



Asia-Pacific Network for Sustainable Forest Management and Rehabilitation

Overall Work Plan for Project “Forest Cover and Carbon Mapping in the Greater Mekong Subregion and Malaysia”

Submitted by

Institute of Forest Resources Information Techniques, Chinese Academy of Forestry,
China

Department of Geography, University of Maryland, USA

Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD)

Cambodia- Forestry Administration

Guangxi Forest Inventory & Planning Institute (GFIPI), China

Faculty of forestry, National University of Laos

Malaysia- Forest Research Institute Malaysia (FRIM)

Royal Forest Department of Thailand

Viet Nam- Forest Inventory & Planning Institute

Southwest Forestry University, China

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Project coordinated office: Dr.Pang Yong Ms.Li Jie		
Address: Institute of Forest Resource Information Techniques, Chinese Academy of Forestry, Beijing 100091, China		
Tel: 86-10-62889804		
Fax: 86-10-62888315		
Email: caf.pang@gmail.com pangy@caf.ac.cn zonghelijie@126.com lijie@caf.ac.cn		

Project executing agency and implementing agency

Name	Organization	Expertise	Contact information (telephone and e-mail)
Li Zengyuan	IFRIT, CAF, China	Forest remote sensing	86-10-62889163 zengyuan.li@caf.ac.cn
Pang Yong	IFRIT, CAF, China	Lidar remote sensing	86-10-62889804 caf.pang@gmail.com
John Townshend	University of Maryland, USA/GOFC-GOLD	Forest remote sensing	01301 405 4050 jtownshend@bsos.umd.edu
Vivarad Phonekeo	Geoinformatics Center (GIC), Asian Institute of Technology (AIT), Thailand	Forest fire monitoring	668-1485-4946 vivarad@ait.ac.th
Li Chungan	Guangxi Forest Inventory and Planning Institute, China	Remote sensing and forest resource monitoring	86-771-2239009 gxali@126.com
Yue Cairong	Southwest Forestry University, China	Forest management	86-871-3863022 cryue@163.com
Khali Aziz Hamzah	Forest Research Institute Malaysia (FRIM)	RS and forest management	60362797201 khali@frim.gov.my
Nguyen Phu Hung	Forest Inventory and Planning Institute, Viet Nam	Forest silviculture and GIS	084-436870600 hungfipi@vnn.vn
Sukan Pungkul	Forest Survey and Assessment Division, RFD, Thailand	Forest ecology RS and GIS	668-4774-5888 mr.sukan@gmail.com
Khamla Phanvilay	Faculty of Forestry, NUoL, Laos	RS & GIS	856-21-770097 klphanvilay@hotmail.com
Kao Dana	Forest Management Office, Cambodia	Forest ecosystem management	855-12-540009 kaodana@gmail.com

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1 Goal and Objectives

The primary goal of the project is to estimate forest coverage and above ground biomass in the Greater Mekong Subregion (GMS) and Malaysia. The proposed 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. Our proposed approach will determine forest coverage and biomass estimates through the following specific objectives:

- 1) To develop pan-GMS and Malaysia forest cover mapping techniques to monitor forest cover type changes in the region, using both optical and radar remote sensing techniques.
- 2) Develop a framework for forest above ground biomass estimation using ground measurements, spaceborne lidar sampling data and imaged remote sensing data.
- 3) Produce forest cover maps of 2005, and 2010 at 30-50m spatial resolution and forest cover maps annually from 2005 to 2010 at 300-500m spatial resolution.
- 4) Produce a forest above ground biomass map for 2005 in the GMS and Malaysia at 300-500m spatial resolution.

2 Expected Outputs and Outcomes

The following **outputs and outcomes** will be accomplished or produced through this project:

2.1 Remote sensing database

The satellite imageries from Landsat TM/ETM+, HJ-1A/1B, CBERS, MODIS, MERIS and FY-3 will be collected and processed. A remote sensing database will be created and make available to different users of the project.

2.2 National-institute-owned ground truth database

We will design a distributed data structure of the ground truth database so that the corresponding work teams could follow the standards to collect the ground truth data. The database will contain previous and current landcover maps, field measurements, and forest inventories. The database will be distributed in each country with same data structure and data access portal. These data will provide fundamental training and validation data for remote sensing products.

2.3 Annual forest map product at coarse resolution (300~500m) during 2005~2010

The forests in the GMS and Malaysia will be mapped using MODIS, MERIS and FY-3 at coarse resolution (300~500m) every year during 2005~2010. These annual forest coverage maps will be used to explore how the forests changed annually and what forest disaster happens in the GMS and Malaysia.

2.4 Mid-resolution (30m) forest map product in 2005 and 2010

The forests in the GMS and Malaysia will be mapped at fine resolution (30~100m) in 2005 and 2010 using Landsat TM/ETM+, HJ-1A/1B, CBERS, ALOS PALSAR. These forest maps will contain more details land cover classes information. This information is useful to discover the driving forces of the forest changes and can provide policy decision supporting information to the local relevant government in the GMS and Malaysia.

2.5 Forest carbon storage mapping product (300~500m) of 2005

The forest carbon storage in the GMS and Malaysia will be mapped using ICESat GLAS, MODIS, MERIS at coarse resolution (300~500m) in 2005. This wall-to-wall forest carbon baseline map will be used to analyze forest quality and its distribution in the GMS and Malaysia.

2.6 Training workshops

Training courses and study tours on remote sensing data processing, forest mapping, and forest biomass/carbon estimation will be conducted for project's attendees and related communities.

2.7 The analysis report of forest coverage and carbon storage in each GMS economies and Malaysia

The forest resource analysis report will be prepared using the map products for each GMS economy and Malaysia. These reports will emphasize how the forest coverage changes and what the forest carbon storage is, which links to the objectives of the APFNet.

3 Main Activities Plan

3.1 Main activities

Activities to be undertaken to achieve individual results are as following:

3.1.1 Project design and management (including training)

A project steering committee comprised of national representatives and international experts will be established. This committee will communicate and make top-level design for the whole project.

One recommended national representative is expected. Milestones and main deliverables will be discussed by this steering committee.

3.1.2 Methods development (including Algorithms)

Institutes with intensive remote sensing technologies or forest resources will be organized as an algorithm development and training group. The common data processing and forest information extraction methods will be explored and developed. Technical progress and innovative methodologies will be regularly synthesized and feed to support operational data processing through training workshops and progress meetings.

3.1.3 Remote sensing data acquisition and pre-processing

The ways and links to get geospatial data that are available will be built. The satellite imageries include Landsat TM/ETM+, HJ-1A/1B, CBERS, MODIS, MERIS, FY, PALSAR and ICESat GLAS. The preprocessing work including radiometric correction, atmospheric correction, geo-referencing or geo-correction, cloud retrieving, multi-temporal composite, reprojection and mosaic will be carried out. A standard workflow of data processing will be developed. Multi-scale satellite data will be transferred to the corresponding working teams of GMS and Malaysia.

3.1.4 Ground truth database development (compiling existing data)

The data structure of ground truth database will be determined at the beginning of the launch of the project so that the corresponding work teams could follow the standards to collect the ground truth data. The fields of the database should include location (latitude and longitude, altitude), landcover type, photos, investigators, point/route/polygon, etc. For data validation, the database should cover data of all kinds of landcover types. Previous and current landcover maps or forest inventories will be collected.

3.1.5 Coarse-resolution forest mapping

The coarse-scale forest map will be generated annually using MODIS, MERIS, and FY-3 images. These images are available for free download through the internet. Some composition and reprojection will be performed. Then the classification will be done by several key groups with training data from fine-scale mapping products.

3.1.6 Mid-resolution forest mapping

The core of the image classification process is the training data selection and extraction process. The core activities include: (1) Regional forest cover mapping – at regional scales and based on satellite imagery of high spatial resolution (30-50m) for year 2005, 2010; (2) Forest cover change

assessment based on these two period forest map products. High spatial resolution (10m) satellite data for test sites and ground truth data will be used for training and evaluation. For this study on forest cover mapping, CBERS, TM/ETM data around 2005 and HJ-1 data around 2010 will be used. Orthorectified TM/ETM images for 2005 have been produced by USGS and UMD, and are available for free download through the internet. The images for 2010 are been produced, and will be available for this project by UMD in 2011. It is also free to get the HJ-1 images. For HJ-1 images, it needs to do the radiometric correction and geometric correction. Orthorectified TM/ETM will be used as the references for HJ-1's geometric correction.

3.1.7 Forest carbon storage mapping product

We will estimate forest biomass and carbon storage for each ICESat GLAS footprint with the aid of ground measurements and other reference data. Then these discrete footprint data will fuse with image data like MODIS/MERIS/FY-3 to estimate a spatial continuously biomass/carbon storage map in GMS and Malaysia.

3.2 Overall plan program

The following is the overall plan program of the project.

Table 3.1 Overall plan program table

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Output 1 Remote sensing database (Sep. 2011 ~ Aug. 2012)																								
Output 2 National-institute-owned ground truth database (Sep. 2011 ~ Aug. 2012)																								
Output 3 Mid-resolution (30m) forest map product in 2005 and 2010 (Dec. 2011 ~ Jun. 2013)																								
Output 4 Annual forest map product at coarse resolution (300~500m) during 2005~2010 (Dec. 2011 ~ Jun. 2013)																								
Output 5 Forest carbon storage mapping product (300~500m) of 2005 2010 (Dec. 2011 ~ Jun. 2013)																								
Output 6 Training workshops (Feb/Mar., 2012 & Aug/Sep., 2012)																								
Output 7 The annual analysis report of forest coverage and carbon storage in each GMS economies and Malaysia (Aug/Sep., 2012 & May~Aug., 2013)																								

4 Monitoring and reporting

4.1 Monitoring

To monitoring the progress of project, the project director will establish a contact work group which is consisted of at least one representative from each country using Email, Tel or Fax to report the project progress weekly. The project director will also hold annual workshop and training workshop to strengthen the capacity of the regional technicians, and communicate with members.

4.2 Project report

4.2.1 Quarterly progress report

A quarterly progress report will be submitted to APFNet at the end of each quarter. That should be covered by execution of the work plan, critical analysis of progress towards the achievement of objectives and conclusions.

4.2.2 Annual report

When the first year project is finished, a complete annual project report will be submitted to APFNet.

4.2.3 Completion report

After the project termination date, a project completion report and financial statement will be submitted.

5 Personnel planning, coordination and institutional relations

5.1 Project personnel, partners and support-organizations

Except the project director, a project steering committee will be established. This committee will communicate and make top-level design for the whole project. One recommended national representative was recommended. Milestones and main deliverables will be discussed by this steering committee. The member of the team will include national representatives and international experts. The tasks and responsibilities of the key members of project management team are described as below (Table 5.1):

Table 5.1 Project steering committee* (one recommended national representative)

Country	Name	Organization	Title	Working Field
China	Li Zengyuan	IFRIT,CAF	Dr.	Forest remote sensing
USA	John Townshend	University of Maryland	Dr.	Forest remote sensing
Canada	Michael Brady	GOFC-GOLD	Dr.	Land cover
Cambodia	H.E Chheng Kimsun	Forestry Administration	Delegate of the Royal Government of Forestry Administration	Management
	Mr. Meas Makara	Department of forest and community forestry management	Director	Management
Guang Xi, China	Li Chungan	GXFIFI	PhD	Remote sensing and forest resource monitoring
Laos	Houngphet Chanthavong	Faculty of Forestry, NUoL	Assoc. Prof.	Forest economy
Malaysia	Abdul Rashid Malik	FRIM	Dr.	Research Management and Planning
	Norini Haron	FRIM	Dr.	Research Planning and Corporate
Thailand	Rerngchai Prayoonwet	RFD	Deputy Director General	Forestry
	Songsak Vidtayaudom	RFD	APFNet Focal Point	Forestry
	Sumet Sirilak	RFD	Director of Foreign Relations Division	Forestry
Viet Nam	Nguyen Tuong Van	ICD-VNforest	Ms.	Environmental
	Nguyen Manh Cuong	ICD -Forest	Dr.	GIS and forestry
	Nguyen Ba Ngai	VN Forest	Dr.	Forestry
	Ngo Ut	FIPI	Dr.	Forestry
	Do Xuan Lan	MARD	Dr.	Remote sensing and GIS
Yunnan, China	Xu Hui	Southwest Forestry University	Vice-President of Southwest Forestry University	Forest Management

*comprised of national representatives and international experts.

5.2 Involved organizations, stakeholders, communities

Institutes with intensive remote sensing technologies and forest resources will be organized as an algorithm development and training group. The common data processing and forest information extraction methods will be explored and developed. Technical progress and innovative methodologies will be regularly synthesized and feed to support operational data processing through training workshops and progress meetings. Followed is the table of common activities committee.

Table 5.2 common activities committee

Country	Name	Organization	Title	Expertise
China	Li Zengyuan	IFRIT,CAF	Dr.	Forest remote sensing
USA	John Townshend	University of Maryland	Dr.	Forest remote sensing
Canada	Michael Brady	GOFC-GOLD	Dr.	Land cover
China	Pang Yong	IFRIT, CAF	Dr.	Lidar remote sensing
Thailand	Vivarad Phonekeo	Geoinformatics Center (GIC), Asian Institute of Technology (AIT)	Dr.	Forest fire monitoring
Malaysia	Khali Aziz Hamzah	Forest Research Institute Malaysia (FRIM)	Dr.	RS and forest management
Viet Nam	Nguyen Phu Hung	FIPI	Dr.	GIS
Thailand	Sukan Pungkul	Forest Survey and Assessment Division, RFD	Mr.	Forest Ecology RS and GIS
Laos	Thoumthone Vongvisouk	Faculty of Forestry, NUoL	Mr.	RS&GIS
Cambodia	Kao Dana	Forest Management Office	Dr.	Forest Ecosystem Management
USA	Huang Chengquan	University of Maryland, College Park	Dr.	Forest mapping and change detection
USA	Sun Guoqing	University of Maryland, College Park	Dr.	SAR remote sensing
USA	Zhu Zhiliang	U.S. Geological Survey	Dr.	Carbon estimation
China	Tan Bingxiang	IFRIT,CAF	Dr.	Remote sensing classification
China	Chen Erxue	IFRIT, CAF	Dr.	SAR remote sensing
China	Liu Jianbo	China Remote Sensing Satellite Ground Station, Chinese Academy of Sciences(CAS)	Dr.	Remote sensing data
China	Li Xingchao	China Remote Sensing Satellite Ground Station, CAS	Dr.	China satellite data