



The Agricultural Land Use Situation on the Periphery of the Tonle Sap Lake

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Abstract The Tonle Sap Lake and its periphery exhibit many diversified land use patterns, including fishing areas, grass fields, agricultural land and forest land. Since there have been dramatic changes in these patterns, this research was conducted to identify the dynamics of agricultural land use from 2005-2010 and to investigate the farmers' socio-economic status in the Baray and Kampong Leaeng districts of Kampong Thom and Kampong Chhnang provinces, respectively. To achieve the objectives, Spatial Analysis on Aerial Photos in 2005 and 2010, Direct Observation, Semi-structured Interviews and Structured Interviews were used. The results showed that the total agricultural land use in Zone 2 of Baray district increased from 23% in 2005 to 30% in 2010, while agricultural land in Zone 2 of Kampong Leaeng district increased from 46% in 2005 to 67% in 2010. 82.39% of total households in Baray district are farmers, while 86.19% of total households in Kampong Leaeng district are farmers, with an average of 5 members per household who rely on rice, subsidiary and industrial crops cultivations. Farming households owned an average of 2.11 ha of rice land and 0.26 ha of cropland in Baray, while in Kampong Leaeng they owned an average of 1.41 ha of rice land and 0.67 ha of cropland. On average, a household in Baray earned \$1,452/year from farming and spent on \$1,690/year daily living and agricultural production, while in Kampong Leaeng a household earned \$1,568/year and spent \$1,840/year. In conclusion, the dynamics of agricultural land use in Baray and Kampong Leaeng districts have reduced the flooded forest areas on the Tonle Sap Lake's periphery. Although farmers have tried to increase their income by extending their productive areas, their income was still found to be lower than expenses. These farmers need to access more job opportunities to support themselves and their families.

Keywords agricultural land use, Tonle Sap lake's periphery, aerial photos, spatial analysis, farmers' socio-economic status

INTRODUCTION

As the main occupation of the majority of the population in Cambodia, more than 75% of rural households rely on agriculture and its related sub-sectors (SAW, 2009). In 2009, agriculture contributed 33.5% of GDP (MAFF, 2010) and the main employment of the majority of the workforce was subsistence farming (SAW, 2009). Agriculture in Cambodia has contributed to the economic growth, poverty alleviation and job employment. Over 70% of Cambodian households are working in agricultural sectors and sub-sectors, leading to a reduction in the poverty rate from

47% in 1994 to 35% in 2004 and recently estimated at 30% in 2007. The poverty rate has been declined by 1% a year, on average (MAFF, 2010).

In 2009, there was drastic growth in the agricultural production and agriculture contributed a high share of GDP. The cultivated area for rice covered about 2.71 million ha, providing an average yield of 2.83 ton/ha, with a total production of over 7.58 million tons. Moreover, the cultivated areas for subsidiary and industrial crops covered on about 0.49 and 0.18 million ha, with total production of over 4.86 and 0.56 million tons, respectively (MAFF, 2010). The consistent growth of agricultural sector in 2009 was due to the decline of the construction industry sector and the services sector since 2008 from the world economic crisis (MAFF, 2010).

The combination of Cambodian population growth from 13.7 million in 2005 (NIS, 2005) to over 14.8 million in 2009 (UNDESA, 2009) together with economic growth and globalization, have resulted in high strains on natural resource, especially critical changes of land use patterns.

The periphery of the Tonle Sap Lake, the main flooded plain area for agricultural production in Cambodia, covers over 1.4 million ha in total and extends to the six provinces between the National Road 5 and 6, included Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom. The area is characterized into 3 main Zones: Zone 1, non-flooded areas which are the residential areas and the productive areas of rice and subsidiary crops; Zone 2, flooded areas which exhibit the residential areas, grass fields, forests, rice field, subsidiary and industrial crops; Zone 3, the flooded forest areas and protected areas. From 2005-2009, encroachments on the flooded forest for farming especially in Kampong Thom and Kampong Chhnang provinces led to an increase in the land used for agriculture by 34% and 40%, respectively (TSA, 2010).

The purpose of this research is to identify the dynamics of agricultural land from 2005-2010 and investigate farmer households' socio-economic status in Baray and Kampong Leaeng districts of Kampong Thom and Kampong Chhnang provinces located on the Tonle Sap Lake's periphery.

METHODOLOGY

Due to the limited time and the accessibility of the Aerial Photos, the research was conducted only in Zone 2 of Baray and Kampong Leaeng districts from May to November 2010. The Interpretation of the Aerial Photos in 2005 and 2010 was done using ArcGIS 9.3 to map the agricultural land use in 2005 and 2010 and the changes between the years. Then, Direct Observation was done to verify between the real situation of agricultural land use and the digitized maps, including GPS marking for any unclear interpretation. Moreover, Semi-structured Interviews were conducted with 21 key informants using a checklist to obtain some basic information about the dynamics of agricultural land use and general information about the farmer households' socio-economic situation in the studied areas. Lastly, the Structured Interviews were done randomly with 25 farmer households from Baray district and another 25 households from Kampong Leaeng district. The interviews used a questionnaire to obtain more information on the real situation of the farmer households' livelihood, agricultural activities, agricultural income and expense, housing condition, financial resource, the access to infrastructure development, education and health care, and some problem affect to their livelihood. All the data from the surveys, both qualitative and quantitative data, were stored and analyzed using simple descriptive statistics in Microsoft Office Excel 2007.

RESULTS AND DISCUSSION

Agricultural land use in Baray district

The result of the Aerial Photos Interpretation in Zone 2 of Baray district showed that the total land area in the Zone 2 is 35,380.67 ha and their land use patterns in 2005 included burned forests, forest, free land, grass field, industrial crops, rice fields, subsidiary crops, settlement areas and water. The land use patterns categorized into agricultural land use are rice fields, industrial crops and subsidiary crops. These totaled 8,075.52 ha in 2005. Among these uses, rice fields covered the most at 22.01%, while subsidiary and industrial crops covered 0.51% and 0.30%, respectively. In

2010, the agricultural land increased to 10,560.10 ha with land from burned forests and grass fields. Rice field increased by 30.36% and subsidiary crops and industrial crops by 25.12% and 70.09%, respectively, compared to the areas in 2005 (Table 1). Furthermore, among the increased areas, all of the burned forest was converted to rice fields and the grass fields were mostly changed to rice fields and partially to subsidiary and industrial crops (Table 2).

Table 1 Agricultural land use in Zone 2 of Baray district in 2005 and 2010

Land use patterns	2005		2010		Changed area (ha)	Growth's percent (%)
	Area (ha)	Percent (%)	Area (ha)	Percent (%)		
Rice Field	7,788.48	22.01	10,152.78	28.69	2,364.30	30.36
Subsidiary Crops	179.90	0.51	225.09	0.64	45.19	25.12
Industrial Crops	107.14	0.30	182.23	0.52	75.09	70.09
Total	8,075.52	22.82	10,560.10	29.85	2,484.58	30.77

Table 2 The decrease and increase of land use patterns in Zone 2 of Baray district

Increased land use types	Decreased Grass Field		Decreased Burned Forest		Total (ha)	Percent (%)
	Area (ha)	Percent (%)	Area (ha)	Percent (%)		
Rice Field	2,187.98	94.79	176.32	100	2,364.30	95.16
Subsidiary Crops	45.19	1.96	0	0	45.19	1.82
Industrial Crops	75.09	3.25	0	0	75.09	3.02
Total	2,308.26	100	176.32	100	2,484.58	100.00

Agricultural land use in Kampong Leang district

The total area in Zone 2 of Kampong Leang district is 29,562.40 ha and their land use patterns included burned forests, cleared forests, fruits, forest, grass fields, industrial crops, rice fields, subsidiary crops, settlement areas, water, and flooded grass and forests. In 2005, the total agricultural land was 13,700.54 ha among which 31.51% were rice field, while subsidiary crops and industrial crops were 14.30% and 0.53%, respectively. In 2010, the agricultural land increased to 19,776.93 ha, with rice fields increasing by 22.63% and subsidiary crops and industrial crops by 80.60% and 359.29%, respectively, compared to the areas in 2005 (Table 3). In 2010, rice field, subsidiary crops and industrial crops increased with land from burned forests, cleared forests, grass fields, some of forest, flooded grass and forest, and some areas of water. Specifically, the burned forests, cleared forests and grass fields were all changed into rice fields and subsidiary crops (Table 4).

Table 3 Agricultural land use in Zone 2 of Kampong Leang district in 2005 and 2010

Land use patterns	2005		2010		Changed area (ha)	Growth's percent (%)
	Area (ha)	Percent (%)	Area (ha)	Percent (%)		
Rice Field	9,316.43	31.51	11,425.13	38.65	2,108.70	22.63
Subsidiary Crops	4,226.68	14.30	7,633.46	25.82	3,406.77	80.60
Industrial Crops	157.43	0.53	718.34	2.43	560.91	356.29
Total	13,700.54	46.34	19,776.93	66.90	6,076.38	44.35

Table 4 Changed categories of agricultural land use in Zone 2 of Kampong Leang district

Decreased land use types	Increased rice field		Increased subsidiary crops		Increased industrial crops		Total (ha)	Percent (%)
	Area (ha)	%	Area (ha)	%	Area (ha)	%		
Burned Forest	1.14	0.05	0.00	0.00	0.00	0.00	1.14	0.02
Cleared Forest	101.30	4.80	3.60	0.11	0.00	0.00	104.90	1.73
Forest	975.23	46.25	1,406.45	41.28	83.95	14.97	2,465.63	40.58
Grass Field	736.35	34.92	222.12	6.52	0.00	0.00	958.47	15.77
Water	294.68	13.98	743.77	21.83	476.96	85.03	1,515.41	24.94
Flooded Grass & Forest	0.00	0.00	1,030.83	30.26	0.00	0.00	1,030.83	16.96
Total	2,108.70	100.00	3,406.77	100.00	560.91	100.00	6,076.38	100.00