



Land / Forest Use and Trends Analysis

Fostering Evidence-based IWRM in Stung Pursat Catchment
(Tonle Sap Great Lake)

December 2013

Prepared for:

Mekong Basin Leader CGIAR Challenge Program on Water and Food

**Australian
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LAND/FOREST USE AND TRENDS ANALYSIS

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1.0 INTRODUCTION

The *Land/Forest-use and Trends Analysis* report is prepared as part of the “Fostering evidence-based IWRM in the Stung Pursat Catchment (Tonle Sap Great Lake), Cambodia” project (also known as MK 16). The MK 16 is an initiative of the Challenge Program for Water and Food (CPWF), supported by funding from Australian Aid program. It is collaboratively implemented by the Ministry of Water Resources and Meteorology (MOWRAM), Tonle Sap Authority (TSA), Supreme National Economic Council (SNEC), Hatfield Consultants Partnership (HCP), and Culture and Environment Preservation Association (CEPA).

The site for this project is Stung Pursat, a sub-catchment of Tonle Sap Basin (TSB) in western Cambodia. MK 16 seeks to address and/or improve three underpinning aspects of water management: (a) cross-sectoral collaboration in the management of water resources; (b) use of data or scientific analyses to inform water management in Cambodia; and (c) institutional mechanism for inter-sectoral management, or interpretation and use of existing or new scientific data.

Land cover and land-use patterns are important to the vitality of a river system. Cambodia’s forests provide important services, like: regulating the water flow to maintain adequate water levels for supporting the aquatic ecosystem and freshwater fisheries; maintaining soil fertility; sustaining wildlife and biodiversity; and, providing a source of income through sale of timber and non-timber products, to name a few (Ashwell et al. 2011).

The *Land/Forest-use and Trends Analysis* report assesses the land cover changes occurring in the TSB and Stung Pursat, describing as well the drivers of these changes. Furthermore, the report provides an overview of how forests are governed in Cambodia, and draws some recommendations and conclusions.

2.0 LAND USE AND TRENDS IN THE TONLE SAP BASIN

2.1 LAND USE IN THE TONLE SAP BASIN

The flow, quality and quantity of water in the Tonle Sap Lake are influenced by forests and land use patterns. Cambodian forests belong to the Indo-Burma hotspot, an area rich in biodiversity (Ang et al. 2010). Forest types include evergreen, semi-evergreen, deciduous, swamp, mangrove and bamboo forests. Moreover, the Tonle Sap Lake floodplains support unique, seasonally-inundated forests (Ang et al. 2010).

The freshwater fishery of the Tonle Sap ranks fourth globally, and the seasonal flooding of the Tonle Sap water produces the most fertile land for agriculture in Cambodia. In fact, ancient Khmer technology developed during Angkorian period (13th century) is believed to have yielded four rice harvests per year on this land (Roudy 2002).

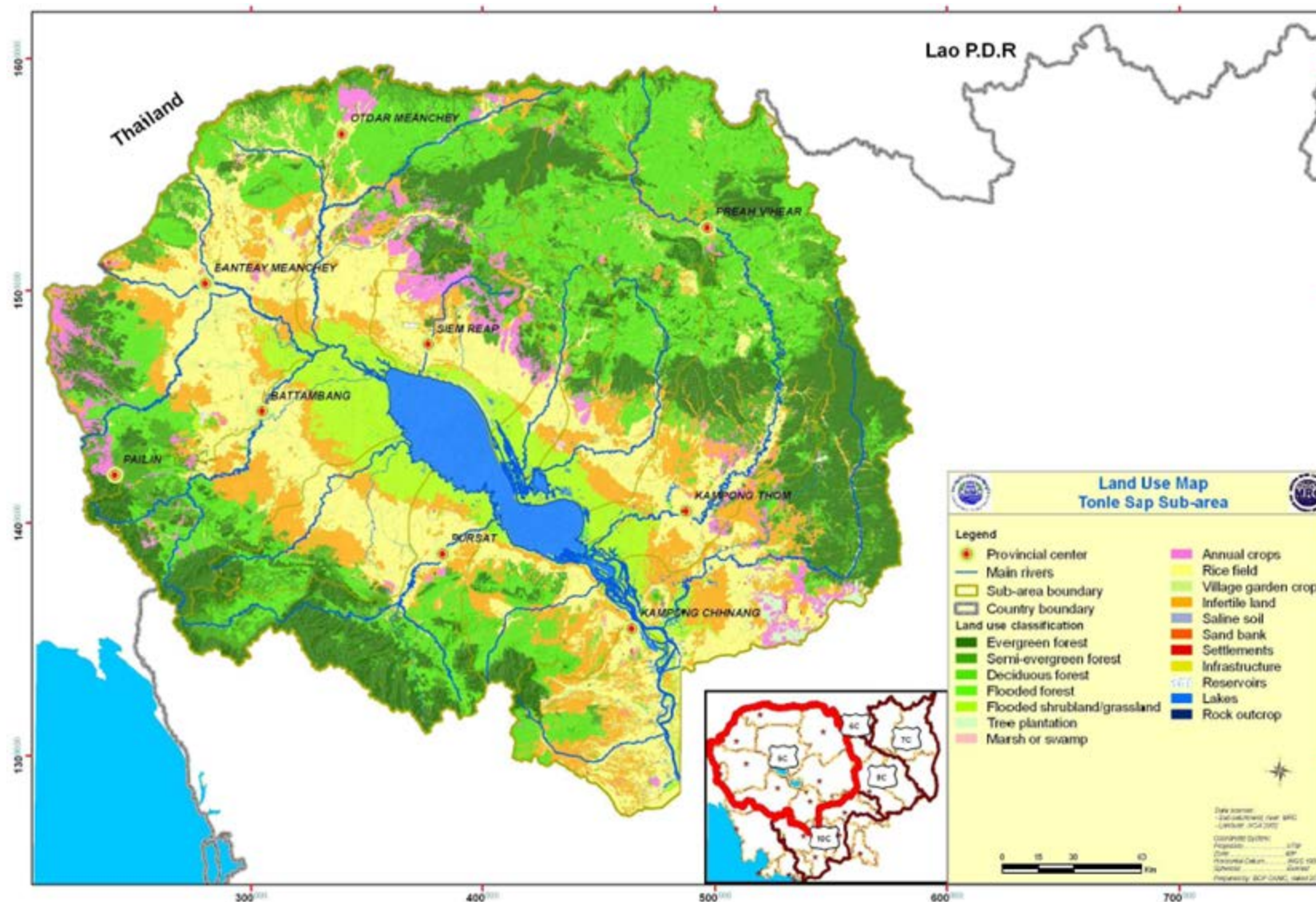
The map in Figure 1 shows land use in 2011 for the 12 tributaries and associated watersheds of the Tonle Sap sub-area¹, including Stung Pursat. The area of land use and major ecosystem types reported for the Tonle Sap sub-area is provided in Table 1.

Table 1 Land use and major ecosystems in the Tonle Sap sub-area (CNMC 2011).

	Land Use and Major Ecosystems	Size (hectares)	Percent of Total Tonle Sap Sub-area
1.	Agriculture - rice, annual cash crops, perennial crops, and village garden crops	1,035,254	12.7%
2.	Aquatic ecosystem - flooded forest, flooded shrubland or grassland, rivers, streams, lakes, and reservoirs	2,081,276	25.5%
3.	Barren land	1,085,518	13.3%
4.	Forest and natural vegetation - evergreen, semi-evergreen, and deciduous Forests	3,965,016	48.5%
5.	Urban	9,249	0.1

¹ In the CNMC (2011) report, the Tonle Sap sub-area is identified as Sub-area 9C (SA-9C) in the Sub-area Delineation (MRC-BDP 2004). This covers a total area of 81,763 km² which is the whole catchment of the Tonle Sap Great Lake.

Figure 1 Land use in the Tonle Sap sub-area (CNMC 2011).



2.2 LAND USE CHANGE IN THE TONLE SAP BASIN

Watershed health is very closely related to land cover and land use change. In the Tonle Sap region, land use is showing rapid change due to a number of factors, including: economic and mining land concessions; logging; governance of natural resources; agricultural expansion; and informal settlements (CNMC 2011). These changes have a profound impact on the ecosystem and the people in the region. A recent study conducted for the USAID HARVEST project posits that the most important driver of community vulnerability and ecosystem instability is deforestation of the upper catchment areas within the 12 watersheds (including Stung Pursat) that drain the region and the flooded forests of the Tonle Sap Lake.

In the TSB, the rate of deforestation is higher than the national rate. A study titled *Land Use/Land Cover Change Detection of Tonle Sap Watershed, Cambodia*, found that the rate of deforestation from 1990 to 2009 in the TSB was 2.26% (Senevirathne et al. n.d.). The study was prepared using Landsat TM and ALOS AVNIR-2 data to identify changes in land cover and land use in the TSB. The report shows that between 1990 and 2009, forest cover decreased in the TSB by 43% (from 20,170 km² to 11,436 km²). The change in forest cover is equal to 15% of the total area of the basin.

Some of these changes in forest and vegetation are due to growth in agricultural land use and other economic activities such as plantation and urban growth. Between 1999 and 2009, there have been significant conversions of land for economic and agricultural purposes (CNMC 2011).

Table 2 Agricultural expansion in the Tonle Sap basin.

Activities	Area in 1999 (ha)	Area in 2009 (ha)	Expansion Rate
Wet season rice	1,019,310	1,172,535	1.3%
Dry season rice	45,466	68,647	3.4%
Non-rice crops (annual cash crops, vegetables, fruit trees)	132,942	247,340	4.6%
Net Agriculture	1.2 million ha	1.5 million ha	2.0%

Table 3 Land concessions in the Tonle Sap basin.

	Economic Concessions	Mining Concessions
Area (ha)	432,420	486,900
Ownership	18 companies are granted 70-years contracting period each	28 companies own mine sites that can range from 30 km ² to 400 km ²
Activities	Land acquired is mainly used for agricultural development. Activities include plantation of agro-industrial crops, like rubber, sugarcane, acacia, eucalyptus, cashew, and other trees.	Gold and metal are one of the main commodities of SA-9C mineral resources. Only mining for construction materials is currently considered legal; metal and nonmetal mineral resources are not legally exploited in the SA-9C.
Total Area in Land Concession	919,320 ha 11.2% of the total Tonle Sap sub-area	

Studies show a number of trends about land use changes in the basin. Table 2 above suggests that economic factors are driving land use changes in the TSB at a much greater rate than demographic factors. While the land used for wet season rice (the dominant agricultural activity of individual farmers) and dry season rice is more extensive than the land for non-rice crops, the growth rate of the latter outpaces the former two. This change can in part be explained by the coming of agro-industries in the TSB. Each of the 18 companies benefiting from economic land concessions have a contracting period for 70 years, and therefore, will play a major role in agricultural growth in the region.

Mining concessions have been provided to 28 companies to conduct exploration for metal and nonmetal mineral resources. Some of these concessions may develop into operating mines in the future. The environmental and social impacts of mining operations can be significant and must be monitored. In particular, mining development needs to ensure that issues related to community resettlement, livelihoods, and potential impacts on water and aquatic resources, air quality, and biodiversity are addressed.

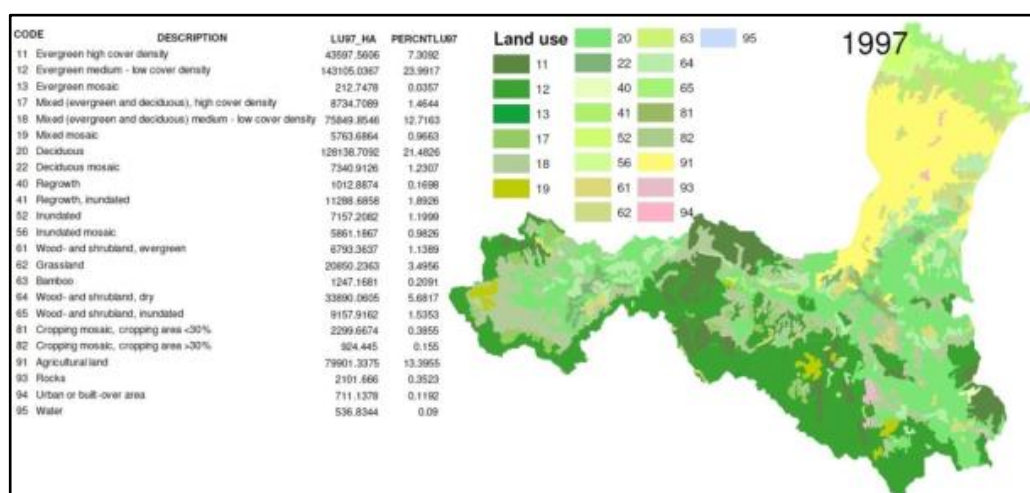
3.0 PREVIOUS WORK ON LAND USE CHANGE IN PURSAT PROVINCE

3.1 THE STUNG PURSAT – SITE FOR MK 16

Situated in western Cambodia, Pursat province occupies 12,692 km² of land area. The Stung Pursat watershed is 2,423 km² and forms part of the TSB (Sovannora n.d.).

The Stung Pursat (or Pursat River) is one of 12 perennial rivers contributing flow to the Tonle Sap Great Lake. The river drains the Cardamom Range in the west before passing through a diverse and complex landscape. The Cardamom Mountains, with a maximum elevation of 1,717 m, experience the highest rainfall in Cambodia (3,000 mm to more than 5,000 mm per annum) and constitute one of the largest and most biologically diverse intact forest landscapes in mainland Southeast Asia (Ashwell et al. 2011). Stung Pursat a catchment discharges an average of 2,818 Million m³ a year into the Great Lake along its western shore (JICA 2011).

Figure 2 Forest cover of the Stung Pursat catchment (Source: MRC forest covers from years 1993 to 1997).



In 2006, a study conducted by JICA found forests and natural vegetation covered over 73% of the province, specifically 438,641 ha. The distribution between deciduous, evergreen and semi-evergreen forests were 130,830 ha, 238,478 ha, and 69,333 ha, respectively (CNMC 2011).

3.2 PREVIOUS WORK ON LAND USE AND LAND COVER CHANGE IN PURSAT PROVINCE

Few studies have focused exclusively on the changes in land use and land cover in Pursat Province. The Mekong River Commission (MRC) investigated land use patterns in Pursat province. The MRC data catalogue holds several maps on land and forest cover in Pursat for periods 1985 to 1987 and 1992 to 1993. These maps were produced over the course of various projects.

As would be expected, some of the mapping covering Stung Pursat has been conducted as part of studies covering the entire Tonle Sap sub-area. The CNMC (2011) report presents some of the changes in Stung Pursat. Agriculture land is reported to have expanded at an estimated rate of 1.4% per year in the last ten years – slightly lower than the rate for the Tonle Sap Sub-area - from 39,979 ha in 1999 to 42,301 ha in 2004 and 46,329 in ha in 2009. Unlike the Tonle Sap sub-area, the maximum growth between 1999 and 2009 in Stung Pursat was seen in dry season rice crops (3.0%), slightly above the growth of non-rice crops (2.8%). However, the growth in wet season rice crops was consistent in Stung Pursat with that in the entire sub-area, amounting to 1.3%. These numbers suggest that agriculture is not only expanding, but evolving in both Stung Pursat and the greater Tonle Sap sub-area. Agricultural activities now include more non-rice crops, especially cash crops, alluding to a shift from traditional, subsistence agriculture.

This change in agricultural practices can be explained by a number of factors, some of which will be discussed during the multi-stakeholder platforms of the MK 16 project. At this stage, a number of drivers of land use change in Pursat can be conjectured.

1. Growth in agro-industries – Studies indicate that by 2009, over 24% of the provincial land was allocated to private agriculture and mining companies. Phea Phimex Co Ltd. operates a tree (Eucalyptus) plantation and paper factory in Stung Kraing Ponley, Stung Baribo, and Stung Pursat, consuming a total land area of 315,028 ha;
2. Ongoing research by the Cambodia Development Research Institute, about climate change and water governance in the TSB (focusing on Pursat and two other provinces), suggests that environmental factors, like climate change, are exerting pressure on the availability of natural resources, like water, and therefore are demanding a change in people's livelihood strategies. People may be autonomously adapting to these stresses by changing their crop cycle, and diversifying their crops and income-generation strategies;

3. Infrastructural development, like dams, might result in relocation and associated changes in livelihood strategies as people may no longer have access to land, water or soil required to continue growing the same crops as they had; and
4. Economic growth, as a result of the arrival of mining and agricultural industries, may be creating new employment opportunities for people.

Like economic concessions, mining concessions are also affecting land use patterns in Stung Pursat. The province hosts Din Xin Mining (Cambodia) Co., which extracts metal and Future Environment, which extracts gold. These companies take up relative small land areas of 123 km² and 262 km² of land, respectively. However, as mentioned in Section 2.0, the potential impacts of mining are not only related to the footprint of the mining operation itself.

4.0 DRIVERS OF LAND COVER AND LAND USE CHANGES

The recent study by USAID's HARVEST project (Ashwell et al. 2011) documents that the most important driver of community vulnerability and ecosystem instability is the deforestation of the upper catchment areas within the 12 watersheds that drain the Tonle Sap along with the flooded forests of the Tonle Sap Lake. Deforestation of steep slopes can increase flood risk in the wet season and may contribute to fluctuations in dry season water flows and groundwater availability. These changes potentially impact the livelihoods of millions of people dependent on agriculture and fisheries for food production, and increase their vulnerability to climate change (Ashwell et al. 2011).

The results of a similar research in the nearby Stung Chrey Bak, Kompong Chhnang provinces, indicate that land use and land cover has changed considerably over the last two decades across their study site (CDRI 2011). Fragmentation and a decline in the quality of evergreen forest have occurred in the upper catchment. The steady decline of remaining secondary forest in the midstream and in some upstream areas is a result of logging, charcoal production, potential reservoir inundation, and commercial agriculture (large scale plantations). The implications of such changes must be taken into consideration when attempting to achieve sustainable catchment management objectives. Various actors that have contributed to land-use and land-cover changes across the catchment need to be considered in the development of management plans.

4.1 A HISTORICAL OVERVIEW

To monitor change in land cover, the Cambodian Forestry Administration conducted a series of assessments in 1993, 1997, 2000, and 2006. Studies suggest that the area of forest cover has changed noticeably. For example, forest cover increased to 61.15% in 2002 from 58.60% in 1993, whereas in 2006 this number dropped again (FA 2010). Approximately 29% of Cambodia's forests are located within three kilometers of a village or one kilometer of a road (or some other vehicle track); this accessibility makes them vulnerable to over-exploitation (Ashwell et al. 2011). Based on land cover data, studies show different rates of change in forest cover. One estimate for the time period 1997-2002 is a 1.0% loss (Amariei 2004), and another study estimates 0.5% loss between 2002-2005/06 (FA 2010).

Land use has changed significantly over the last 40 years, even considering the relatively little economic growth in the 1980s, as compared to other southeast Asian countries (Ashwell et al. 2011). Forests were managed differently before the Khmer Rouge period. Forests were designated for production, conservations, wildlife and research purposes with stronger institutional controls (Ang et al. 2010). In a study conducted in March 1999 in Pursat, local communities shared how forests were managed and used at the time (Sovannora n.d.):

“People dared not cut trees for fear of being fined. To build a house they needed permission from the provincial forestry office in Leach. In the dry season some local people worked as forestry staff employed by forest concessions and traditionally paid respect to big old trees by building a small spirit house and by not cutting the trees.”

However, this system of forest management was obliterated during the Khmer Rouge. Forest degradation and decline reached heights in the 1990s, because of legal and illegal logging, weak law enforcement and land management practices, forest fires, land-grabbing, and other reasons (Ang et al. 2010; ARD and Chanthy 2006). Between 1994 and 1997, the government granted 36 forestry concessions, equaling 70% of the forest cover in Cambodia (7 million hectares) (Ang et al. 2010).

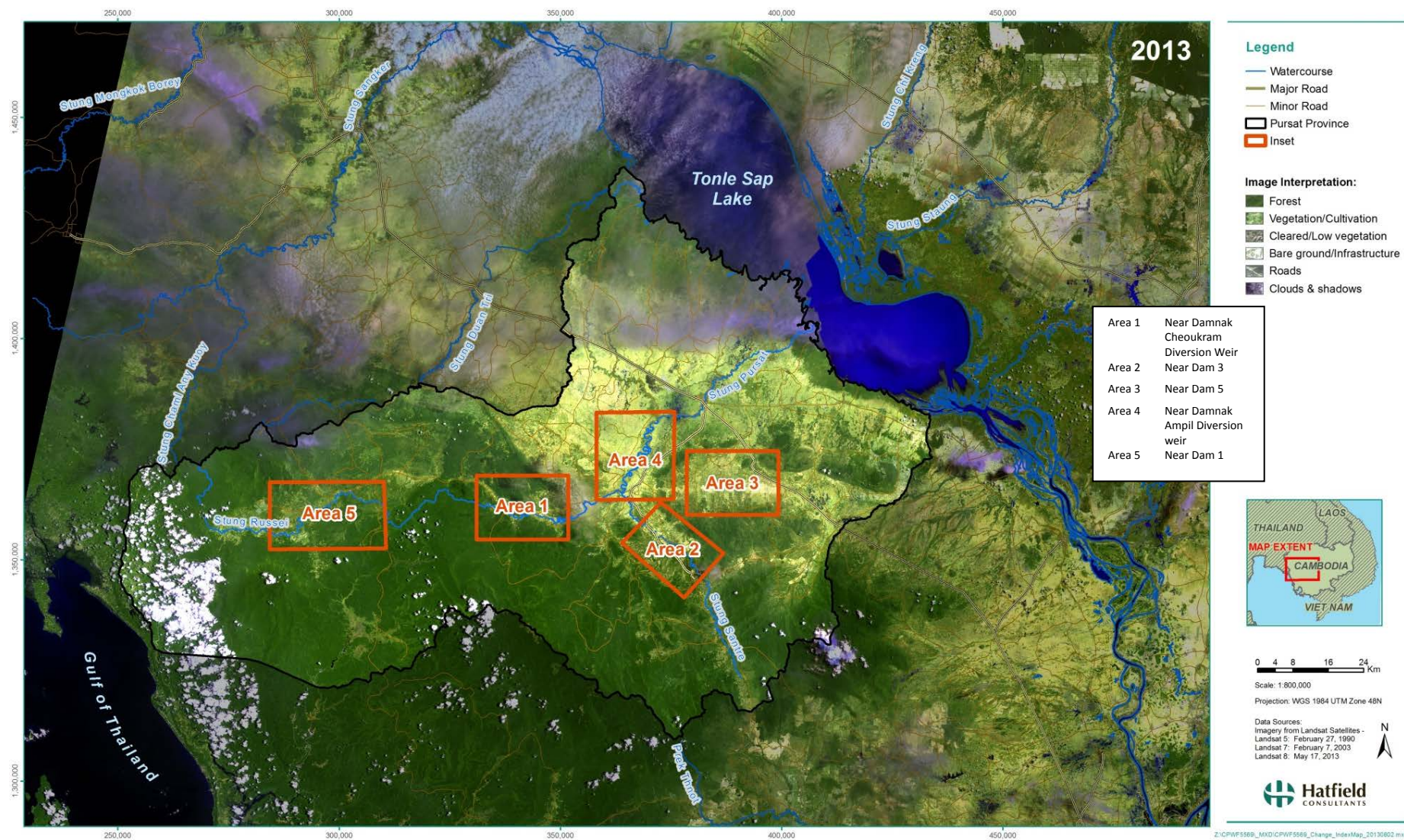
To address forest management issues, the government introduced reforms in early 2000s. Forest concessions were suspended through a logging moratorium passed on January 1, 2002, alongside a number of institutional reforms in that year. To lift the hold on logging, developers had to prepare and obtain approval on strategic forest concession management plans and environmental and social impact assessments, and they had to re-negotiate concession agreements (Ang et al. 2010). Governance instruments, such as the Land Law of 2001 helped clarify and redefine land rights, ownership, administration, and management (ARD Inc. and Chanthy 2006).

5.0 SYNTHESIS ON KEY LAND USE CHANGES IN PURSAT PROVINCE

To address limited information on land use change studies in Pursat Province, the MK 16 project obtained satellite images of the area in February 1990, February 2003, and May² 2013 to observe the changes in land and forest cover in the past two decades. The Landsat images were freely obtained from the US Geological Survey’s Global Visualization service: <http://glovis.usgs.gov/>. The May 2013 image was from the new Landsat-8 satellite. Through consultations with stakeholders from MOWRAM and MIME, five sites were identified that are undergoing dam development, water diversion, and irrigation expansion. These sites are labeled in the map below.

² Due to limitations of data availability, a clear image for February could not be obtained for 2013.

Figure 3 Land use sites in Pursat.



Each of the five sites were visually assessed to make observations about land use changes between 1990, 2003, and 2013. These images can be found in Appendix A1. Land use changes are apparent in each of these five map series and they provide a good source of discussion at the second multi-stakeholder platform meeting.

Classification and ground-truthing of the images was not possible within the scope of the MK 16 project, but the maps were discussed during the second multi-stakeholder consultation workshop (MSP 2) of the MK 16 project. A number of note-worthy points were made at the workshop.

1. Decline in forest cover is clearly apparent between 1990, 2003, and 2013;
 - Near Damnak Cheoukram Diversion Weir, it is quite noticeable from the image that much of the land adjacent to the water-course has been converted to farmland, and that this cultivated area is also expanding outwards;
 - Near Dam 3, there is a noticeable expansion in the bareground area from 1990→2003→2013; and
 - Near Damnak Ampil Diversion weir, there is a noticeable change of land cover from forest to vegetation/ cultivation area (2003) and bare ground in 2013 in the western part of the image.
2. The 2013 image falls in May (beginning of rainy season), whereas the 1990 and 2003 images fall in February (middle of dry season). Therefore, some of the land use changes in 2013 can be attributed to the seasonal differences in agricultural practices and livelihood strategies of the Pursat people;
3. People agreed that forests in Pursat are important in regulating the flow and balance of water in Stung Pursat, and that they are able to provide protection from floods (flash floods);
4. People agreed that drivers of deforestation in Pursat have been land grabbing, legal and illegal logging, domestic and international demand for forest wood, demographic growth (more land and forests cleared for food production, domestic use and settlement);
5. People agreed that while the Landsat images produced by the MK 16 team were good visual depiction of the changes in land cover, ground-truthing work is required to add to and confirm these findings. This will also provide more insights about how forest cover has changed in quality and quantity; and
6. Participants mentioned that there has also been considerable degradation in the quality of forest over the years, a trend that may not be visible in the Landsat images. Many areas around Stung Pursat that were once occupied by mainly primary forests, are now predominantly covered with secondary forests.

6.0 ONGOING INITIATIVES IN THE FORESTRY SECTOR

The Royal Government of Cambodia (RGC) has undertaken a number of measures to demonstrate their commitment to protecting the country's forests. A target has been set to return forest cover to 60% of 2000 levels by 2015. In addition the Cambodian Millennium Development Goal (CMDG) for 2015 includes maintenance of forest cover, Protected Forests and Protected Areas, an increase of fishing lots and an increase of land titles (FA 2010).

In November 2004 the Technical Working Group on Forestry and Environment (TWG-F&E) was created for coordinating measures taken by government and development partners in the forestry and related sectors. The government is also finalizing the National Forestry Programme for the years 2009 to 2020, which will support forest management during this period and thereafter. Currently, the Forestry and Environment Action Plan (2007-2010) and one-year Framework Work Plans and Indicative Budgets for 2007 and 2008 are in place to guide government. The latter work plan specified 26 prioritized activities within six prioritized programmes of the NFP (FA 2010).

RGC's commitment to cracking down illegal activities is widely recognized by ASEAN countries and civil society organizations. For example, the government has made progress in reducing the rate of forest degradation in the country. The government will need cooperation from its regional countries, especially neighboring ones, in protecting its forests base (FA 2010).

7.0 RECOMMENDATIONS AND CONCLUSION

Cambodia's forests are important for effective water management as they provide essential services like regulating water flow, maintaining soil fertility, sustaining wildlife and biodiversity and providing a source of income for the poor, among others. Land use change in the Stung Pursat Basin can affect the supply of these services, and adaptations in land use management may be required.

Land use has changed considerably in the last 40 years in Cambodia, including Pursat province. Between 1965 and 2006, forest cover declined from 73% to 59% (FA 2010). This report lists a numbers of drivers of change, including agriculture expansion; logging and economic concessions; economic growth; uncontrolled timber trade; poverty and increasing number of farmers without land or with decreasing land parcels; inadequate human, financial and technical capacity for improved governance and management of forests.

RGC has set a tangible target for forest cover in the country – 60% cover by the Year 2020. Coordinated and proper forest governance can be the key to achieving this aim. The government has demonstrated commitment in this direction by: (i) introducing a number of reforms in early 2000s and the following time period to better manage the use of forests; (ii) instituting a Technical Working Group on Forestry and Environment to coordinate measures taken by the government and development partners; and (iii) making strides in catching and obstructing illegal activities.

To bolster these measures, this paper can make the following key recommendations for better management and governance of land in Pursat:

1. Coordinated governance with strong channels for communication, collaboration and integration of efforts among the various ministries and offices responsible for forest management;
2. Participation of various stakeholder in management of forestry resources, including the community and relevant social groups (CSOs and NGOs) that represent and serve the private sector;
3. Decentralization and a greater role for local authorities and the community;
4. Collaboration and coordination of efforts with relevant sectors, including water resources, agriculture, regional trade and development of forestry products;
5. Clarity over land use rights and security of land tenure for the poor;
6. Understanding the pressures faced by forests due to poor governance, poverty and economic growth in the country. Forest resources should be developed sustainably, so that they are accessible to the poor and government to meet the country's social and economic development targets, and continue to provide the country with various ecological services. This will require evaluation of current practices and a study and implementation of new and innovative approaches to meeting various development targets without reaching unhealthy rates of forest exploration (e.g., intensive vs. extensive agriculture); and
7. Greater human and financial resources are required in this sector to implement studies and measures for better monitoring and managing forests. There is also a high dependence on development partners or foreign aid to implement many conservation programs in the country. Development programs should more carefully consider how their initiatives can be maintained by the local and national authorities beyond the length of their programs.

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9.0 CLOSURE

We trust the above information meets your requirements. If you have any questions or comments, please contact the undersigned.

HATFIELD CONSULTANTS:

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Sokhem Pech
Project Manager

20 December 2013

Date

Approved by:



Grant Bruce
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20 December 2013

Date