

# Implementation of forest cover and carbon mapping in the Greater Mekong subregion and Malaysia project – A case study of Thailand

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**Abstract.** The Great Mekong Subregion (GMS) contains one of the world's largest tropical forests and plays a vital role in sustainable development and provides a range of economic, social and environmental benefits, including essential ecosystem services such as climate change mitigation and adaptation. However, the forest in this Subregion is experiencing deforestation rates at high level due to human activities. The reduction of the forest area has negative influence to the environmental and natural resources issues, particularly, more severe disasters have occurred due to global warming and the release of the greenhouse gases. Therefore, in order to conduct forest management in the Subregion efficiently, the Forest Cover and Carbon Mapping in Greater Mekong Subregion and Malaysia project was initialized by the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) with the collaboration of various research institutions including Institute of Forest Resource Information Technique (IFRIT), Chinese Academy of Forestry (CAF) and the countries in Sub region and Malaysia comprises of Cambodia, the People's Republic of China (Yunnan province and Guangxi province), Lao People's Democratic Republic, Malaysia, Myanmar, Thailand, and Viet Nam. The main target of the project is to apply the intensive use of recent satellite remote sensing technology, establishing regional forest cover maps, documenting forest change processes and estimating carbon storage in the GMS and Malaysia. In this paper, the authors present the implementation of the project in Thailand and demonstrate the result of forest cover mapping in the whole country in 2005 and 2010. The result of the project will contribute towards developing efficient tools to support decision makers to clearly understand the dynamic change of the forest cover which could benefit sustainable forest resource management in Thailand and the whole Subregion.

## 1. Introduction

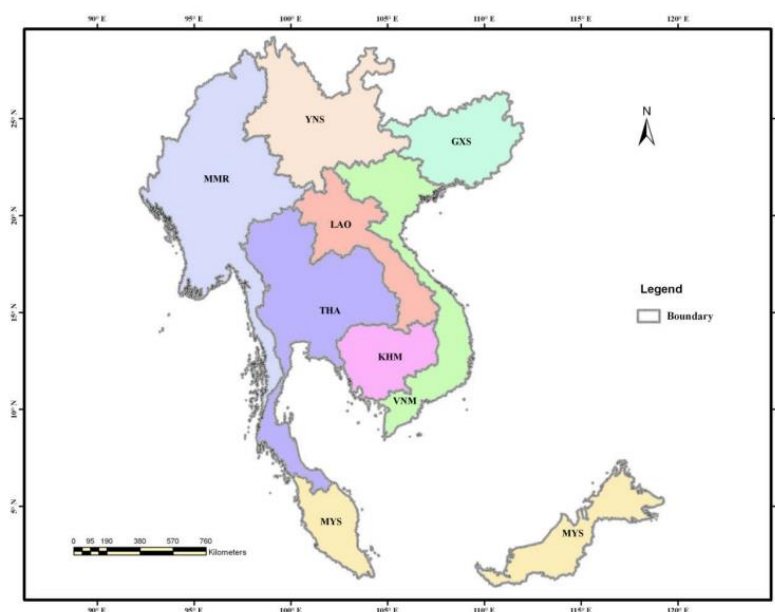
Forest monitoring is important natural resources of the Southeast Asian region which is very useful for help maintaining the environmental and ecological balance. With the fast growth of the social and economic development among the countries in the region in the past decades, enormous area of tropical forest was destroyed to transfer to be urban, industrial and plantation areas to serve the booming economy of the countries. The deforestation is widely recognized as one of the regional leading environmental problem [1] which is the major cause to land use land cover change and lead to

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the all anthropogenic carbon emissions, contributing directly to environmental problem, in particularly global warming and climate change [2].

Therefore, it is necessary to understand the current status of the forest cover in the region, in particularly, the Great Mekong Subregion (GMS) and Malaysia, and to have better perception of the forest cover and it change efficiently, the project was launched by the initiative of Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) in which the Institute of Forest Resource Information Technique (IFRIT), Chinese Academy of Forestry (CAF) was assigned as the leader organization to implement the project together with the countries in Sub region and Malaysia comprises of Cambodia, the People's Republic of China (Yunnan province and Guangxi province), Lao People's Democratic Republic, Malaysia, Myanmar, Thailand, and Viet Nam. The discussion on the project was held in the first workshop in Nanning city, China in January 2011. The duration of the project is from July 01, 2011 to February 28, 2014.



**Figure 1.** Study area of the GMS and Malaysia project.

The area of the GMS and Malaysia project ranges from 92.2° to 119.3° east longitude and 0.8° to 29.2° north latitude, with total land area of 3,172,420 km<sup>2</sup> and total population of 348 million. It includes Cambodia, the People's Republic of China (Yunnan province and Guangxi province), Lao People's Democratic Republic, Malaysia, Myanmar, Thailand, and Viet Nam. The total forest area is 1,481,280 km<sup>2</sup> reported by Forest Resources Assessment 2010 (Yunnan & Guangxi data were from the 7<sup>th</sup> national forest inventory of China). Study area of the GMS and Malaysia project is shown in Figure 1.

The GMS covers large geographical diversity including massifs, plateaus and limestone karsts, lowlands, fertile floodplains and deltas, forests (evergreen and semi-evergreen, deciduous, dipterocarp, mangroves, and swamp), and grasslands. The geographic sub-region encapsulates 16 of the World Wild Fund for Nature (WWF) Global 200 ecoregions. The region's biodiversity is ranked as a top-five most threatened hotspot by Conservation International. High forest coverage and rich forest resource result in large amounts of wood export from this region. The WWF states that the region is particularly vulnerable to global climate change [3]

The main activities for the project are the estimation and evaluation of the state of forest resources, carbon sequestration, and the results of forest program implementation, which provide a key source of information used to for the crackdown on illegal logging, forest fire monitoring and early warning for forest degradation, the reduction of deforestation, and the improvement of forest quality. Also, the result of project can support sustainable forest resources management can provide the earth

observation data and technical support needed by countries to effectively fulfil their obligations arising from international environmental agreements such as United Nations Framework Convention on Climate Change (UNFCCC) [3].

The primary goal of the project is to estimate forest coverage and above-ground carbon stock in the GMS and Malaysia. The approach will integrate multi-sources remote sensing data, ground measurements and other thematic geographic data. The outcomes of this project will help to clarify how, when and where the forests changes in the GMS and Malaysia. As Thailand is one of the participating members of the project, in this paper, the authors will describe the implementation of the GMS and Malaysia project in Thailand by the Royal Forest Department of Thailand as the leading government organization in the forest management of the country and implementing agency in collaboration with Geoinformatics Center, Asian Institute of Technology.

## **2. Objectives of the project**

From the primary goal of the project as mentioned in previous section, the main objective of the project is to determine forest coverage and biomass estimates through the following specific objectives:

- Develop forest cover mapping techniques to monitor forest cover type changes in the region, using both optical and radar remote sensing techniques.
- Develop forest carbon estimation framework using ground measurements, spaceborne Lidar sampling data and remote sensing satellite data.
- Produce forest cover maps of 2005 and 2010 at 30-50 m spatial resolution and yearly forest cover maps from 2005 to 2010 at 300-500m spatial resolution.
- Produce a forest carbon storage map for 2005 at 300-500m spatial resolution.

## **3. Implementation of the project for Thailand**

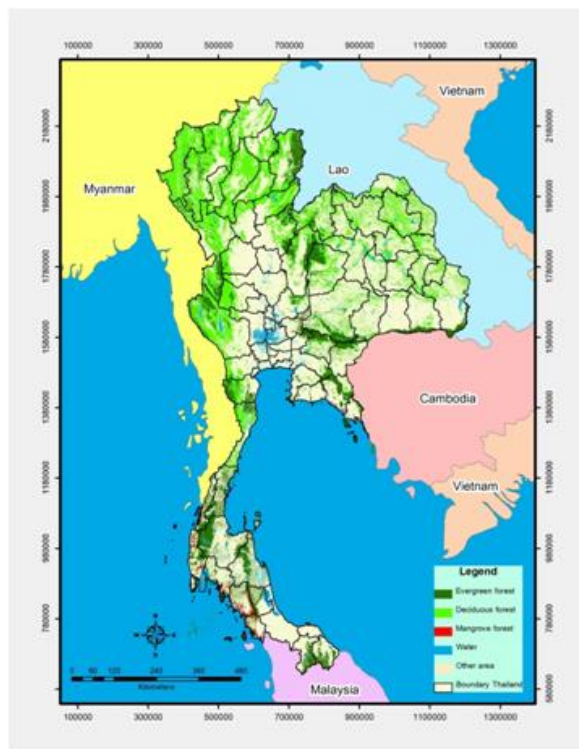
The project in Thailand has started on July 01, 2011. However, the activities of the project were started to implement lately in early 2012 due to the impact from the great flood in October 2011 in Thailand. Regardless of the problems from the flood, many activities were implemented since they were started during the pre-flood period and some of them were achieved according to the requirements of the project work plan.

For the content of the implementation as designed in the project work plan, after the project working team was set up, the project implementation has started with the establishment of the remote sensing data, which include Landsat, Rapid Eye and GLAS data that are necessary for forest cover and biomass mapping. Secondly, in order to conduct data validation for the newly-generated map products, the project team members have collected the data from the field survey, together with the secondary data available from the data archive to be a dataset of ground truth information for further map validation. The most important and final output for the project is forest cover mapping of the country, therefore, three main study test sites were selected in Trad, Lampang and Ubon Rachathani as initial study area for applying the recommended classification methodology for forest cover mapping.

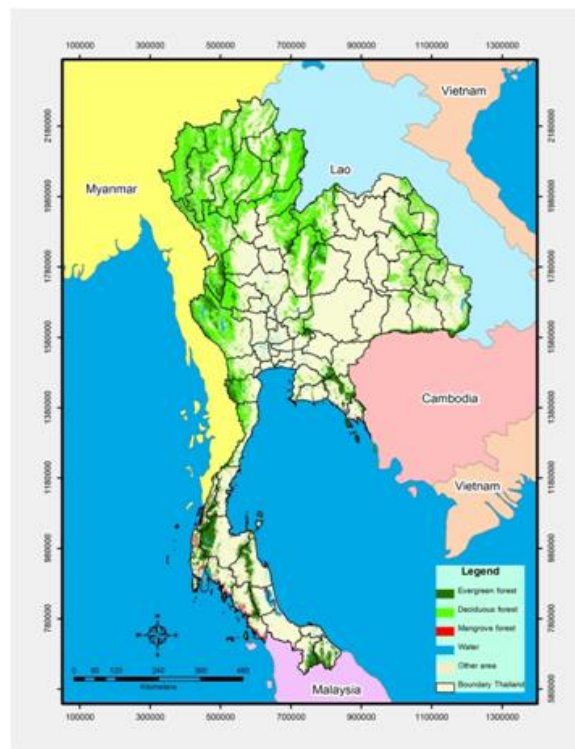
During the implementation of the project in the early stage, mapping process was carried out for the year of 2000, 2005 and 2010 using Landsat data and Rapid Eye. Biomass mapping as second target of this project has been started with the implementation of plot layout following the provided GLAS foot prints, by starting in Trad province, then following by Lampang and Ubon Rachathani, which are the test study sites for this project. Additionally, one test site for biomass mapping was selected in Kanchanabury province, which is the representative of the forest types in Western part of the country. Apart from the implementation of the technical aspect, meeting with local community in the study area of Trad province is necessary to provide information on the activities of the project. In the meeting, the purpose of the field visit was informed, the objectives of the Project were introduced. The local community plays important role to support this Project, in particularly, for field survey in the test sites.

## **4. Results of the project**

Since the starting date of the project to present, the project work has been achieved and the result can be described in the next paragraph.



**Figure 2.** Preliminary forest map 2010.



**Figure 3.** Preliminary forest map 2005 under progress of visual interpretation.

The field data from the test sites in Trad and Ubon Rachathani provinces was completed, in which in Lampang province is still in progress. These data from field survey will be used for forest distribution map evaluation of the whole country. Forest classification map for whole country of 2010 is completed (Figure 2), only for 2005 is still under data interpretation as shown in Figure 3. Field data for the whole country for biomass mapping were collected, and the work at this part is focusing on the development of the methodology for biomass calculation.

#### 4. Conclusions

Forest cover and biomass mapping is the main target of this regional Project, which is important to fulfil the requirements and objectives of the Project. To increase forest cover and improve forest quality are main objectives of the APFNet, therefore the result from this project will be supportive information to the regional management of the forest cover and biomass in the future for sustainable development in Thailand and the subregion as well. The forest coverage map from this project will also reflect the location of the forest and its increasing. With the collaboration from each organization, the ground measurements and mapping activities are undergoing. More information about this project is available at <http://www.apfrm.net>.

#### Acknowledgement

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