 2005).

Financial asset can be all kind of financial resources that people use to achieve their livelihood objectives, including financial flows as well as stocks that can contribute to consumption and production (DFID 1999). Cash, savings and credit are the basic indicator for livelihoods assessment. Livestock possession by (Kristjanson et al. 2005; Ahmed and Chowdhury 2006; Cramb et al. 2004; Westley and Mikhaev 2002; Soini 2005) and remittances by (de Sherbinin et al. 2008; Westley and Mikhaev 2002) are used at financial asset indicator.

Social asset which is rather complicated (DFID 1999; Scoones 1998) are networks and connections, memberships of formalised groups and relationships and the relationship of trust (de Sherbinin et al. 2008). Density of active community and benefit from kinship could be another social asset indicator (Kristjanson et al. 2005; Westley and Mikhaev 2002; Ahmed and Chowdhury 2006), as well as the collective action and accessibility to knowledge (Soini 2005).

Physical asset comprises of basic infrastructure and producer goods needed to support livelihoods (DFID 1999). Houses and occupational equipments are basic indicators of physical asset (Ahmed and Chowdhury 2006; Cramb et al. 2004; de Sherbinin et al. 2008), and so is transportation network (Kristjanson et al. 2005). Vehicles, machinery, shops and other agricultural implements can also be considered as physical asset (Westley and Mikhaev 2002), while land is also found used as the physical asset (de Sherbinin et al. 2008).

In the context of agriculture dominated country like Thailand, where commercially oriented farming influenced by international trade has been one major factor of land use change, land use is an important factor influencing livelihood of farmers (Veerapong 1999). Phatthalung watershed, a major agricultural area of southern region of Thailand where more than half of total population earns their livelihoods from agricultural activities, is a typical example of such changes driven by a variety of internal and external factors, economic return being one of the major drivers. Until the last decade, paddy fields, which were the dominant land use types in the watershed, are on decline as the result of the rising rubber price and subsequent government support in rubber cultivation. During 1989-2000, rubber price fluctuated between 17 to 20[1] baht/kg. In 2003, it has been raised up over 30 baht/kg and reached up over 100 baht/kg in 2006[2] (OAE 2006).

[1] 1 USD=25 Baht approx.
[2] 1 USD=42 Baht approx.

The change in farming system, such as land use change can affect farmers' livelihoods and livelihood strategies (Soini 2005; Salisbury and Schmink 2007). Understanding of the relationship between land use change and its effects on rural livelihoods is crucial in formulating the strategies to improve the livelihood of the rural households.

2.0 Objective of Study

The objective of the study were to investigate how land use and livelihoods of farm households are related to suggest the desirable actions towards improving farmers' livelihoods.

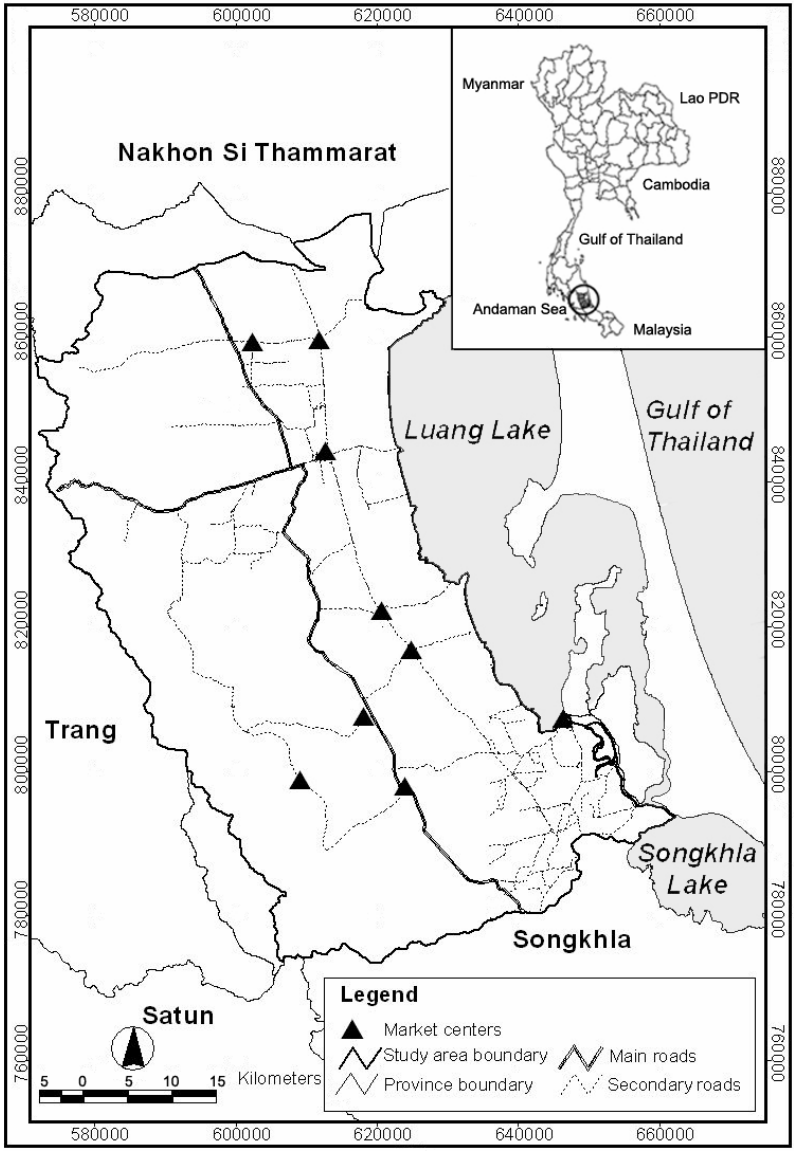
3.0 Study Area

The study area, Phatthalung watershed, is located in southern Thailand between 7º 5′-7º 55′latitude and 99º 44′ to 100º 25′longitude consisting the part of Phatthalung and Songkhla province (Figure 1). Beside the western part, which is mountainous area covered by evergreen forest, most of the area is floodplain with some rolling terrain. The study area covers approximately 302,406 ha and elevation ranges between 0 to 1,200 m. above m.s.l. The average annual temperature in the study area is 28ºC and the annual average rainfall is about 1,800 mm. with average rained days of 154. Rainfall distribution is bimodal, with the long rains from September to January and the short rains from May to June (MoI 2006). The soils of Phatthalung watershed have developed from river flood plains and characterised by deep and fertile soils.

The estimated households (HH) and population of the study area is 140,618 and 500,000, respectively in 2006 (MoI 2006). The area being one of the major agricultural regions in the southern part of Thailand, and agriculture has been the primary source of livelihood for the majority of the population. The major agricultural land uses include rubber, rice, orchards, shrimp and animal husbandry. The farmers are usually smallholders with an average land holding size of 1.9 ha (Field survey 2006). The major farming system consists of a highland rubber plantation (*Hevea brasiliensis*), intercropped with pineapple, and a lowland rainfed paddy field. There are four major rice varieties grown in the area, namely Sang Yod, Phatthalung, Leb Nok and Pathumthani. Livestock is usually raised together with other farming systems and the dominant livestock types are cattle, swine and poultry (Field survey 2006).

Land use conversion is a prominent problem in Phatthalung watershed, especially the encroachment of paddy fields by rubber plantation. From 1990 to 2006, more than a quarter of paddy area has been replaced by rubber plantation.

Figure 1: Location Map of Study Area



4.0 Materials of Methods

4.1 Data collection

In order to examine the land use change and its relation on rural livelihoods, the study made use of remote sensing data and the field data collected by administering the questionnaire.

4.1.1 Remote sensing data

Landsat images for Path/Row-128/55 in digital format were acquired to investigate the land use changes. Landsat Multispectral Scanner (MSS) data acquired on 30 March 1976 and downloaded from http://glovis.usgs.gov/, Landsat Thematic Mapper (TM) acquired on 1 June 1990 and downloaded from the Global Land Cover Facility (http://glcfapp.umiacs.umd. edu:8080/esdi/index.jsp), and Landsat Enhanced Thematic Mapper (ETM+) acquired on 27 August 2006 purchased from the United State Geological Survey (USGS) were used to prepare the respective land use maps of 1976, 1990 and 2006.

4.1.2 Secondary data

The socio-economic information related to number of household, population and others were obtained from the Ministry of Interior (MoI). Historical data (1989-2005) on prices and planted area of agricultural commodities, e.g. rubber, were obtained from the Office of Agricultural Economics (OAE). The information on rubber price in 2006 was obtained from the Rubber Research Institute of Thailand (RRIT).

4.1.3 Primary data

In order to investigate the relation between land use change and livelihoods, the selection of respective villages and farm household for conducting interview was based on the result of land use change analysis. Hence, a stratified sampling, from the area where changed was observed and rest where no change was observed, was adopted. The first category of farm households (Group I) included those who changed their land use from paddy to rubber during the study period, the second (Group II) those who have not changed to other uses and are still growing rice paddy, and the third category (Group III) included those farm households who have been growing rubber before the study period.

A household (HH) survey was conducted in February to March 2007 by administering structured questionnaire, which included both closed and open-ended questions for collecting both qualitative and quantitative data at the household level. A total of 180 household in the study area were interviewed. A proportionate sampling containing 95 in Group I, 45 in Group II, and 40 in Group III as the sample household was drawn from fifteen representative villages in the area.

4.2 Data analysis

4.2.1 Analysis of land-use change

In order to analyse land use changes, land use maps of 1976, 1990 and 2006 were prepared by digitally classifying Landsat data using maximum likelihood classification procedure in ERDAS IMAGINE software. The maximum likelihood classification algorithm requires training area to be identified for every class that represent the spectral behaviour within every class (Hylten and Uggla 2000). In this study, four major land use classes, namely forest, rubber (including perennials), paddy field and wetland were classified following level I of land cover classification as suggested by Anderson et al. (1976).

The classification accuracy was assessed by examining the classified map against all available reference data and field information including author's experience on the study area by constructing the confusion matrices. The matrix compares, on category-by-category basis, the relationship between known reference data and the results after classification (Lillesand and Kiefer 2000).

4.2.2 Socio-economic and livelihood assessment

The collected household information described and analysed using Statistical Package for the Social Sciences (SPSS). Thirteen indicators were used to represent five livelihood assets. Human asset indicator was derived from three indicators, namely household size, labour availability and proportion of labour engaged in agriculture as the major occupation. Natural asset was derived from three indicators, namely land holding size, soil fertility status and water sufficiency. The financial asset was assessed based on income from crop production, income from livestock production and amount of credit and loan. Social asset was derived from accessibility to knowledge (literacy level) and benefit from kinship, such as remittance. Physical asset was assessed using access to market and irrigated area.
Because of the different scale of each household characteristic treated as indicator, it was necessary to standardise them before computing livelihood indices. Among several procedures available, it was used the simplest technique, i.e. linear scaling, by using the minimum and maximum values as scaling points of 0 to 1 as shown in the following equation.

$$X_i = [(R_i - R_{min}) / (R_{max} - R_{min})]$$

Where, X_i = computed or normalised value, R_i = raw value to be normalised R_{min} = actual minimum value of the variable, R_{max} = actual maximum value of the variable.

For all the indicators, maximum value within an indicator category was given higher value, i.e. 1 and the minimum as zero except for credit/loan amount for which the scoring was vice versa with an assumption that no or less credit representing better indicator of livelihood. In case of perception response, such as 'increase' in soil fertility and water sufficiency was given a maximum score of 1, 'no change' as 0.5 and the 'decrease' as the zero. The scores obtained from the linear scaling was average to derive livelihood asset index to explain the rural livelihood in the study area. A compared means with one-way ANOVA was employed to examine the difference between selected livelihood indicators of three household groups and the comparison between all pairs of household groups was achieved using Least Significant Difference (LSD) technique.

5.0 Results and Discussions

5.1 Land-use change in Phatthalung watershed

The land use changed was assessed overlaying the classified images of three time periods. The overall accuracy of the three classified images were above 80 per cent, which is regarded as reasonably satisfactory with Landsat images as suggested by (Anderson et al. 1976) for land use classification from remote sensing data.

Land use in Phatthalung watershed has undergoing change since 1976. In the past, paddy field was the dominant land use pattern in lowland area in Phatthalung watershed and some rubber plantation on upland area. Among the major land use changes occurring in the area are conversion of forest and paddy field to rubber plantation.

The study area has relatively less proportion of forest cover mostly distributed in the western mountainous part. In Table 1, the forest has been depleting over time though not speedily. The forest cover accounted to 15.6 per cent in 1976, and decreased to 14.7 per cent in 1990 and 12.9 per cent in 2006. Similarly, wetland area has been depleted from 4 per cent in 1976 to about 2 per cent in 2006. The two major changes observed were reduction in overall area under paddy field and increase in overall area under rubber plantation. Paddy area occupied about 36 per cent of the study area in 1976 and reduced to nearly 24 per cent by 2006 whereas area under rubber plantation grew from 44 per cent of the total area in 1976 to 61 per cent in 2006. Not much change was observed during the first period (1976-1990). Majority of changes occurred during the latter period (1990-2006).

Table 1: Land-use Change in Study Area between 1976, 1990 and 2006

Land-use type	*Area (%)*			*Change in percentage*	
	1976	*1990*	*2006*	*1976-1990*	*1990-2006*
Forest	15.6	14.7	12.9	-5.6	-12.4
Rubber plantation	44.2	44.9	61.6	+1.4	+37.3
Paddy field	36.1	36.9	23.6	+2.4	-36.1
Wetland	4.1	3.5	2.0	-15.4	-42.4

Note: Total area: 302,406.2 ha.

Land use change matrix showing the change in each land use category is presented for the period of 1976 to 1990 in Table 2. Of the total forest (47,175 ha) in the year 1976, 21.4 per cent was lost to rubber plantation by the year 1990. The conversion was observed around the foothills as the forests are easier to encroach. In case of rubber, 20.8 and 5.7 per cent of the rubber plantation area (133,694 ha or 44.2 per cent of total area) in 1976 were lost to paddy field and forest in 1990. Reclaiming back to paddy from rubber was primarily in the areas where water table is too low resulting into low productivity of rubber. This was common that the paddy fields being converted to rubber and it was about one-fourth of total paddy areas (109,138 ha) in 1976 that was converted to rubber plantation. About 22 per cent of the wetland area (12,399 ha) in 1976 was found reclaimed as paddy field by 1990.

Table 2: Area of Land-use Change in Each Land-use Category in 1976 and 1990

Land use in 1976	*Land use in 1990*			
	Forest	*Rubber Plantation*	*Paddy Field*	*Wetland*
Forest	36891.1	10105.0	179.3	0.0
Rubber Plantation	7623.1	97911.2	27875.1	284.4
Paddy Field	0.0	27520.0	80911.5	706.9
Wetland	0.0	93.0	2803.4	9502.3

Note: Total area: 302,406.2 ha.

During the period of 1990-2006, two major land uses had accelerating changes, i.e. paddy to rubber and wetland to paddy although the latter was smaller in terms of area coverage. In Table 3, forest area continued to convert to rubber nearly at the same pace during 1976-1990 although Thailand adopted a Forest enactment law by prohibiting logging in the country in 1989. During the period, about 2 and 5 per cent of rubber area in 1990 were found converted to forest and paddy areas, respectively with majority of rubber areas remaining intact. This is to note here that forest land use also includes other perennials than rubber, lost of rubber areas could potentially be to other perennials rather than natural mountain forest. Paddy

areas further lost to rubber during this period and the proportion of conversion was about half of the total paddy area in 1990. This coincides with the steadily increasing rubber price which grew from less than 20 Baht/kg in 1990 to more than 70 Baht/kg in 2006. Nearly half of wetland area in 1990 was lost to paddy by 2006.

Table 3: Area of Land-use Change in Each Land-use Category of 1990 and 2006

Land use in 1990	*Land use in 2006*			
	Forest	*Rubber plantation*	*Paddy field*	*Wetland*
Forest	35789.4	8484.4	240.4	0.0
Rubber Plantation	3228.0	124982.1	7391.8	27.1
Paddy Field	0.0	52006.2	58488.8	1274.2
Wetland	0.0	660.1	5122.0	4711.7

Note: Total area: 302,406.2 ha.

5.2 Factors of land-use change

The land use change in the area has been influenced by various factors. Interviews with the farmers revealed that the economic factors are predominant forces of land conversion. Land conversion from paddy field to rubber plantation is the major type of land use change in the study area. Most often combination of various factors is responsible to drive land use change as suggested by (Geist and Lambin 2002) who examined the proximate causes of tropical deforestation using demographic, economic, technological, policy, institutional, and cultural factors. The factors of land use change in Phatthalung watershed can also be described using similar framework.

The economic factor includes market growth and commercialisation, economic structure, urbanisation and industrialisation. As Thailand is one of the largest rubber exporters (OAE 2006), commercialisation and the growth of rubber markets with relatively assured price structure can be the major factors to drive the conversion of paddy field into rubber fields. Price of rubber in the local market at the early period (1989-2000) was fluctuated between 10-30 Baht/ kg (Figure 2) but has been continually increasing since 2001 reaching as much as 50 Baht/kg in 2005 and 70 Baht/kg in 2006 (RRIT 2004). It was confirmed by the household survey result as 70 per cent of household in Group I indicated that commodity price as the major driver influencing land use change decision (Figure 3). This was due to the higher average income obtained from rubber plantation (3,947 USD/ha) compared to 1,842 USD/ha from the rice cultivation (Field Survey 2006).

Figure 2: Local Market Rubber Price in Phatthalung Watershed, Thailand

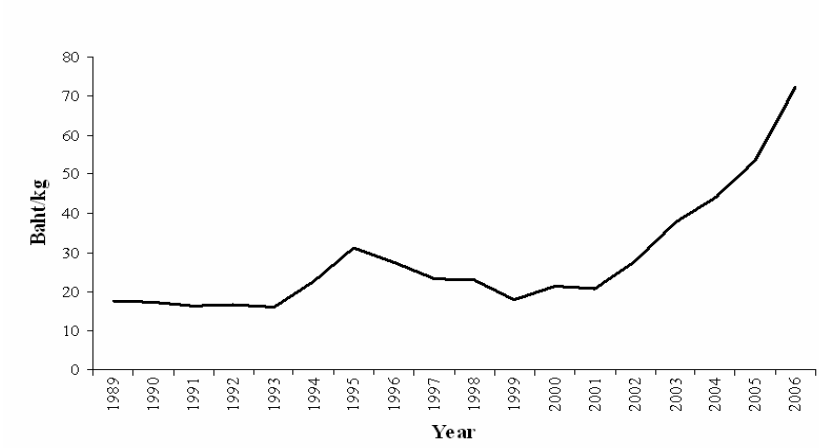
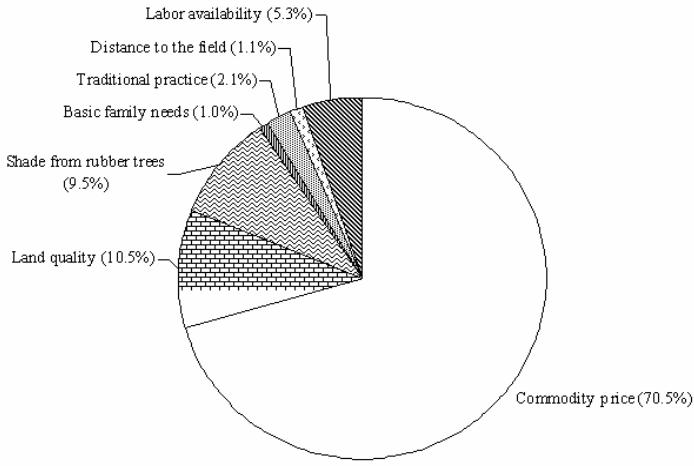


Figure 3: Factor Influencing of Land-use Change



The technological factor basically included agricultural production factors. In this study, land and soil quality were considered as the factors influencing agricultural production and land use decision resulting into land use change. In Figure 3, 10.5 per cent of those household who changed their land use, i.e. Group I household, indicated that land quality was the reason for changing the land use. The border effect of adjacent parcels held by other owners was also found as another influencing factor in some cases. In this case, since the rubber crop in neighbouring parcels creates shades to rice crop, 9.5 per cent of household were found to change the paddy to rubber to avoid such shading effect to their paddy crop.

The population is an important demographic factor. Availability of labour is important determinant for selecting land use type. Though not very high proportion, yet 5.3 per cent of surveyed household in Group I were found to change the traditional paddy cultivation to rubber plantation due to increasing shortage of labour in the study area. Other factors, like distance to the field, traditional practice and basic family needs accounted a total of about 4 per cent of the surveyed household.

5.3 Socio-economic characteristics of farm households

The average household size in the study area consists of 3 to 4 members in the family (Table 4) with a range of 1 to 6 members. In the study area, more than half (55%) of surveyed household belonged to medium category, more than a quarter (28%) in small category and nearly 17 per cent in the large category. With respect to other household characteristics, land holding size is important from livelihood point of view. The average land holding for all the surveyed household was 1.9 ha with minimum and maximum land holding of 0.4 and 11.2 ha, respectively. Average land holding was relatively larger in case of Group III (2.2 ha) compared to Group I (1.9 ha) and Group II (1.5 ha). The proportion of household having their own land was relatively small (86.7%) in case of Group II compared to Group I and III, in which almost all household do have possession of their own land. About 13 per cent of household in Group II were also found to have rented-in the land for cultivation. Irrigation plays an important role in household income by providing opportunity to cultivate more number of crops in a year. About 27 and 40 per cent household in Group I and Group II, respectively possess irrigation area whereas none of household in Group III.

The agriculture was the mainstay of farm household in the study area. The major source of income came from the crop production with an amount ranging from 1,759 USD/HH (Group II) to 5,450 USD (Group III). On an average, the crop-based income constituted about 45 per cent (Group I) to 61 per cent (Group III) of the household income. Instead, the Group II household had relatively higher share (13%) of income from livestock and other sources, e.g. wage labour and remittances (41%) compared to Group I and III. More than half of surveyed household in Group I and II and one-fifth in Group III have borrowed the money for different purposes, such as farming, running small enterprise (grocery shop), and home consumption. More than 30 per cent of surveyed household have standing loan for crop production purpose in case of Group I and Group II. An average amount of loan per household was 6,512, 6,658, 7,632 USD in Group I, II, and III, respectively, of which nearly one quarter was for crop production purpose, where as it was only 5 per cent in Group III. It was interesting to note that the amount of loan was nearly equal to the amount of earnings from

Table 4: Household Characteristics

Variable	*Group I*			*Group II*			*Group III*			*Study area*		
	Average	*SD*	*%*	*Average*	*SD*	*%*	*Average*	*SD*	*%*	*Average*	*SD*	*%*
Total Surveyed Households	95 HH			45 HH			40 HH			180 HH		
Household size (people)	3.5	1.2		3.4	1.3		3.0	1.2		3.4	1.2	
Small (<2)			25.3(24)			26.7(12)			37.5(15)			28.3(51)
Medium (3-4)			54.7(52)			55.6(25)			55.0(22)			55.0(99)
Large (>4)			20.0(19)			17.8(8)			7.5(3)			16.7(30)
Total land holding size (ha)	1.9	1.3		1.5	1.1		2.2	1.5		1.9	1.3	
Owned	1.9	1.3	98.9(94)	1.4	1.1	86.7(39)	2.2	1.5	100.0(40)	1.9	1.5	96.1(173)
Rented in	4.8	0.0	1.1(1)	2.0	1.1	13.3(6)	-	-	-	2.4	1.4	3.9(7)
Area in irrigation system (ha)	1.7	1.2		1.6	0.8		2.9	1.7		1.8	1.7	
Owned	1.6	1.1	27.4(26)	1.4	0.7	40.0(18)	2.9	1.7	20.0(8)	1.7	1.2	28.9(52)
Rented in	4.8	0.0	1.1(1)	2.2	1.0	11.1(5)	-	-	-	2.7	1.4	3.3(6)
Income (USD/HH)												
Cropproduction	3,365	3,482	75.8(72)	1,759	1,772	77.8(35)	5,450	4,235	100.0(40)	3,506	3,603	81.7(147)
Livestock production	682	553	26.3(25)	481	649	26.7(12)	430	310	12.5(5)	595	560	23.3(42)
Others e.g. wage labour, remittance, business	2,209	2,398	56.8(54)	1,588	1,445	60.0(27)	3,084	3,037	32.5(13)	2,152	2,295	52.2(94)
Loan (USD/HH)												
Crop production	1,508	1,688	30.5(29)	1,546	1,672	33.3(15)	1,711	2,047	5.0(2)	1,529	1,654	25.6(46)
Livestock production	1,842	1,028	3.2(3)	-	-	-	3,421	2,605	5.0(2)	2,474	1,724	2.8(5)
Small enterprise	1,746	1,774	6.3(6)	3,026	3,163	4.4(2)	-	-	-	2,066	2,007	4.4(8)
Household consumption	1,416	1,451	15.8(15)	2,086	1,889	15.6(7)	2,500	2,158	10.0(4)	1,763	1,668	14.4(26)
Total Surveyed Population			329 People			154 People			120 People			603 People
Gender (Male: Female)			1:0.9			1:1.3			1:1.1			1:1.1
Age category (people):												
<15	0.6	0.8	17.6(58)	0.5	0.8	14.3(22)	0.6	0.8	20.0(24)	0.6	0.8	17.2(104)
15-60	2.1	1.2	61.7(203)	2.3	1.4	66.2(102)	1.9	1.2	64.2(77)	2.1	1.3	63.4(382)
>60	0.7	0.9	20.8(68)	0.7	0.9	19.5(30)	0.5	0.8	15.8(19)	0.7	0.9	19.4(117)
Education level (people)												
Illiterate	0.9	0.4	5.5(18)	0.2	0.5	6.5(10)	0.4	0.5	11.7(14)	0.2	0.5	7.0(42)
Literate	2.1	1.3	61.1(201)	2.2	1.1	64.9(100)	1.4	0.9	47.5(57)	2.0	1.2	59.4(358)
High school	0.7	0.7	20.4(67)	0.5	0.8	13.6(21)	0.7	0.9	24.2(29)	0.7	0.8	19.4(117)
College	0.5	0.8	13.1(43)	0.5	0.7	14.9(23)	0.5	0.9	16.6(20)	0.5	0.8	14.2(86)
Occupation of population (people)												
Agriculture	2.0	1.0	56.5(186)	2.0	1.0	57.1(88)	1.9	0.7	61.7(74)	1.9	0.9	57.7(348)
Non-agriculture	0.6	0.9	16.1(53)	0.7	1.0	19.5(30)	0.5	0.9	17.5(21)	0.6	0.9	17.3(104)
Retired, student	0.9	0.9	27.4(90)	0.8	1.1	23.4(36)	0.6	0.9	20.8(25)	0.8	1.0	25.0(151)

crop farming in case of Group II where as it was less than half in case of Group I and just one-third in case of Group III, indicating the low level of income of household who have not changed their paddy cultivation to other land uses. Ten to fifteen per cent of surveyed household belonging to different group also borrowed the money for household consumption purpose.

The demographic characteristics, such as age composition, education level, occupation, exert an important influence on livelihood of the people. We examine some of these for those three Groups under study. In terms of age groups, more than 60 per cent of the surveyed population belonged to the working age (15 to 60 years) in study area as a whole or three different groups, however it was slightly higher in Group II (66.2%) compared to Group III (64.2%) and Group I (61.7%). About one-fifth of the population was elderly people with average age of 60 years and above. Nearly another one-fifth population were younger people (<15 years age). The male to female ratio was 1:0.9 in Group I, 1:1.3 in Group II and 1:1 in Group III.

In relation to education attainment of the surveyed population, on an average about three-fifth of the surveyed population were literate, and nearly one-fifth with high-school level education and about 14 per cent with college level education and the rest illiterate. In general, educational level was slightly less in Group III compared to rest two groups. Agriculture is the major occupation of the people in the area. Nearly three-fifth of the surveyed population in the study area were found to engage in agriculture as the major occupation, less than 20 per cent in engaged in the occupation other than agriculture and the rest with no occupation. The latter category included either retired population or students.

The perception of farmer on soil fertility and water sufficiency was also assessed using the information collected during the household survey to understand the peoples' awareness on environmental issues as these directly affects the agriculture on which their livelihood depends. Regarding soil fertility, the majority of household in all the groups (55 to 69.5%) perceived no significant change in soil fertility in their farmland (Figure 4a). There was no specific trend of such perception among those household who feel that soil fertility is either increasing or decreasing? Almost similar proportion of household in Group I (15.8 and 14.7%) and Group II (17.8 and 17.8%) opined that the soil fertility has increased and decreased, respectively over time while it was 30 and 15 per cent of Group III household who opined of increasing and decreasing soil fertility, respectively.

Figure 4a: Perception of Farmers on Soil Fertility

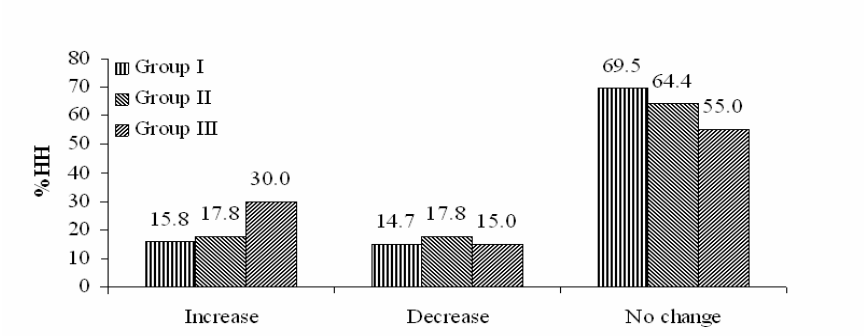
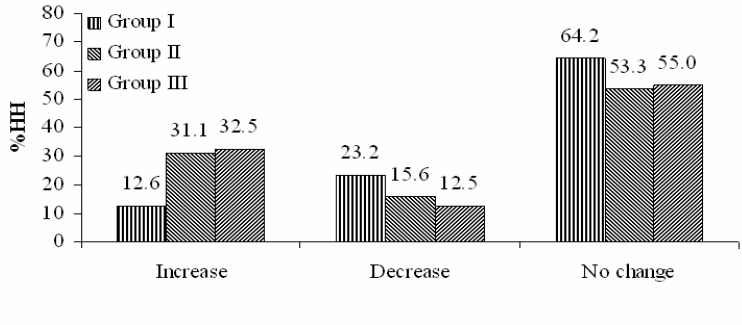


Figure 4b: Perception of Farmers on Water Sufficiency



Similar responses from different groups were observed in case of water sufficiency (Figure 4b) except there was slight increase in the Group II household who opined that increased water sufficiency indicating adequate water for their paddy crop.

5.4 Assessment of rural livelihood

The assessment of rural livelihoods can be achieved through identification of what the rural people have and hold (Allison and Ellis 2001), which is more important than what they do not have (Moser 1998). SLA developed by DFID has been widely used to assess rural livelihoods. The framework employs a group comparison method in order to compare livelihood of different household groups. This method differs from the one used by Cramb et al. (2004) who used the average value to be the score of livelihood assets. As mentioned earlier, detail information on household characteristics were collected by conducting household survey and administering a structured questionnaire in this study. It is also to note here that although indices help to compare between the groups, it is within the context of the households and population being studied in a given area.

Radar diagram of five assets based on the computed score is presented in Figure 5(a), (b) and (c), which explains the livelihood status of different Groups through each asset. Table 5 presents the detailed computed score for each indicator under each livelihood asset, namely human, natural, financial, social, and physical asset. The overall livelihood index which was an aggregated index value for the whole study area was 0.571 and for Group I, II and III were 0.559, 0.580 and 0.591, respectively indicating medium level of livelihood in general for all the groups, however there was no significant difference between the groups. In terms of five livelihood asset comparison, social asset index (0.893) was highest among all followed physical (0.6), financial (0.579), human (0.577) and natural (0.426) for the whole study area. This is to note here that except natural asset, the computed livelihood score was above average in general in the study area indicating the relatively poor situation of natural asset, which can have implication on sustainability of livelihood on the long run.

Figure 5a: Livelihood Pentagons of Group I Households

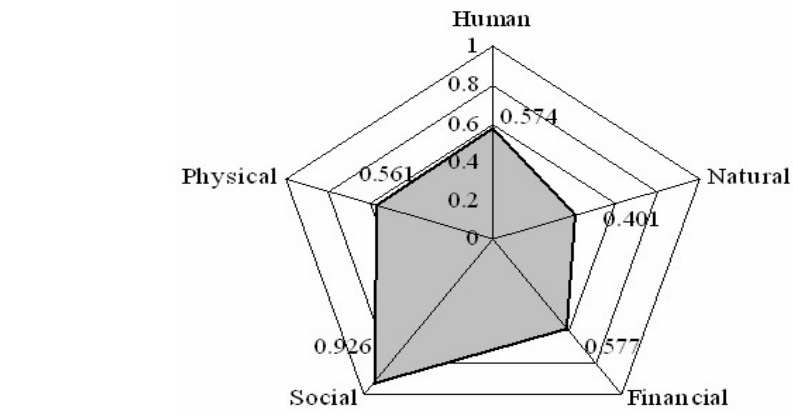


Figure 5b: Livelihood Pentagons of Group II Households

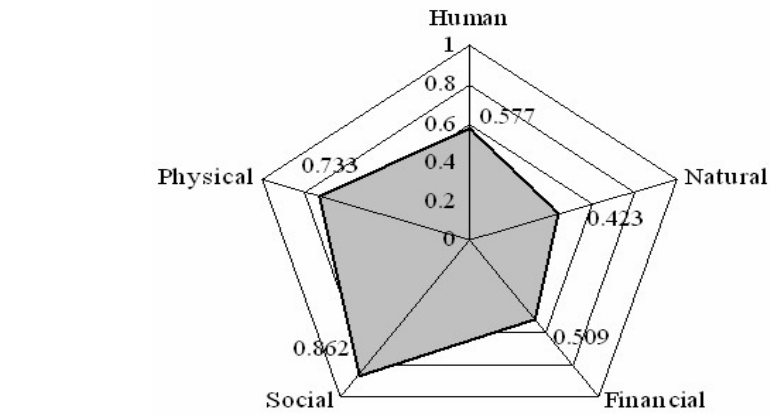
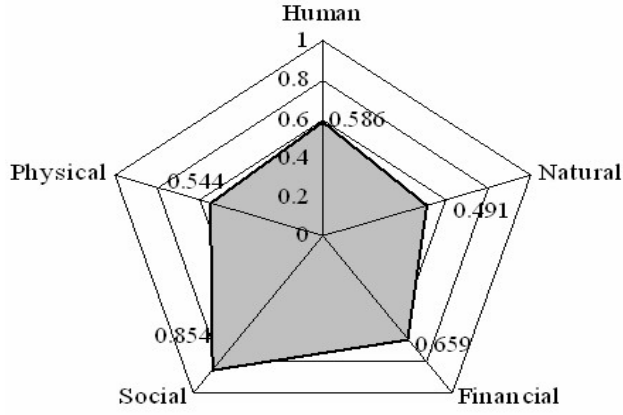


Figure 5c: Livelihood Pentagons of Group III Households



With regard to individual asset for each group, it was observed that Group III has relatively better livelihood as shown by higher index for human, natural and financial asset compared to two other groups, where as the computed value of physical and social asset were relatively higher for Group II and Group I, respectively. Human asset was slightly above average for all three groups and no significant difference was observed between the groups based on human asset. So was the case with social asset except the computed score were much higher than human asset indicating relatively rich social integrity in the study area.

Natural asset, which is one of the important assets of livelihood, was below average for all the groups as it compares with other livelihood asset. Group I (0.401) and III (0.491) significantly differed ($p<0.05$) in terms of natural asset. In terms of each indicator of natural asset, land holding size (0.191) of Group II was significantly smaller ($p<0.05$) than of Group III HH (0.298) and which seems to be obvious as the Group II farmers belong to paddy growers and Group III to rubber growers. So was the case with water sufficiency but at higher significance level of $p<0.01$.

Financial asset, however, did not show any significant difference between the groups, income from crop production, at individual indicator level, showed highly significantly different among the groups with computed score of 0.219, 0.110, 0.369 for Group I, II, and III, respectively. Physical asset was highly different ($p<0.01$) between the groups with computed score of 0.561, 0.733, and 0.544 for Group I, II, and III, respectively. Both indicators used to compute physical asset were also diffident between the groups, access to market at $p<0.05$ and irrigated area at $p<0.01$. The difference was the there was relatively high accessibility to market compared to the irrigated area as shown by the computed score for each indicator.

Table 5: Livelihood Asset Indicators

Livelihood asset indicator	*Group I*		*Group II*		*Group III*		*Study area*		*Sig*
	Average	*SD*	*Average*	*SD*	*Average*	*SD*	*Average*	*SD*	
Human asset									
Household member	0.493[a]	0.249	0.484[ab]	0.261	0.395[b]	0.229	0.469	0.250	0.103[ns]
Working age members	0.614[a]	0.325	0.626[a]	0.353	0.652[a]	0.354	0.626	0.337	0.839[ns]
Agriculture as main occupation	0.615[a]	0.295	0.619[a]	0.301	0.712[a]	0.288	0.638	0.296	0.199[ns]
Human asset index	*0.574[a]*	*0.296*	*0.577[a]*	*0.312*	*0.586[a]*	*0.323*	*0.577*	*0.306*	*0.933[ns]*
Natural asset									
Land holding size	0.254[ab]	0.204	0.191[b]	0.168	0.298[a]	0.234	0.248	0.205	0.049*
Soil fertility status	0.505[a]	0.278	0.500[a]	0.302	0.575[a]	0.331	0.519	0.296	0.404[ns]
Water sufficiency status	0.442[b]	0.290	0.578[a]	0.336	0.600[a]	0.324	0.511	0.317	0.007**
Natural asset index	*0.401[b]*	*0.281*	*0.423[ab]*	*0.323*	*0.491[a]*	*0.327*	*0.426*	*0.304*	*0.024**
Financial asset									
Income from crop production	0.219b	0.235	0.110c	0.120	0.369a	0.286	0.228	0.244	0.000**
Income from livestock production	0.346a	0.285	0.245a	0.351	0.217a	0.160	0.303	0.292	0.504ns
Credit and loan	0.842a	0.258	0.819a	0.297	0.906a	0.246	0.851	0.266	0.295ns
Financial asset index	0.577ab	0.396	0.509b	0.425	0.659a	0.377	0.579	0.402	0.067ns
Social asset									
Access to knowledge	0.954a	0.110	0.921ab	0.199	0.891b	0.172	0.932	0.152	0.081ns
Kinship	0.486a	0.436	0.191a	0.192	0.358a	0.092	0.366	0.327	0.411ns
Social asset index	0.926a	0.182	0.862a	0.282	0.854a	0.217	0.893	0.220	0.101ns
Physical asset									
Access to market	0.895b	0.262	0.989a	0.075	0.888b	0.240	0.917	0.227	0.047*
Irrigated area	0.226b	0.389	0.477a	0.482	0.200b	0.405	0.283	0.430	0.002**
Physical asset index	0.561b	0.471	0.733a	0.429	0.544b	0.479	0.600	0.468	0.007**
Overall livelihood index	*0.559[a]*	*0.368*	*0.580[a]*	*0.382*	*0.591[a]*	*0.372*	*0.571*	*0.373*	*0.262[ns]*

Note: Means not sharing a common superscript letter between row values differ significantly *(p<0.05)*
ns = Non-significant, * Significant at *p<0.05*, ** Significant at *p<0.01*

6.0 Conclusion and Recommendation

Phatthalung watershed of Thailand is dominated by agricultural land uses. As in other places of the country, rice farming has remained the major land use in the past, which has been converting to other land uses, e.g. rubber. In the last thirty years, rubber plantation, which occupied 44 per cent of the study area increased to 61 per cent mostly occurring after 1990. The area under all other land uses, such as rice paddy, forest, and wetland, were decreased during the period. The motivation for land use conversion and modification was the expected gain in household income by cultivating rubber crops due to ensured and higher price of rubber compared to other crops. The conversion of paddy to rubber was forced in some cases due to the shading effect of the neighbouring rubber fields owned by the fellow farmers. Similarly, increasing shortage of labour availability and accessibility were other factors for switching into rubber farming.

Agriculture is the mainstay for all the households. Among three groups of farm households, it was observed that the farm household who had relatively larger land holdings have been cultivating or changing to rubber crop. The paddy growers usually have smaller land holdings. The latter group depends on other business than crop farming for earning their livelihood compared to other groups who have long been cultivating rubber or have recently changed to rubber. Farm household with rubber as major farming occupation usually have higher earning with less loan compared to the rest of household.

The study shows that in general all the surveyed households have moderate livelihood as indicated by above average livelihood index. The household are relatively better off in terms of social asset but worse-off in terms of natural asset. Although opinion survey showed nearly half of surveyed population perceived no change in soil fertility and water sufficiency, relatively low score of natural asset index indicates the very need of natural resource conservation in the area for providing sustainable livelihood. The household which have been growing rubber for long are potentially in suitable land for rubber but there has been increasing conversion of other land uses to rubber and this might occurring in potentially not suitable land as the conversion is motivated by the increasing rubber price as demonstrated by low natural asset index value for households who have changed their land use to rubber in the recent past. This is also evidenced by the lowest computed overall livelihood index for this group than the rest two groups of household although the difference was not statistically significant. Such practices can have notable effect on the natural resources and environment. This also lead to the point that market driven land use changes may not necessarily contribute to

rural livelihood as livelihood is not only the household income but overall resources required for a sustainable living.

As such, the comparison of livelihood assets between the household groups depicts the livelihood status in terms of comparative worse- or better-off situation but it is to note that there is difficulty in quantifying such attributes of farm household, which are subjective in nature. Given that understanding the situation of rural livelihoods is important for rural development and sustainable natural resources management, inclusion of additional household characteristics in livelihood assessment exercise would help improve the findings.

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