IS OIL PALM AGRICULTURE EXPANSION REALLY RESTRICTED TO PRE-EXISTING CROPLAND?

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KEY WORDS: Land use change, Oil palm, Para rubber, GIS, Agricultural sustainability, Government policy

Abstract: Sustainable land use is vital for sustainable agricultural development. For years 2004-2029, the Thai government policy has promoted biodiesel as a renewable energy from the production of oil palm with an aim to increasing the plantation area to 10 million rai by 2029. Potential areas of oil palm cultivation are located in the south of Thailand. The aim of this study was to monitor oil palm agriculture expansion in Phang-Nga province before and after the policy set up using geographic information system. Results show that cultivation area was increased from 42,136 rai to 115,767 rai during 2000-2009. The areas to which the new plantings were expanded were para rubber plantation (62,726 rai; 54%), other agricultures (16,229 rai; 14%), evergreen forest (8,417 rai; 7%), and others (6,944 rai; 5%). Our findings indicate that a majority of the expansion has been restricted to the pre-existing croplands. Nevertheless, a further study is needed to investigate the invasion of the forest on which the policy-makers should pay attention. Continuous monitoring of agriculture land use change in this area is essential for sustainable management of the land resources.

INTRODUCTION

Sustainable development is an important issue that includes social-economic, environmental and cultural responsible. The success of achieving sustainable development depends on a decision-making about sustainable agriculture and resources management.

In the time of the shortage energy resources worldwide, oil palms are one of alternative energy sources to generate the renewable energy, fuels, and biodegradable products. Global production of palm oil and oil palm plantation have been increasing tremendously (Colchester et al., 2011). Indonesia has been the world's largest producer since 2009, supplying approximately 50% of world palm oil volume, followed by Malaysia (38.8%) and Thailand (2.9%). As the results, oil palm is a valuable economic crop and provides a major source of employment. In contrast, oil palm production is a cause of substantial and often irreversible damage to the natural environment. Its impacts include deforestation and habitat losses of critically endangered species (Brown and Jacobson, 2005). Large areas of already threatened tropical rainforest have often been cleared to make way for palm oil plantations, especially in the Southeast Asia (Carrere, 2006).

In Thailand, oil palm plantation area has been expended continuously due mainly to the government policy focusing on supporting additional production of bio-diesel within the program of promoting renewable energy. Thus, the government aims to increasing oil palm plantation area throughout the country by adding more than 400,000 rai every year in order to reach 10 million rai in 2029 (Bandita, 2007). Such agriculture development in conjunction with environmental protection is needed for being strengthen the stability of the available land use while maximizing the benefits.

This study aimed to monitor oil palm agriculture expansion in Phang-Nga province, southern Thailand, before and after the policy set up between 2000 and 2009 using Geographical Information Systems (GIS). Monitoring land use change in this area is necessary to ensure the sustainable agricultural development coupled with no or minimal detrimental impacts on environment and biodiversity.

METHODS

Study area

Phang-Nga province is located on the coast of the Andaman Sea and has many islands of the Phang-Nga Bay. It covers an area of approximately 4,170 square kilometers (Figure 1). The terrain is covered prominently by mountains and forests combined with para rubber plantations. There are only two seasons, the summer from January to April, and the rainy season from May to December. Phang-Nga province is famous on the natural beauty of beaches, islands, mountains and forests. The major sources of population income are tourism, fishing, and agricultures (Thanawood et al., 2006).

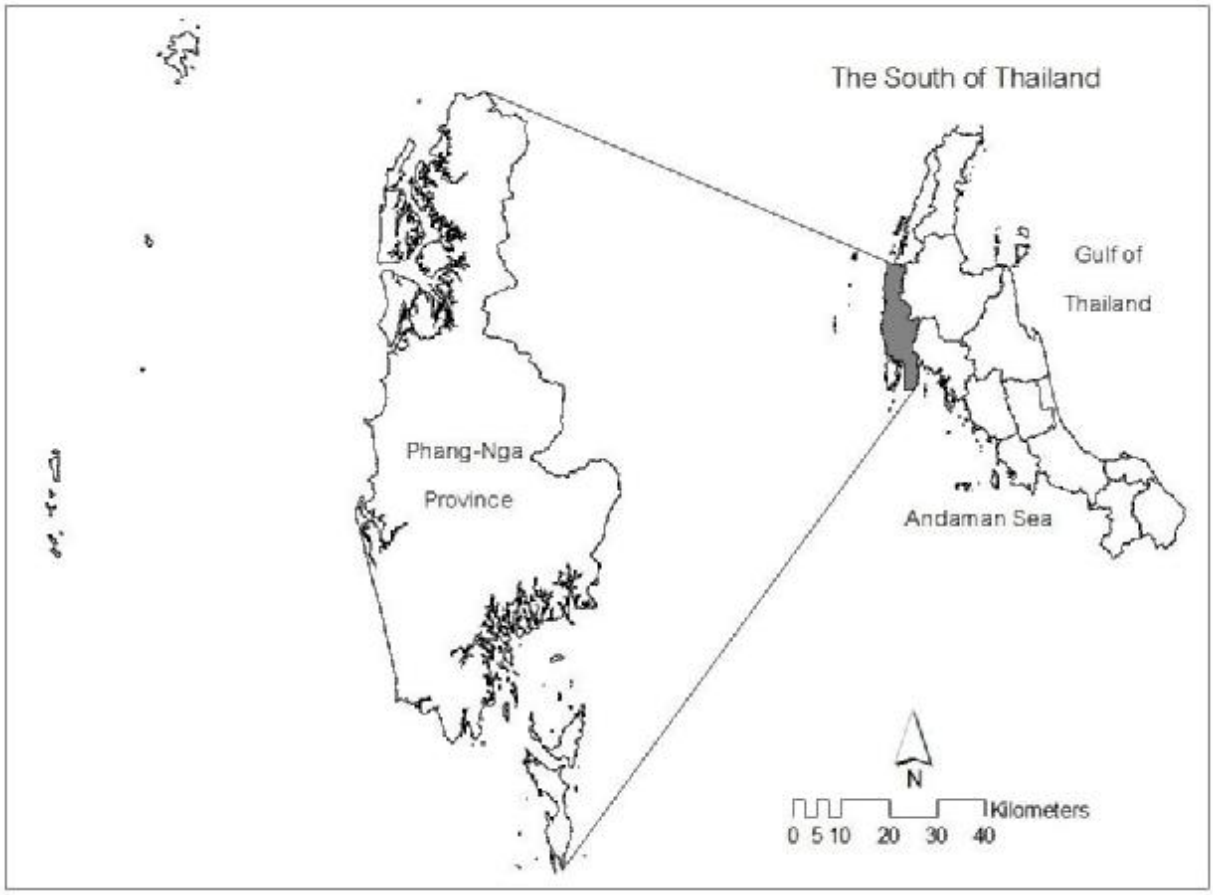

Figure 1: Study area of Phang-Nga province, southern Thailand.

Land use classification

Land use maps in 2000 and 2009 were obtained from the Land Development Department, Ministry of Agriculture and Cooperatives of Thailand. The original maps were classified into 3 levels; the first level of five categories, including agriculture, forest, water body, urban and others; the second level of 18 (in 2000) and 22 (in 2009) categories; and the third level of 79 (in 2000) and 96 (in 2009). We reclassified land use types into eight categories with a focus on agricultural expansion detection. These categories were oil palm, para rubber, other agricultures, evergreen forest, mangrove forest, water body, urban and others. We applied the GIS technique to detect land use changes by comparing land use types in different time periods.

RESULTS

Land use change

Figure 2 shows classifications of land use mapping for Phang-Nga province in 2000 and 2009**.** Para rubber plantation has remained the dominant type of agricultural land use with a decreasing area of 1,489 rai (37% of the

total area) in 2000 to 1,216 rai (30%) in 2009 (Table 1). Water body, oil palm and urban area increased approximately by 22%, 17%, 10%, respectively, whereas evergreen forest slightly decreased over the study periods.

Table 1: Land use changes of Phang-Nga Province between 2000 and 2009. A minus sign indicates a decrease in land use areas during the study periods.

Land use type	2000		2009		Variation		(%) variaton
	Sq km	Rai	Sq km	Rai	Sq km	Rai	
Oil palm	67.42	42,136.23	185.22	115,766.87	117.80	73,630.64	17.01
Para rubber	1,489.73	931,080.43	1,216.81	760,503.00	-272.91	-170,577.43	-39.42
Other agricultures	232.74	145,464.99	196.00	122,490.91	-36.75	-22,974.08	-5.30
Evergreen forest	1,555.16	971,974.84	1,526.30	953,938.56	-28.86	-18,036.28	-4.16
Mangrove forest	405.01	253,130.65	412.45	257,784.68	7.44	4,654.03	1.07
Water body	5.71	3,567.95	154.69	96,679.84	148.98	93,111.89	21.52
Urban	44.46	27,789.07	116.35	72,733.35	71.89	44,944.28	10.38
Others	196.87	123,042.75	189.28	118,289.72	-7.59	-4,753.03	-1.09
Total area	3,997.10	2,498,186.94	3,997.10	2,498,186.94	692.22	875.89	100.00

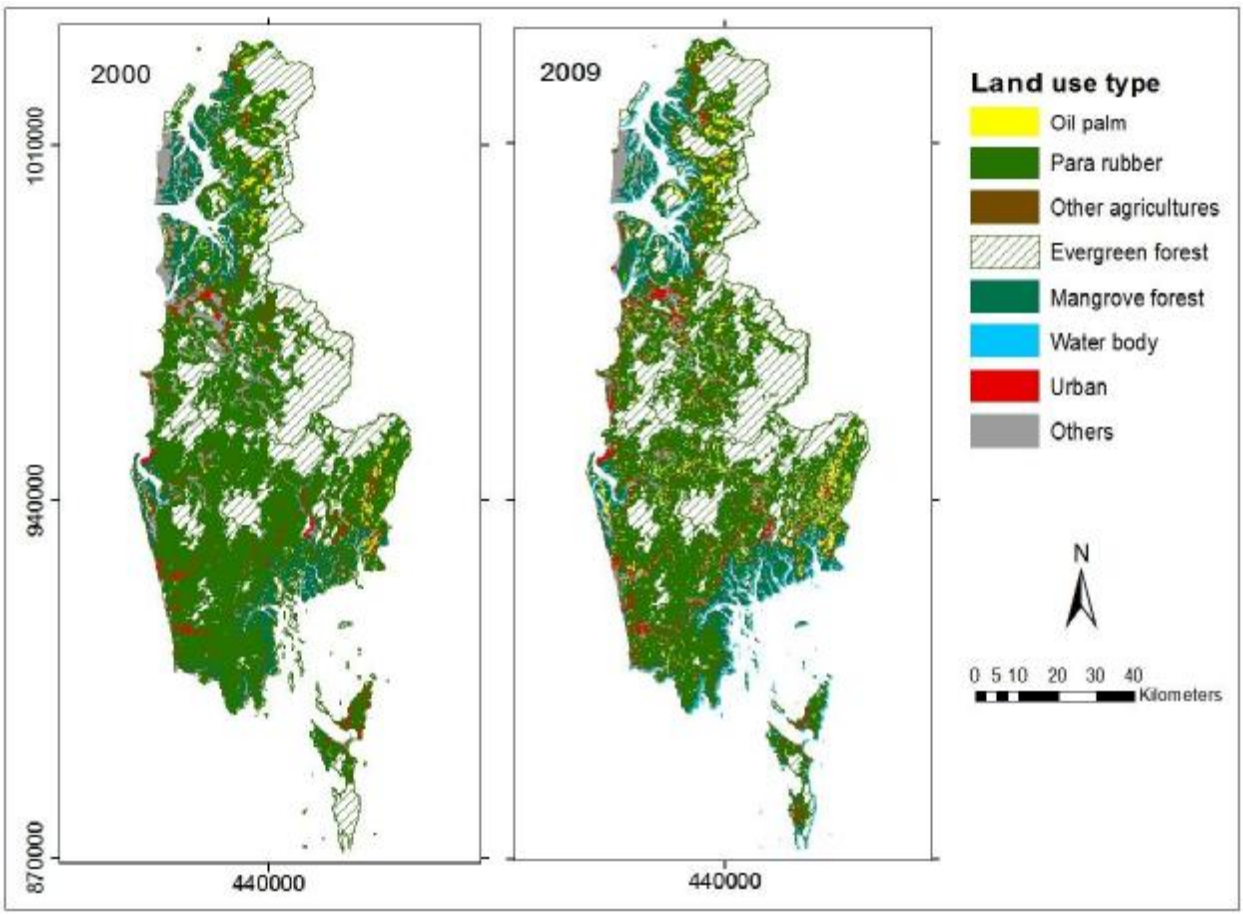

Figure 2: Maps of land use classification of Phang-Nga province in 2000 and 2009. For a clearer visualization, small islands were excluded from the maps because their land uses were not significantly changed.

Oil palm agriculture expansion

Oil palm cultivation areas were increased approximately by three-fold, from 42,136 rai to 115,766 rai, within ten years (Table 2). Oil palm expansion was mainly converted from the para rubber plantation (62,726 rai; 54% of the total oil palm area) and other plantations (16,229 rai; 14%).

Deforestation

Evergreen forest was lost about 18,000 rai, accounting for 4% of total forest cover (Table 2). Our findings indicated that the reduction was not due to forest encroachment for the oil palm expansion. In fact, the decreasing forest was converted to para rubber agricultures (81,442 rai) and water body (43,987 rai).

Table 2: Change detections for an increase in oil palm agriculture and a decline in evergreen forest of Phang-Nga province during 2000-2009**.** Major land use types in 2009 that were transformed to oil palm land are indicated in **bold** and major land use types in 2009 to which forest were converted are shown in *italic*.

Land use type	Oil palm agriculture			Evergreen forest		
	Sq km	Rai	%	Sq km	Rai	%
Oil palm	**29.60**	**18,501.60**	**15.98**	13.47	8417.35	0.87
Para rubber	**100.36**	**62,726.20**	**54.18**	*130.31*	*81442.56*	*8.38*
Other agricultures	**25.96**	**16,229.96**	**14.19**	18.82	11766.34	1.21
Evergreen forest	13.46	8,417.35	7.27	*1259.38*	*787112.89*	*80.98*
Mangrove forest	1.91	1,197.51	1.03	43.15	26971.05	2.77
Water body	0.71	445.48	0.38	*70.38*	*43987.71*	*4.53*
Urban	2.28	1,428.67	1.23	3.94	2466.55	0.25
Others	10.94	6,820.1	5.89	15.70	9807.87	1.01
Total areas	185.22	115,766.87	100.00	1555.14	971972.33	100.00

DISCUSSION

Obvious deforestation in Malaysia (20% of the total forest area) and Indonesia (30%) has resulted from clearing lowland rainforest for oil palm plantations (Wicke et al., 2011), subsequently significant carbon emissions (Tanrivermis, 2003), environmental damage and tremendous loss of biodiversity. For example, the primary forests in Malaysia have nearly 80 mammal species, just over 30 in disturbed forests, and only 11 or 12 in oil palm plantations. A similar loss in variety occurs for insects, birds, reptiles and soil microorganisms. In Indonesia, orangutans are unable to adapt to conversion of forest to oil palm plantations and therefore increasing in a significant poaching of orangutans for food, pet trade, and traditional medicines (Casson, 2003; Fitzherbert et al., 2006). In Peninsular Malaysia, oil palm agriculture development reduces the habitat for most forest bird species (Peh et al., 2005). Unlike the two countries, Europe and the United States of America have managed an expansion of oil palm with sustainability development standards for preventing forest encroachment and biodiversity reduction (Fitzherbert et al., 2008).

In Thailand, areas planted with oil palm have been increasing constantly. Such expansion has primarily been driven by agricultural and economic development policies. The Thai government policy has promoted biodiesel as a renewable energy source from the production of oil palm with an aim to increasing the plantation area to 10 million rai by 2029 (Bandita, 2007). The government has encouraged farmers to expand oil palm areas strictly to pre-existing croplands, including abandon paddy fields and old para rubber plantation with very low latex production. Many studies by Colchester et al., (1994), Witt et al., (2005), Aratrakorn et al., (2006) and Turner et al., (2011) have indicated that Thailand has a better management practices than Indonesia and Malaysia in terms of sustainable agricultural development concerning a balance between cultivation expansion and natural conservation. Our findings in Phang-Nga province were similar to those studies, pointing out the expansion restricted to the pre-existing croplands. However, few studies conducted in southern Thailand has reported some evidence of forest invasion for oil palm expansion with losses of bird species, especially woodpeckers (Aratrakorn et al., 2006). Therefore, the co-operations between the government, local authorities, and farmers are necessary and essential for sustainable agricultural development in preventing future biodiversity losses in Phang-Nga province.

CONCLUSIONS & RECOMMENDATIONS

The objective of this study was mainly to apply the Geographic Information System to monitor oil palm agricultural expansion in Phang-Nga Province before (in 2000) and after (in 2009) the policy implementation for conversions of pre-existing crop lands to the oil palm expansion. A significant change in the para rubber cultivation to the oil palm agriculture was established and there was not an evidence of forest invasion. Our study concluded that agricultural development and natural resources, at this time, are balance. Continually monitoring oil palm expansion is essential to maintain such balance.

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