

The Effect on Land Used Changed on Ecosystem Services in the Lower Songkhram River Basin

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Abstract: There has long been a recognition that ecosystem services are essential. Not only for maintaining ecosystems themselves but also for socio-economic development, however, the ecosystems are complex interweaving from small local to mega global scale. This has a result that in terms of methodology for studying the ecosystem services, it is difficult to determine the boundary of individual ecosystem. This study places a focus on land use change and its implication on ecosystem services, by considering river basin as a boundary of ecosystem. Land use change was determined by using Quantum GIS computer program interpreting satellite images. Qualitative methods combine with secondary sources of data were employed to study the implication of land use on change of ecosystem services. This study found that during 1992-2008, wetland of Songkhram river basin was changed to be used in agriculture. Land that was previously grown rice and different types of cash crops were found to change into rubber and cassava growing significantly. The change of land use has a significant effect on the loss of ecosystem services, both to ecosystem and local livelihoods. This is because wetland forests play an important in maintaining ecosystem of Songkhram River Basin. Loss of wetland forest lands result in irregularity of flood pules, loss of source for nurturing and reproducing fish, poor quality of water, soil erosion and etc.

Key words: Land usechange, ecosystem services, the lower Songkhram River Basin, services, fish

INTRODUCTION

The Lower Songkram River Basin is recognized as a nationally important wetland of Thailand. The river basin has a catchment area that is approximately 12,367 km² and its boundary covers all districts in a province of Nakhon Phanom. The river basin provides a rich of aquatic biodiversity and fertility of natural resources such as soil and the inundated forest. Geographical characteristic of the Lower Songkram River Basin is a specific floodplain and surrounded by the oxbow lak (Research Group on Wellbeing and Sustainable Development, 2012). It is to say that a lake is formed by the flood in wet season. Several oxbow lakes are formed in the river basin and covering approximately 960 km² witha period of 3-4 month of inundation followed by a slow discharge into the Mekong River. The lower Songkhram River Basin consists of a variety of ecosystems particularly the inundated forest ecosystem. The inundated forest provides ecosystem services to the lower Songkhram River Basin in various forms such as flood plain, creeks, forest and etc. In dry season, when water level in the floodplain decreased, villagers, approximately 40,000 persons in communities nearby are

able to access the flood plain and use the floodplain for agriculture activity such as collecting foods in the forest, feeding animal, fishing, conducting tourism and learning center. Moreover, the floodplain also pay important role to maintain a rich of natural resource and create a balance of ecosystem in the river basin. Ecosystem in the lower Songkhram River Basin presents an interaction within environment. Animals and plants rely to each other and create a balance of ecosystem. Additionally, human also uses various forms of ecosystem services for their livelihoods (Millennium Ecosystem Assessment, 2005). This is to say that the lower Songkhram River Basin is beneficial to human's living, animals and plants in the ecosystem nationally and internationally. According to several reports related to the ecosystem deterioration, the development of irrigation system for agriculture provided effects to the land use change. Lands have been changed to serve the commercial farming, operated by the private agriculture company. Deforestation is generally found to conduct the mono-crop farming and animal feeding. These problems are slowly deteriorating ecosystem. Therefore, this research investigated the land use change and its effect on ecosystem in the lower Songkram River Basin (Fig. 1).

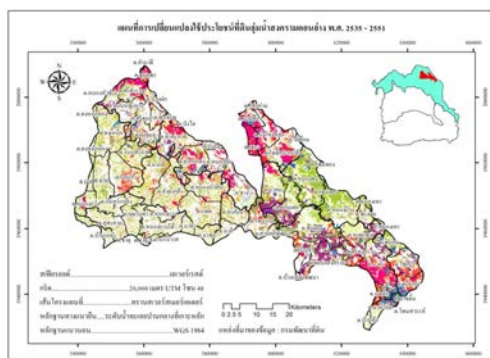


Fig. 1: Map of land use in lower Songkhram River Basin

MATERIALS AND METHODS

Research area focused on an area of the Lower Songkram River Basin in the districts of Sri Songkram, ThaUten and Nathom in Nakhon Phanom Province. Mixed-method sequential design was applied in the study as details:

- Focus group discussion and in-depth interview were used to collect qualitative data from key informants who were totally 60 household leaders in the research area
- Maps of the 1992 and 2008 land use changes were compared and analyzed. Analysis method was explained as follows
- Collecting information of the lower Songkhram river basin boundary and related issues from the department of land
- Analyzing and interpreting data of the land use change images from the Land Satellites (with the ratio of 1:50,000) to compare the land use changes from 1992-2008
- Two sets of the analyzed land use images were compared by the Overlaying method and together with using Quantum GIS computer program interpreting satellite images. Based on the analysis, 12 patterns of the land use change were found
- Secondary data was gathered from reports which were issued by the Department of Land, the Provincial Irrigation Office, the Provincial Fishery Department and the District Agricultural Office. All the data would be analyzed by the content analysis method

RESULTS AND DISCUSSION

The landuse change in the lower Songkhram River Basin: A study of the land use change in the lower

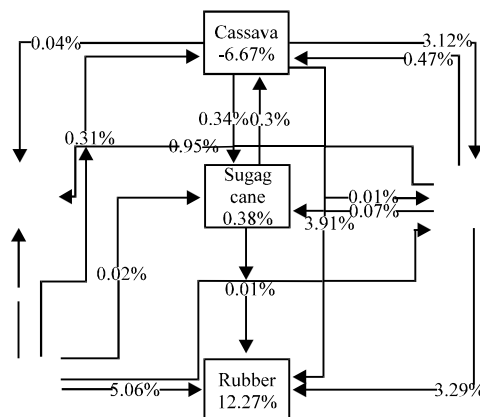


Fig. 2: Map of land use in lower Songkhram River Basin

Songkhram River Basin was conducted by comparing the GIS data and the landuse data in 1992 and 2008. The results found the lands were changed to be used for agricultural purposes. During 1992-2008, agriculture activity in the lower Songkhram River Basin covered the river basin which was approximately 792,446 acres (Fig. 2). According to the map above, the study found the changes of land use in the lower Songkhram River Basin since, 1992-2008 as per detail; the study found the largest decrease of forest area (-13.51%). Forest area was turned into the rubber tree area (5.06%), rice farming area (0.01%), sugarcane farming area (0.02%), residential area (0.61%) and cassava farming area (0.31%). Cassava farming area decreased (-6.67%) and was turned into rice farming area (3.21%), rubber tree area (3.91%) and sugarcane farming area (0.34%). There was the increase of rice farming area (5.92%) while cassava farming area was decreased (3.12%) and turned into rice farming area. Forest area (0.01%) and sugarcane farming area (0.01%) were also decreased and turned into rice farming area as well. However, rice farming area decreased and was turned into the rubber tree area (3.29%), cassava farming area (0.47%), sugarcane farming area (0.07%) and residential area (0.95%). The rubber tree area (12.27%) increased and expanded to forest area (5.06%), sugarcane farming area (0.01%), cassava farming area (3.91%) and rice farming area (3.29%). Sugarcane farming area (0.38%) decreased and was turned into cassava farming area (0.31%), the rubber tree area (0.01%) and rice farming area (0.01%). Also, sugarcane farming area increased and expanded to forest area (0.02%), rice farming area (0.07%) and cassava farming area (0.34%) (Table 1).

In conclusion, the study found there were changes on agriculture activities in the lower Songkhram river basin during in 1992-2008. Forest area decreased by 106,681.28 acres, followed by cassava farming area

Table 1: The comparison of the landuse changes in 1992 and 2008

Land using	1992		2008		Change rate	
	Area size (acres)	Percentage	Area size (acres)	Percentage	Area size (acres)	Percentage
Residential area	1,950.6	1.8	26355.88	3.3	+ 24,405.28	+5.92
Fish pond	48	0.0	181.2	0.0	+133.2	+0.06
Forest area	206,100.76	26.0	99,419.48	12.5	-106,681.28	-50.89
Other agriculture						
Activities	2,129.88	0.3	58,106.72	7.3	+55,976.84	+26.70
Rice	344,957.56	43.5	353,883.52	44.7	+8,925.96	+4.26
Miscellaneous area	97,285.24	12.3	84,631.96	10.7	-12,653.28	-6.04
Cassava	99,502.12	12.6	12,341.16	1.6	-87,160.96	-41.58
Vegetables	3,144.16	0.4	-	0.0	-3,144.16	-1.50
Water source	24,453.48	3.1	44,455.08	5.6	+20,001.6	+9.54
Sugarcane	874.24	0.1	3,639.96	0.5	+2,765.72	+1.32
Corn	-	-	3,019.04	0.4	+3,019.04	+1.44
Watermelon	-	-	1,196.6	0.2	+1,196.6	+0.57
Rubber tree	-	-	105,215.52	13.3	+105,215.52	+50.19
Total	792,446.12	100	792,446.12	100.0	-	-

(87,160.96 acres), miscellaneous area (12,653.28 acres) and vegetables area (3,144.16 acres), respectively. In addition, the rubber tree area increased by 105,215.52 acres, followed by other agriculture area (55,976.84 acres), water source (20,001.6 acres), residential area (24,405.28 acres), rice farming area (8,925.96 acres) corn farming area (3,019.04 acres), sugarcane farming area (2,765.72 acres) and watermelon farming area (1,196.6 acres), respectively. The study also found that lands in the lower Songkhram River Basin were used increasingly for the rubber tree plantation by 105,215.52 acres and followed by other agriculture activity (55,976.84 acres), water source area (20,001.6 acres), residential area (24,405.28 acres), rice farming area (8,925.96 acres), corn farming area (3,019.04 acres), sugarcane farming area (2,765.72 acres) and watermelon farming area (1,196.6 acres), respectively.

Effects of land use changes on ecosystem in the lower Songkhram River Basin

Effect on soil ecosystem: Type of soil in most agricultural areas in the lower Songkhram River Basin was the flood plain soil which was full of the recent and semi and the recent alluvium. Soil texture was light and absorbed water slowly. Fertility of the floodplain soil was in a range of medium to high and was suitable for cultivation. Soil in the lower Songkhram River Basin was considered as the large container of the organic carbon. However, land reclamation for the mono-cropping caused a decreasing of organic carbon and that followed by the deterioration of soil. Most of farmers in the districts of Sri Songkram and Nathom stated that they had to reclaim the river basin area to expand the cash crops and rice farms. It was necessary for them to do the mono-cropping for more household income.

Impact on sub-ecosystems: Sub-ecosystems in the lower Songkhram River Basin have been categorized into 4 groups based on land altitude. The groups consisted of the upland ecosystem, the lowland ecosystem, the Riparian ecosystem and the aquatic ecosystem. A variety of ecosystem contributed the supporting services to the river basin. For instance, inundated forest in the river basin was used as the nursery places and shelters for aqua species. However, farmers in nearby forest have changed forest area into the rubber tree area and rice farming area. Moreover, some development projects such as constructing road and dredging up an irrigated canal in the inundated forest were also the cause of ecosystem deterioration in the lower Songkhram River Basin.

Impact on inundated forest ecosystem: Many farmers in Sri Songkram district and Nathom district believed that forest was a major cause of raining. So, they were engrossed in conserve trees and forests. The conservation was conducted through a belief of "Don Pu Ta" community forest. Villagers nearby believed that this community forest was a host of ancient spirits whose protected communities. So, villagers were afraid of forest reclamation and not to do the deforestation.

Impact on aquatic ecosystem in the river basin: In dry season, water level in Songkhram river is generally low, so, farmers always confronted a problem of polluted water. Chemical using is a major cause of polluted water in the lower Songkhram River Basin and polluted water from fishing industry was also found in some areas.

CONCLUSION

The land use changes in the lower Songkhram River Basin since, 1992-2008 covered approximately 792,446.12

acres. The land use changed area lied within the provinces of BeungKan, Nakhon Phanom and Sakon Nakorn. Research results found that most of the changes in the river basin got involve in agriculture activity which most of the change was for rice farming while making the fish pond was a smallest change happened in the river basin. Comparing the land use changes in 1992 and 2008 found that forest area decreased the most by 106,681.28 acres (50.89%) while the rubber tree area was expanded the most by 105,215.52 acres (50.19%). The driving factors which caused of the land use changes for agricultural purpose have been identified included agriculture policy by the government that promoted the plantation of the mono-crop such as rubber tree, sugarcane and cassava, the expansion of the mono-crop farm area in the lower Songkhram River Basin, the rubber tree promotion policy and reclamation of industry sector in the lower Songkhram River Basin.

Effects on ecosystem in the lower Songkhram River Basin: Positive effects included the regulating service of soil ecosystem. The ecosystem maintained the carbon in soil. The carbon was a crucial resource that nourished the fertility of ecosystem. Fertility and diversity of ecosystem services in the lower Songkhram River Basin provided positive effects to ecosystems in other river basins, a benefit of forest in case of being a source of water for agriculture activity in the river basin. Negative impacts included the decreasing of forest area caused the loss of the carbon in soil, chemical using was a cause of ecosystem deterioration, the nursery places in the inundated forest was decreased since the reclamation of the forest for agricultural purpose. The land use change in the lower Songkhram River Basin reflected to driving factors which provided effects to the change of ecosystem in the river basin. The changes occurred are able to provide both positive services and negative services (disservices) to ecosystem.

A result of the disservices of ecosystem in the lower Songkhram River Basin was supported by an economical study by Zhang *et al.* (2007) which defined term of disservices as “Externalities”. In addition, an increasing of the mono-crop area played an important cause of ecosystem deterioration. Chemicals were used hardly in the mono-cropping and provided direct effect to soil condition and indirect effect to ecosystem and farmer themselves (Aimpan, 1988). This can be concluded that effects occurred from the land use change was caused by human particularly.

SUGGESTIONS

The study of ecosystem should be conducted covering all path of the Songkhram River Basin in order to develop proper guideline of natural resource management which affects to socio-economical perspective and environmental perspective. In addition, results from this research would be acknowledged to person related to the land use issue in government sector and public sector to find out the best guideline of ecosystem protection.

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