MOEJ/GEC REDD+ Demonstration Study 2014
Summary of the Final Report

"Improvement of REDD+ implementation using IC technology"
(Implementing Entity: Mitsubishi Research Institute, Inc. (MRI))

1. Overview of the Proposed JCM Project

<table>
<tr><td>Study partners</td><td colspan="3">NEC Corporation (NEC)
Ecological Economic Solutions Sdn Bhd (2ESolutions)
Borneo Orangutan Survival Foundation (BOS-F)</td></tr>
<tr><td>Project site</td><td colspan="3">Republic of Indonesia, East Kalimantan Province</td></tr>
<tr><td>Category of project</td><td colspan="3">REDD+ (Reducing Emissions from Deforestation and forest Degradation in developing countries)</td></tr>
<tr><td>Description of project</td><td colspan="3">In order to address common issues regarding monitoring activities in REDD+ projects, high-spec MRV methodologies are considered by making the best use of Information Communication Technologies (ICTs).</td></tr>
<tr><td rowspan="2">Expected project implementer</td><td>Japan</td><td colspan="2">NEC Corporation (NEC)
Mitsubishi Research Institute, Inc. (MRI)
Ecological Economic Solutions Sdn Bhd（2ESolutions）</td></tr>
<tr><td>Host country</td><td colspan="2">Borneo Orangutan Survival Foundation（BOS Foundation）</td></tr>
<tr><td>Initial investment</td><td>190,000（Thousand yen）</td><td>Date of groundbreaking</td><td>2016（Expected Project Start)</td></tr>
<tr><td>Annual maintenance cost</td><td>1,067（Thousand yen）</td><td>Construction period</td><td>20 Years (REDD+ Project Period)</td></tr>
<tr><td>Willingness to investment</td><td>Yes（to be decided based upon the results of a study on institutional arrangements)</td><td>Date of project commencement</td><td>2016（Scheduled Project Start)</td></tr>
<tr><td>Financial plan of project</td><td colspan="3">Initial cost of 190 million yen and operating costs of 32 million yen (total cost for 30 years) are envisaged. Of the initial cost, the amount for acquiring the Ecosystem Restoration Concession (ERC) has already been invested, through PT RHOI, by BOS Foundation, the local counterpart. In the Study Project for the current fiscal year, studies and surveys will be carried out and capital planning will be worked out in more concrete terms.</td></tr>
<tr><td>GHG emission reductions</td><td colspan="3">180,000 (tCO2/year)/3,600,000 (tCO2): Total amount for the project period of 20 years. Assuming deforestation can be controlled by implementing project activities such as forest patrols and forest conservation etc., the GHG reduction potentials have been calculated on a trial basis.</td></tr>
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2. Study Contents

(1) Project development and implementation

1) Project planning

Project feasibility will be closely examined on the basis of a project proposal being studied by BOS Foundation along the lines of the REDD project to be implemented under JCM or the conventional carbon credit system (VCS). The basic policy has been mapped out to establish a cost-efficient project implementation method, making best use of the results of the Study Project for the last fiscal year (FY2013), and applying the MRV methodology, which is to be improved in the Study Project for the current fiscal year (FY2014).

2) Contribution of Japan

The MRV Methodology to be developed in this Study Project will use Earth Observation Satellites and Satellite Remote Sensing, which incorporate advanced Japanese technologies, and is expected to contribute to further improving the efficiency of REDD+ Project operation. Among the merits and features of satellite observations are that periodic and homogeneous data can be obtained, because satellites have a wide high-altitude one-time observation range (swath) in terms of space; long-term continuous observations (in terms of several years) are possible; and, there are no constraints on aerial coverage (such as national boundaries). The following table summarizes ICT equipment and solutions, whose applicability and usability at the ERC Site has been confirmed by BOS Foundation and Japanese forestry officials and personnel.

Table: ICT Functions Required at Observation Spots

Items	Functions	Notes
1. Digitalization of books	Weight saving will be achieved with portable electronic illustrated reference books, etc. for *in-situ* verification and reference	In lieu of illustrated books of flora and maps, etc.
2. Integration of electronic equipment	The books in 1. above will be integrated in lieu of individual pieces of equipment	n/a
3. Assimilating *in-situ* data collected	When assimilating data from stationary observation equipment, memory cards are usually used. A large volume of data can be easily transferred from observation equipment.	No equipment for storing data is available at the present ERC site. In the future such a system is likely to become available for tracking wildlife.

3) MRV structure

The organizational set-up for implementing MRV during the period of Project implementation envisages the following approximate division of roles.

- Examination of Overall Implementation Policies and Planning and Operation, etc.: Mitsubishi Research Institute, Inc. and NEC
- Support for MRV Methodology Operation, Image Analysis, etc.: Mitsubishi Research Institute, Inc. and NEC
- In Situ Field Surveys and In Situ information collection: BOS Foundation, 2ESolutions
- Local Cooperative Organizations: East Kalimantan Provincial Government, Research Institutes (Mulawarman Universities and NGO, etc.)

Generally, REDD+ Project MRV requires the following tasks of: 1) identifying, through satellite image analyses, etc., active mass per land-cover classification (Area change data) and 2) identifying emission factors per land cover classification (Carbon stock per unit area). Moreover, data-collection methods must also be examined in terms of (A) whether its own data should be collected and (B) whether existing statistical data should be used. When reliable data are available, using existing statistical data according to (B) would be conducive to improving operational efficiency. In the FY2013 Study Project, data developed on our own were used in terms of both land cover change and emission factors. In the Project this fiscal year (FY2014), the same line will be followed. However, in the actual REDD+ Project, implementation will be in line with what has been agreed bilaterally.

In monitoring activities at the ERC site, forest quadrat surveys were conducted to verify emission factors. The instruments and tools required for carrying out such surveys were measures, cameras, illustrated books of flora and stationery, etc. Such items are the same as those used in conventional vegetation surveys. The duties of quadrat surveys have already been transferred. Compared to the outcome of the FY2013 survey, the outcome of the FY2014 survey was more stable in terms of contents. The outcome of the survey needs to be verified. However, there seem to be no problems that need to be raised and addressed on the survey implemented solely by the local counterpart.

On the other hand, as regards satellite image analysis, transferring duties in the immediate future will be difficult because of the operational activities, which were unfamiliar to BOS Foundation and because of the different expertise required. A gradual transfer of technological duties in the process of REDD+ Project implementation is considered to be the proper course of action.

Table: Items of MRV

Classification	(A) Collection of own data	(B) Using existing statistical data
Land cover changes per Strata (Land cover classification)	Analysis of satellite images of the Project Area 【MRI, EC, etc.】	Basic data for setting up REL as posted on RAD-GREK (Availability must be verified) [East Kalimantan Provincial Government, etc.]
Emission Factor per Strata (Land cover classification)	Creation of Emission Factor data based upon In On-Situ Sampling Surveys [BOS Foundation, etc.]	Basic data for setting up REL as posted on RAD-GREK (Availability must be verified) [East Kalimantan Provincial Government, etc.]

4) Environmental integrity and Sustainable development in host country

The main objective of the REDD+ Project and ecotourism is to conserve ecosystems in tropical rain forests, and they are expected to have diverse environmental conservation effects on the areas where the Project is implemented. In particular, it is expected to contribute to enhancing conservation activities for orangutans, preventing illegal logging, poaching, and environmentally damaging development, and maintaining ecosystem services such as water resources

- Conservation of Orangutans

A large part of the monitoring budget of the BOS Foundation is earmarked for activities to monitor orangutans carried out after they have been released in the ERC area. Therefore, the budget for forest survey activities is limited. The forest surveys being carried out by BOS Foundation at present are limited to monitoring under ERC arrangements, as well as those for the purpose of selecting sites to release orangutans and locating their edible plants. By implementing a REDD+ Project, more comprehensive forest surveying and monitoring will become possible.

- Preventing illegal logging, poaching, and environmentally damaging development

The road infrastructure within the Project Area and its surrounding areas remains undeveloped. Therefore, development of roads and bridges in these areas will contribute to facilitating orangutan conservation activities now being carried out by BOS Foundation and promoting ecotourism.

- Maintaining ecosystem services such as water resources

Telen River, which flows through the Project Area, is situated in the upper reaches of Sungai Mahakam River flowing through Samarinda, the provincial capital. Sungai Mahakam River is one with the largest basin areas in Kalimantan. The ERC Area plays an important role in terms of maintaining water resources and flood control in these basin areas. The rain forests, as well as fauna and flora, are an important part of the cultural heritage of the Dayak people living in areas adjacent to the ERC Area. Good examples are their tattoos featuring local fauna and flora motifs and the hornbill dance. Activities for conserving the ERC Area through this Project will contribute to the sustainable development of these ecosystem services.

5) Toward project realization (planned schedule and possible obstacles to be overcome)

As indicated in the figure below featuring the future schedule, the present Project is at the final stage of developing a methodology. Within approximately one year from now, the Project Design Document (PDD) will be prepared. After feasibility has been approved, REDD+ activities will move on to the implementation stage. After initiation of this stage, activities are planned to continue for a period of from 20 to 30 years, with a data review every five years.

The future agenda includes procurement of funding for preparing PDD. This is likely to be done in the next fiscal year. Activities will continue to look for the necessary financial support. Because no profits are expected from the period during which financial support, such as subsidies, can be received until crediting actually takes place.

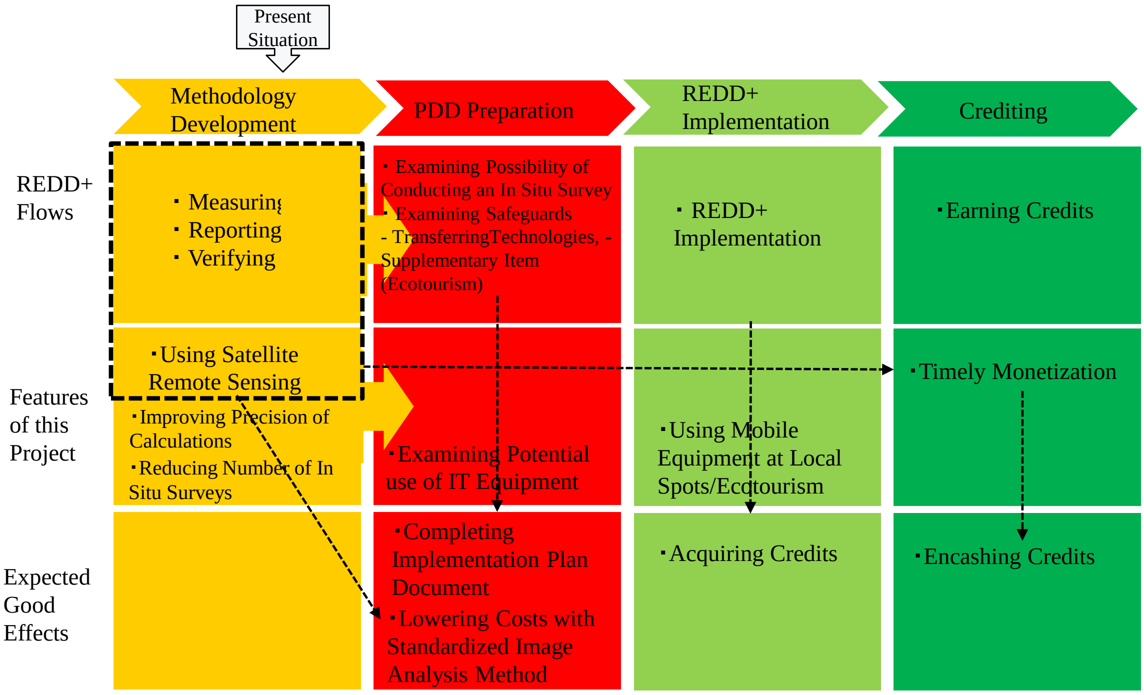


Figure: Future Schedule

(2) JCM methodology development

1) Eligibility criteria

The requirements for qualification have been examined for the methodology concerned. The following Table summarizes the examination results. At present, five requirements have been established as Requirements for Qualification. It was decided that by applying a methodology that meets those requirements, emission reductions achieved when the Project is implemented will be assessed quantitatively.

Table :Equirements for Qualification of Methodology

Item	Contents
Requirement 1: Scope of REDD+ Definition	Ensuring that the targeted forest shall be in line with the definition of a forest applicable in the host country, and that the targeted forest conservation activities shall be in line with the scope of REDD+ in the country. <Definition of Forest in Indonesia > Crown Ratio: 30%, Minimum Tree Height: 5 m, Minimum Forest Area: 0.25 h ＜Scope of REDD+(Example)> (1) Emission Reduction from Forest Decline (2) Emission Reduction from Forest Degradation (3) Conservation of Forest Carbon Stock (4) Sustainable Forest Management (5) Intensification of Forest Carbon Stock
Requirement 2: Concession within Targeted Project Area	That the concession within the Project Area must be in a state of ‘already obrtained’ possession. That approval for REDD+ implementation has already been obtained from administrative authorities concerned (Provincial Government, etc.) responsible for granting such concession.
Requirement 3: Specifications of Satellite Images and Analysis Methods	That the resolution of high-resolution satellite image data and analysis methods, etc. shall meet the following specifications. High-resolution remote sensing data in the latest year of the project implementation period (Resolution 5 m or higher resolution: ALOS, PRISM, etc.)
Requirement 4: Consideration for	Safeguard measures including consideration for biodiversity shall be taken in REDD+ activities. In case there are stipulations, etc. regulating safeguard

Safeguards	measures in the host country, there shall be compliance with such stipulations.
Requirement 5: No Peat Swamp Forest	No peat swamp forest is included in the Project Area. Or the impact of deforestation and forest degradation are negligible small in terms of emissions from soil organic carbon.

2) Calculation of GHG emissions (including reference and project emissions)

1-1 Methods of Calculating Reference Emissions

Based on the rules for setting up the reference area, expansion of the reference area has been examined. Reference Area 2 includes areas where forests are more developed. The assessment can be carried out, including future development risks, which may also happen within the ERC Site in the future. The following figure shows Reference Area 1 and Reference Area 2.

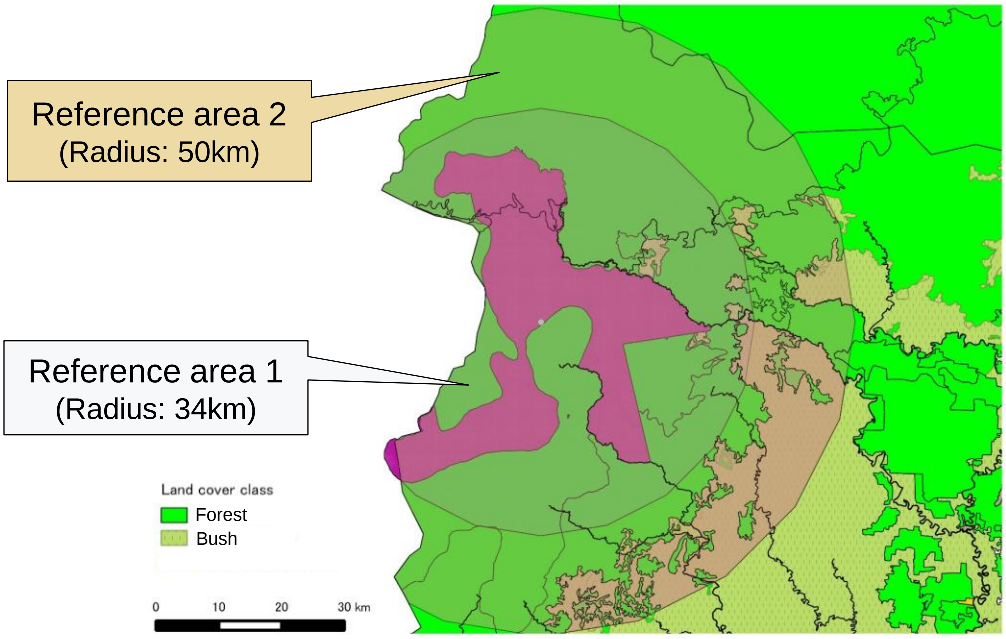


Figure: Set-up for Reference Areas

The calculated reference emissions within Reference Area 2 are shown in the Table below.

Table : Calculated Reference Emissions

	Reference Area 1 (Radius 34 km)	Reference Area 2 (Radius 50 km)
Reference Emissions (@Project Area)	162,000[tCO2/year]	180,000[tCO2/year]

2-1 Methods of Calculating Project Emissions

As the methodologies for calculating Project Emissions, the following two methods are proposed: (a) Method using moderate resolution optical remote-sensing data and (b) Method using high-resolution remote-sensing data. The following figure shows the process flow of both methods.

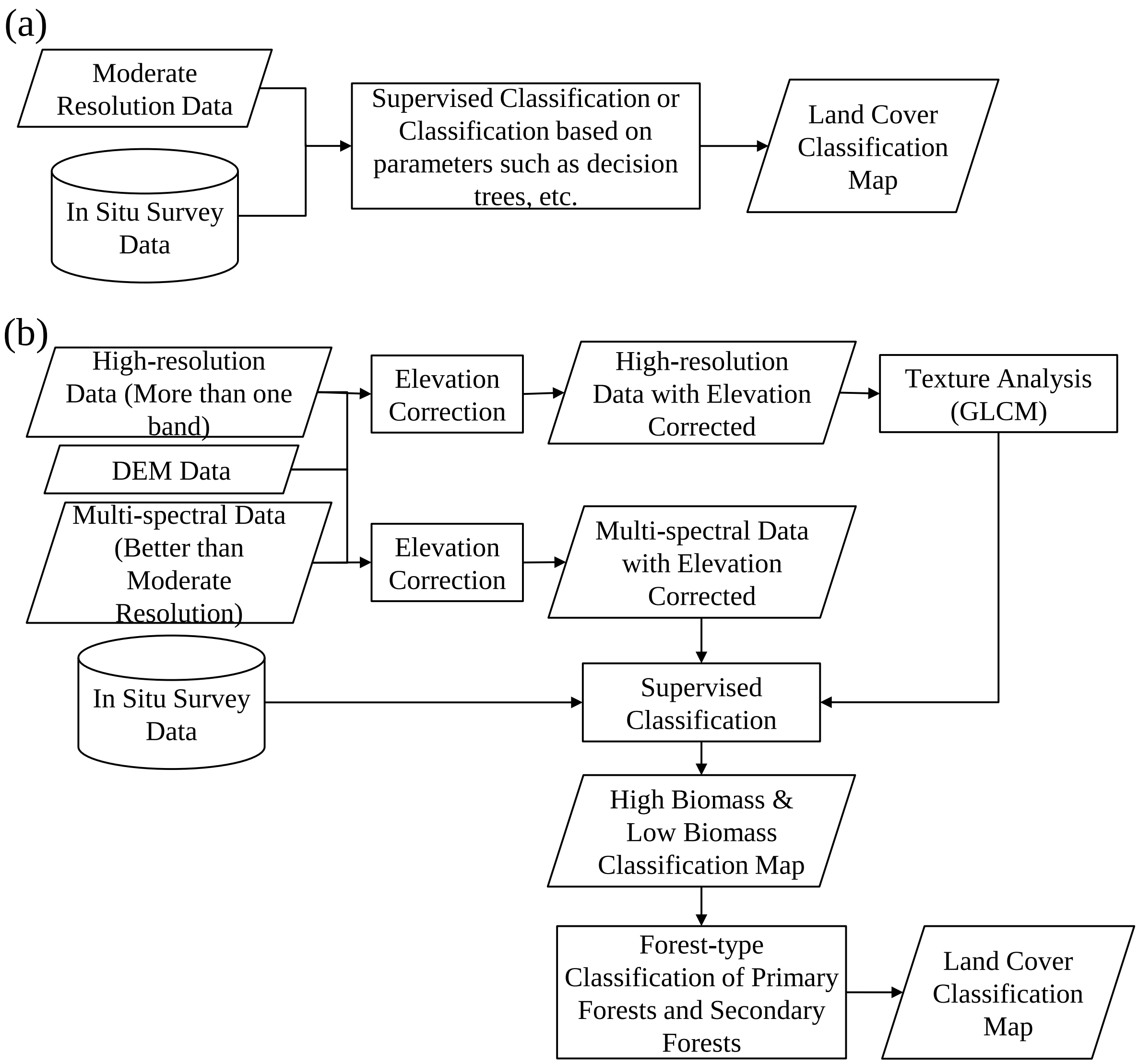


Figure: Flow chart of methods of calculating Project Emissions with high-resolution sensors

Based on the results of the Project conducted in the last fiscal year (FY2013), the texture analysis, which uses high-resolution images, is adopted as the Method (b). As a result, when developing the methodology, support vector machine is used as a supervised classification. Since the Project site is in a mountainous and remote area where in-situ surveys are expected to be difficult to undertake, best option is made of remote sensing data. However, due to the configurations of mountains, it is necessary to correct images. Because of the possibility that ecological succession in the direction of sparse vegetation will occur due to elevation changes, sufficient ground survey data featuring diversity and high precision will be required to ensure the precision of the resulting classification map and the estimation model used for its calculation. As indicated by the results of the analysis conducted using the RapidEye images (The following figure), it is inferred that in terms of macro-scale, surface vegetation may change in accordance with elevation changes.

(a) (b)

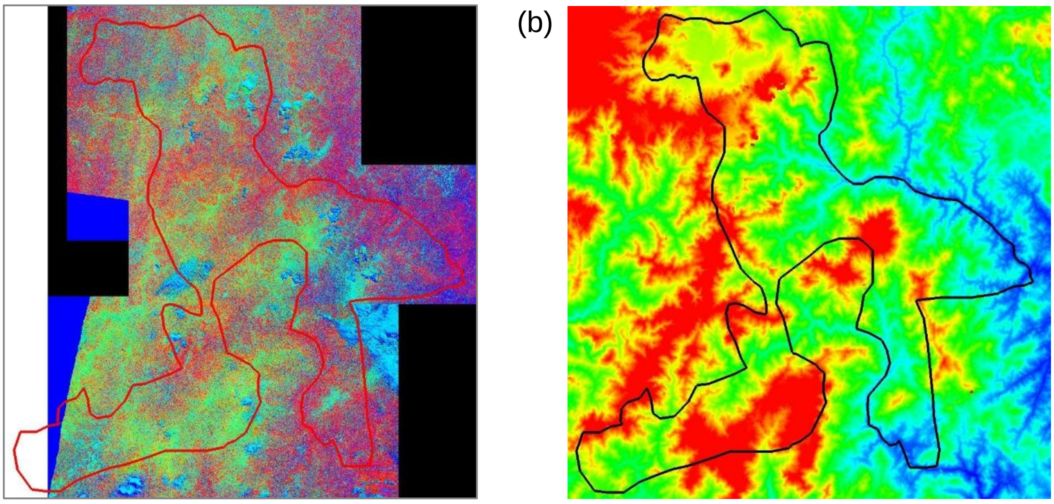


Figure: Vegetation Change is Likely with Elevation Changes
(a) Rapid Eye Regularized Images (R: Band 5, G: Band 4, B: Band 2), (b) DEM Data

Under the conditions, a lot of time, funds, and human resources will be needed to conduct In-situ surveys that ensure the sufficient level of precision. Therefore, a scheme will have to be developed for a highly reliable forest-type classification. In the current fiscal year (FY2014), therefore, with a view to developing a methodology that ensures efficient operation, the possibility of a methodology by which development factors (roads, rivers and villages, etc.) that may aggravate forest decline has been identified and proxy variables used as evaluation criteria have been verified. Equally, the possibility of a method by which classification is undertaken through a forest-canopy-structure analysis using satellite data with a sub-meter (less than one meter) resolution made available from Worldview 1/2 and ASNARO to be launched in the future, etc. has been verified. The following figure shows the entire process flow. Each of the two methods is explained in detail below.

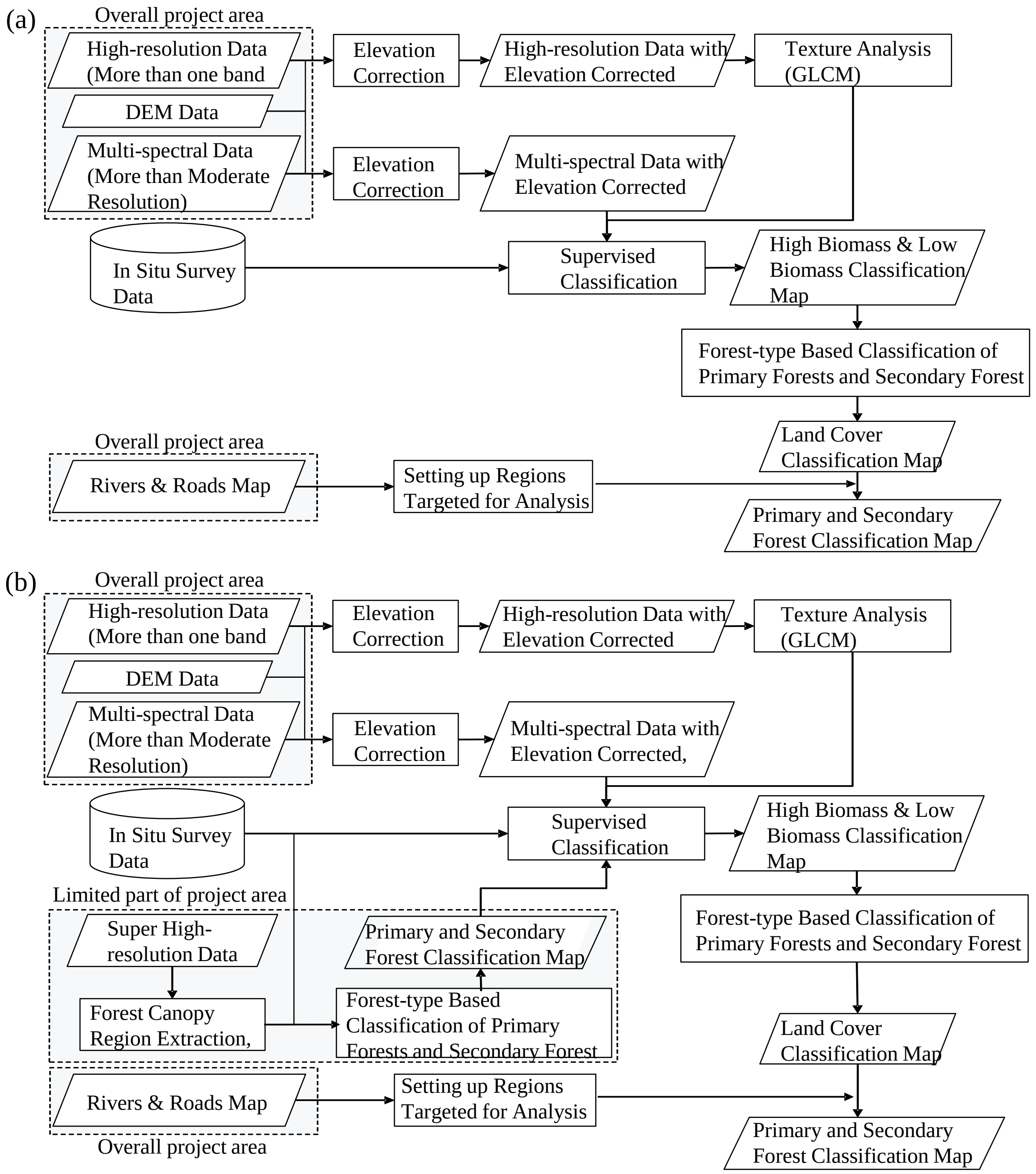


Figure: Flow chart of methods of calculating Project Emissions with Super High-resolution data

2-2. Method for Using Proxy Variables

It is difficult to ensure transport routes with logging constituting a disturbance factor, because the targeted Project Area is located in steep mountainous areas and unless there are rivers or roads wide enough to be detectable with high-resolution satellite data (A width of approximately several meters) that enable such transport. These points have also been confirmed through in-situ interviews, etc. There are studies that have extracted roads and canals for transport to make estimates used as a method of identifying deforestation areas. This may be a relatively reliable scheme. This area is rugged and it is difficult to penetrate deeper into areas more than 250 m from a road. Therefore, the areas for analysis have been limited to the areas within a distance of less than 250 m. Conversely, it will be difficult to transport logged trees in areas more than 250 m from a road or river. Therefore, these areas have been defined as natural forests where no logging will take place. The following figure shows this line of reasoning.

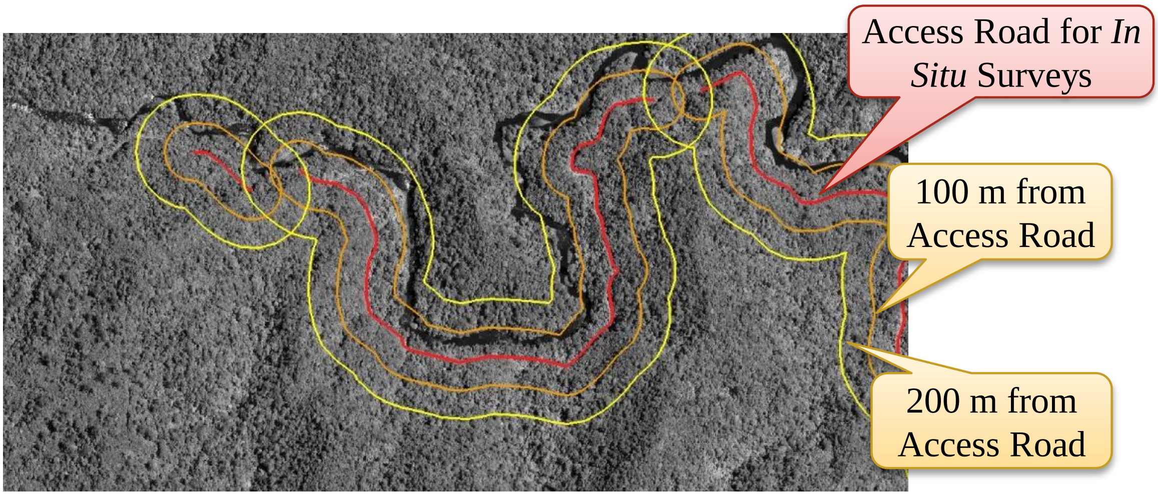


Figure: Reasoning of Proxy Variables (Method of Setting up the Scope of Verification)

In the areas mentioned above, forest-type classification is undertaken, as in the last fiscal year, using a method that applies high-resolution data such as RapidEye. When using this method it is important to get the lay of roads and rivers. These will be identified using remote sensing data with a spatial resolution of less than 5 m/pixel, including RapidEye, and by resorting to visual observations or visual observation extraction, which uses an automatic extraction algorithm. Local information or existing GIS data, if available, may also be used.

In monitoring activities, the expansion and extension of roads need to be monitored during the project implementation period. Such monitoring can be carried out by two methods, namely extraction based on remote-sensing data and that based on local information to be provided. In the process of using remote-sensing data, locations which is subject to environmental changes are identified through time-series change extraction method, which will use high-resolution data with a spatial resolution of 5 m/pixel such as RapidEye, and surveys will focus on such locations. Such a time-series change extraction method will extract areas where changes occur using second and third principal component analysis images to be computed from the principal component analysis. As far as this Project Area is concerned, there will be neither high-resolution satellite-images of roads being expanded of pre- and post- construction. Therefore, the precision will have to be verified separately in other areas in the future. Local information will be verified by the organization responsible for local surveys etc. (BOS Foundation in the case of this Project) through patrols, etc. For areas identified as having roads that are likely to be expanded or extended, such verification is undertaken by visual observations, using sub-meter resolution satellite images. Such data are siphoned into GIS data. Satellite images from WorldView1/2/3 and ASNARO, etc. are envisaged for sub-meter resolution images.

2-3. Method of Analysis Based on Super High-resolution Data

To reduce the burden of in-situ surveys, as well as to prevent inconsistency of precision in in-situ surveys, these prove to be a major advantage for monitoring activities. In recent years, databases from satellites with a resolution of less than one, such as those from Worldview1/2/3 and ASNARO to be launched in the future, have expanded. Taking advantage of these super high-resolution data, a classification based on a forest canopy structure analysis are carried out, and it is applied as supervised data for the classification scheme carried out in the last fiscal year using high-resolution data such as those from RapidEye. This method focuses on the fact that while disturbed forests are restored from secondary forests to primary forests, there are major differences in tree canopy structures between secondary forests in the process of growth and primary forests. This method has the inherent advantage that clear differences in tree canopy structures can be extracted at a sub-meter class resolution. A method that integrates the macro-texture structure and spectral data focusing on differences in forest species had been employed because at present non-sub-meter high-resolution images such as Rapid Eye cannot provide detailed information. It is believed that classifications with a precision higher than can be realized. Furthermore, in the case of spectral classifications, forest types per area have to be identified with in-situ surveys, which must be conducted at many locations. However, super high spatial resolution images will enable photo-interpretation of tree canopy sizes. Therefore, classification can be conducted just by identifying thresholds that set lines between forest-type classifications in in-situ surveys. However, unlike multi-spectral data such as those from Landsat8 and RapidEye, super-high resolution data are limited in terms of the area that can be imaged at one time and the cost of images is extremely high. Therefore, it is more realistic to expect that the analysis will be conducted in a very limited part of the whole Project area.

Accordingly, with this methodology, the results of the classification undertaken on the basis of super high-resolution data are treated as supervised data for the analysis carried out last fiscal year using multi-spectral data. The overall operational process is described below.

i) Forest canopy structures are classified using super-high resolution images. However, as super high spatial resolution images are small range of observation area and therefore they are limited to small confined areas.

ii) Using supervised data for areas resulting from the classification mentioned in i) above, supervised classification will be undertaken using RapidEye data, which cover the entire ERC site. Data mentioned in i) above will be used for evaluating the process and outcome of developing the classification model. However, the area of i) for model development and the area i) for verification shall not be overlapped.

iii) Carbon stock can be estimated using the land cover map (primary and secondary forest classification) derived from applying the proxy variables in (2) to the classification results acquired in ii).

When extracting forest canopy structures using super high-resolution data, first, the configurations of tree canopies are extracted using a morphological analysis. The concept of a morphological analysis as such is a historic methodology dating back to the 1960s, and is a technique for extracting the configurations of objects from images. Technically, image-processing operations on a configuration basis will be carried out in the process of image processing. With this methodology, pixel codes are added to the thresholds of objects within images using dilation, which is the most basic morphological operation. The following figure shows the images analyzed before and after such extraction.

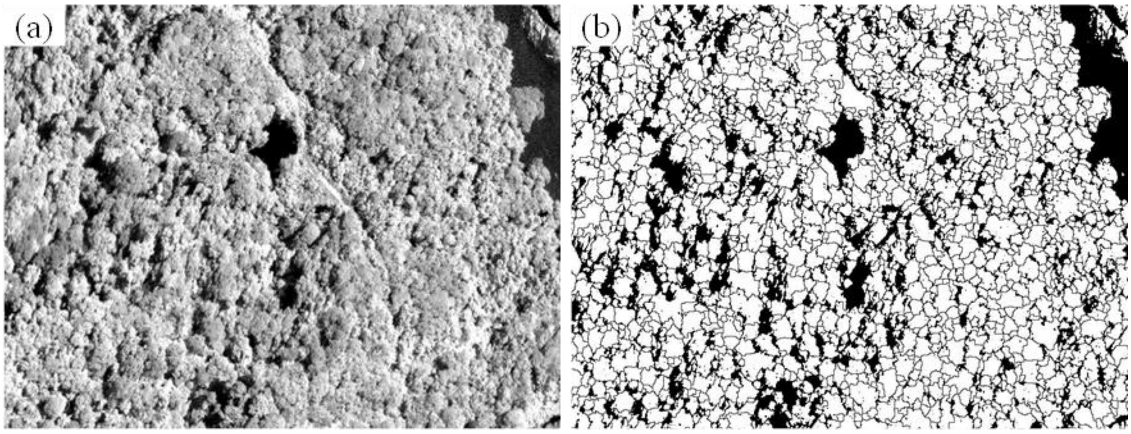


Figure: Results of Forest Canopy Structure Extraction

(a) Super High Spatial Resolution Image (WorldView1) (b) Results of Forest Canopy Extraction

For the forest canopy structures extracted as described above, the following definitions are provided based on the definitions of primary and secondary forests used in the last fiscal year. Accordingly, area classifications are carried out.

- Primary Forests: Large-diameter trees (Trees with large trunk shapes) are prevalent.
- Secondary Forests: Large-diameter trees are fewer there because of the influences of ecological disturbances and logging.

The following figure shows the above presented in the form of a schematic figure.

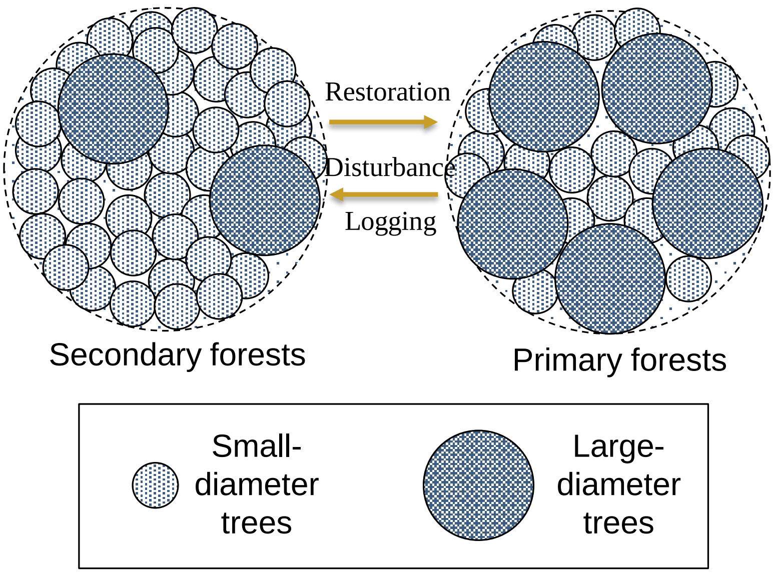


Figure: Definitions of areas of Primary forests and Secondary forests

The following figures show the results of the analysis.

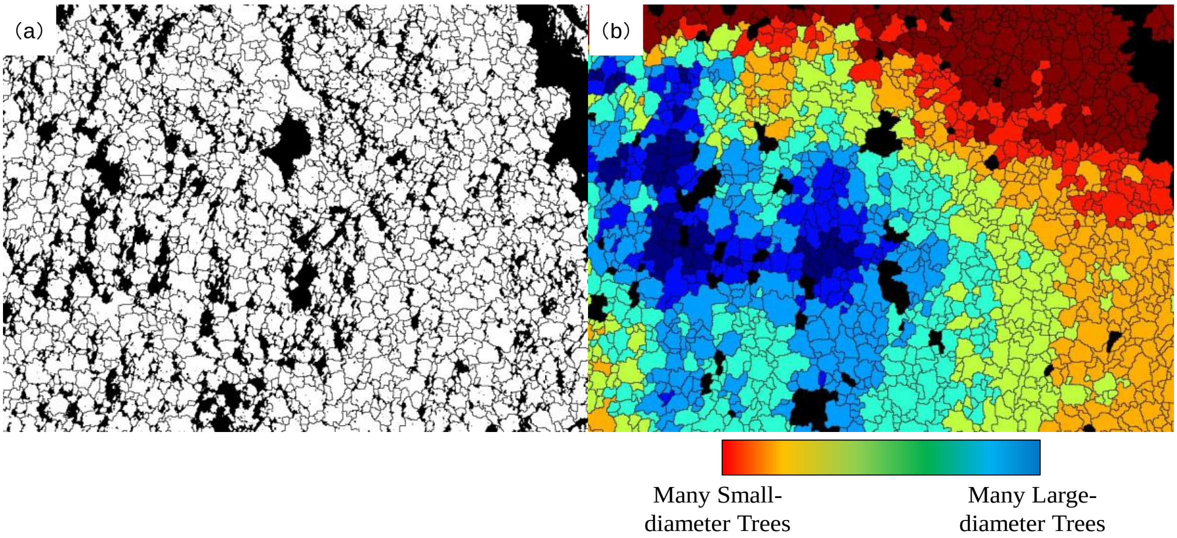


Figure: Example of distributional ratio of small-diameter trees by use of Segmentation Data
(a) Results of forest canopy extraction, (b) Distributional ratio of small-diameter trees

In order to classify areas between primary forests and secondary forests on this map, a certain threshold has to be established in terms of the ratio of small-diameter trees. The threshold can be the basis of the classification of primary forests and secondary forests in the region, which results from in-situ ground surveys.

The primary forests and secondary forests within the entire Project Area are classified by conducting a supervised classification of RapidEye data. In the classification analysis, the results of area classification between primary and secondary forests by use of the threshold mentioned earlier are applied.

The above-mentioned methodology will enable us to reduce the number of points to be monitored in in-situ surveys without compromising the precision level of classification. In the actual in-situ monitoring activities to be done in the future, a sufficient number of points will be monitored during the activities in the first fiscal year. Thereafter, the focus will be more on analyses based on super high-resolution data to be carried out each year. Such arrangements enable us to replace and save a number of actual in-situ activities.

2-4. Results of Calculating Project Emissions

As indicated in the following figure, this Project Area is mostly covered with forests. Under the general and traditional land cover classification methodologies, the classification is either for forest or for non-forest. Therefore, based on the methodologies, this Project Area falls mostly into the category of forest. This means that the extent of restoration cannot be assessed in a precise manner with respect to areas where logging has taken place in the past and forests are now under restoration. Therefore, precision in estimating carbon stock can be improved using the method described above.

3-1. Methodology by use of proxy variables

The rivers and roads within the Project Area have been extracted through in-situ surveys, as well as through satellite images analyses. The following figure shows the outside view.

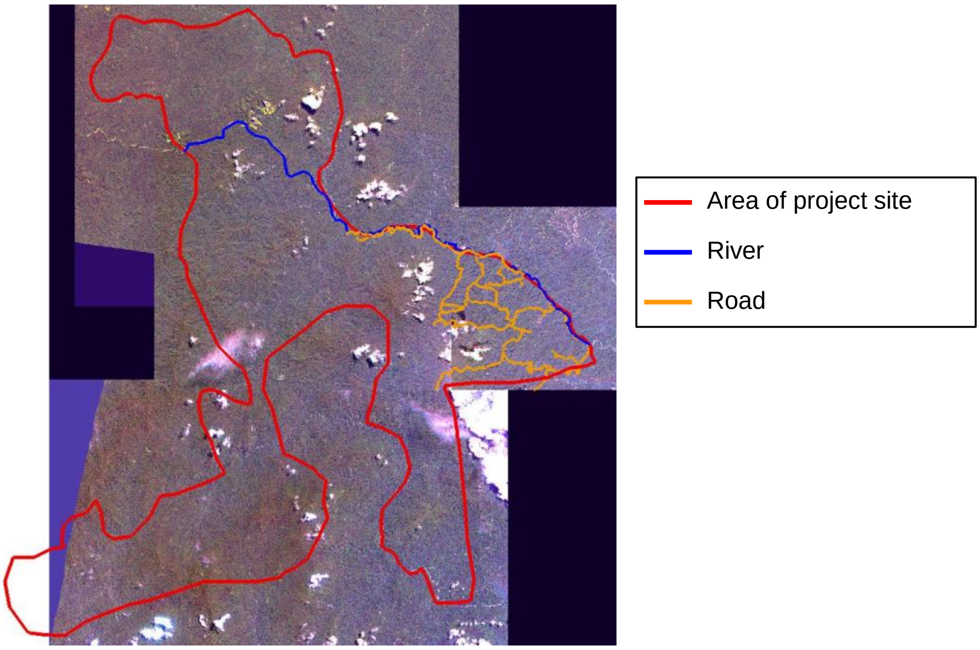


Figure: Rivers and Roads within the Project Area

By covering forests within a distance of 250 m from roads and rivers, a primary forest or secondary-forest classification has been undertaken on the basis of RapidEye images and ground in-situ survey data.

First, a supervised classification was carried out for RapidEye images covering most of the Project Area, using the images obtained through texture analyses, as well as the ground level data obtained from in-situ surveys. Furthermore, in accordance with the line of thought followed in the last fiscal year, land cover classification was carried out to identify types of primary forest and secondary forest. The results covering the entire Project Area are as shown in the following figure.

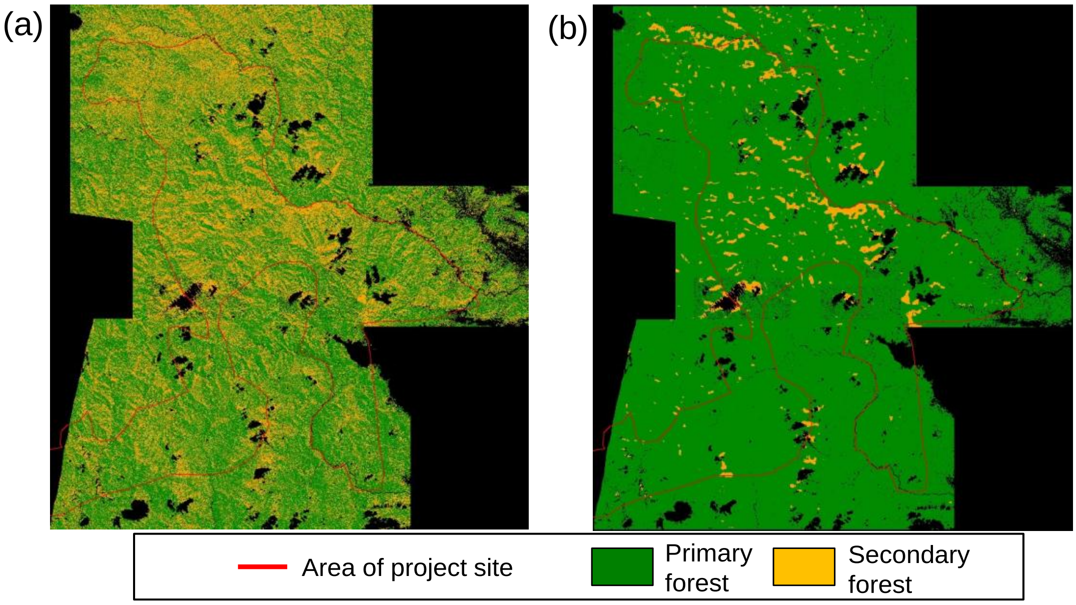


Figure: Results of primary or secondary forest classification
(a) Results of classification on a pixel basis (b) Results of classification b/w primary or secondary forest

Using the results of the classification mentioned above, areas defined as those of secondary forests within 250 m of the rivers and roads, were extracted. The results are shown in the following figure.

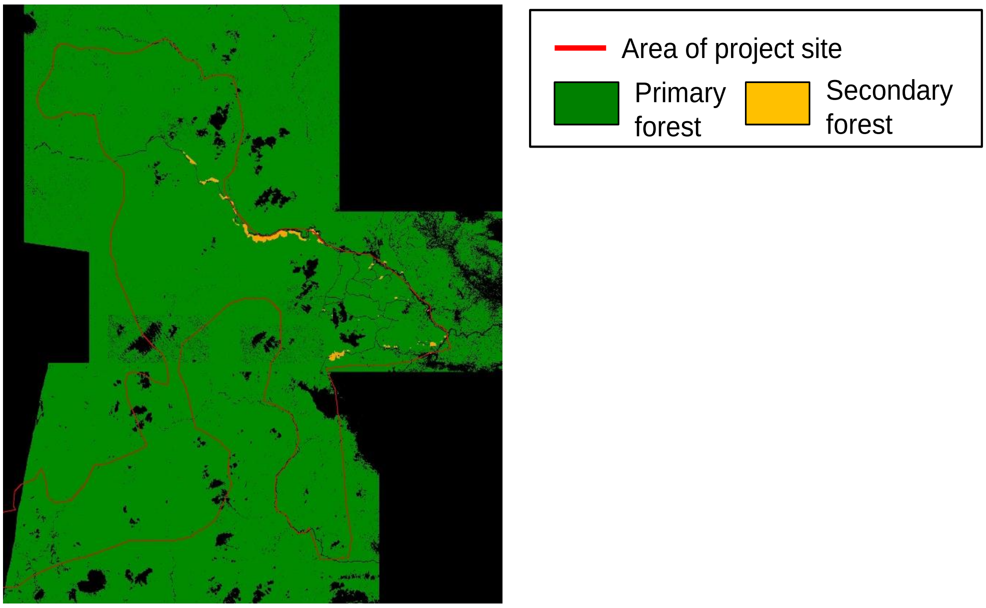


Figure: Results of secondary forest classification carried out using proxy variables

The areas of the primary and the secondary forest in the Project Site are shown in the following table (Areal Space of Primary Forest and Secondary Forest). By multiplying these by the primary-forest emission factor and the secondary-forest emission factor, the amount of emissions is calculated.

Table: Areal Space of Primary Forest and Secondary Forest)

	Primary Forest	Secondary Forest
Area [ha]	89,490	610

Emissions [Mt]	17.5	0.10

4-1. Method of Analysis Based on Super High-resolution Data

One of the main objectives of the methodologies using super high-resolution data is to reduce the number of points to be checked in in-situ survey data without compromising the precision of classification. Here, the two different methodologies have been compared in terms of the precision of the classification to evaluate the validity of this classification method. The results of the primary and secondary forest classifications carried out using super high-resolution data and the results of the in-situ surveys are shown in the following figure.

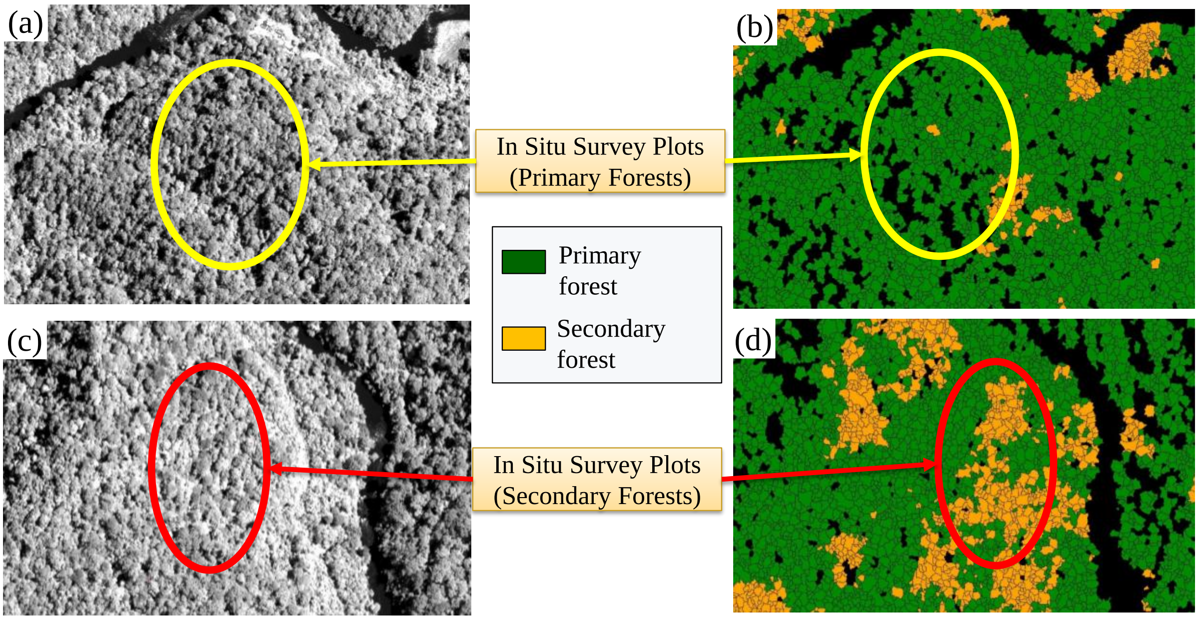
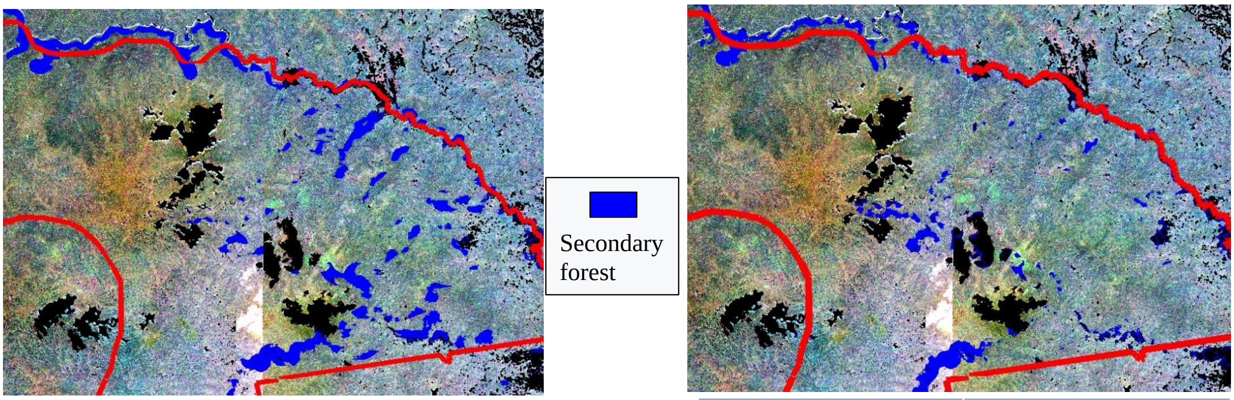


Figure: Results of primary and secondary forest classification obtained by use of Super High-resolution Data : (a) and (c) Worldview1; (b) and (d) Classification results

The results of primary and secondary forest classifications carried out with RapidEye images using the map derived from the classification results based on super high-resolution data are shown in the following figure. It can be said that the precision of the classification is almost at the same level, showing a high degree of precision. The map also shows more or less the same trends, although there are differences in some areas. As regards the areas indicated at the right in the figure, it would be appropriate for the results of future in-situ verification work to be reflected when determining parameters.

(a) (b)



(a)

Classification	Accurancy
Primary forest	71.4 %
Secondary forest	87.5 %

(b)

Classification	Accurancy
Primary forest	96.3 %
Secondary forest	72.2 %

Figure Comparison between results of two classification results: (a) Methodology using High-resolution Data, (b) Methodology using Super High-resolution Data

3) Data and parameters fixed *ex ante*

The Methodology stipulates that, as regards emission factor data used for calculating GHG emissions, either using existing emission factor data, or using emission factor data compiled by the project proponents on its own may be freely selected. In this Study, the official emission factor data compiled by the Indonesian Ministry of Forestry and widely used in Indonesia are used. This database covers areas of 22 land-cover classifications as a GIS database. The emission factor database stipulated in RAD-GRK (Emission Reduction Plan of the Province) published by the East Kalimantan Provincial Government is shown in the Table below. Based on the outcome of the Study Project for the last fiscal year, the possibility of application focusing on two forest classifications marked red and six non-forest classifications marked green, has been studied.

Table: Emission Factors per Land Cover Classification of RAD-GRK in East Kalimantan Province

No.	Land Cover	Proposed carbon stock [t/ha]
1	Primary dry land forest	195.4
2	Secondary/former logged dryland forest	169.7
3	Primary mangrove forest	170
4	Primary swamp forest	196
5	Plantation forest	64
6	Bush	15
7	Plantation/garden	63
8	Settlement	1
9	Open land	0
10	Grass	4.5
11	Water area	0

12	Secondary/former logged mangrove forest	120
13	Secondary/former logged swamp forest	155
14	Swamp bush	15
15	Dryland agriculture	8
16	Mixed dryland agriculture shrubs/garden	10
17	Field	5
18	Embankment	0
19	Airport/port	5
20	Transmigration	10
21	Mining	0
22	Swamp	0

Source: Provincial Government of East Kalimantan "Local Action Plan for Greenhouse Gas Emission Reduction East Kalimantan Province"

In addition to the land-cover database, additional information has been collected within the Project Area to improve the precision of analyses.

Table: Outline of Own Information Collection within the Project Area

Pre-set Point	Contents of Information Collected
Information on road conditions within the Project Area	GIS Data on roads suitable for car traffic within the Project Area. Development such as deforestation starts with roads. In that context, information will be collected to verify areas surrounding roads because it is highly likely that further development will take place there.
Information on rivers and streams within the Project Area	GIS data obtained on rivers and streams flowing within the Project Area. Rivers are navigable by vessels and are used for accessing gold mines in adjacent areas and for transporting goods. Log transport using rivers is taking place and further development is likely. For that reason information has been collected.
Information Collected by In Situ Surveys	Information has been collected on DHB, tree species, understory species, and rakes, etc., and photographs were taken of survey spots during in-situ surveys. Information has also been collected to obtain training data and identity data with a view to developing a biomass estimation model for the Project Area.

4) Elaboration of the JCM methodology based on applying the draft to measure GHG emission reductions

As mentioned earlier, the reference emissions in the Project Area in the case of Reference Area 2 with a relatively large area coverage are 180,000 [tCO2/year]. In this trial calculation, this value has been adopted for reference emissions resulting from the Study.

As regards the expected value of Project emissions, the precision of the calculation will have to be further improved. However, when it is presumed that the ratio of decline of forest carbon stock can be decreased to 0% through Project activities such as forest patrols, including control of illegal loggings, re-vegetation, and forest conservation, etc., the emissions reduction resulting from the REDD+ Project can reach 180,000 [tCO2/year] at maximum. Furthermore, if the Project is implemented over a period of 20 years, the total reduction of GHG emissions will reach 3.6 [MtCO2].

(3) Activities for acquiring international understanding of REDD+ under the JCM

In the process of Project implementation in the future, cooperation with the Indonesian side and contributions in the following fields may be possible and may be considered effective.

【Capacity building in the area of MRV methodologies, etc.】

As repeatedly stated in this Report, studies have been ongoing in Indonesia with a view to developing legal frameworks for REDD+. Among these studies, those on methodologies for quantitatively assessing emission reductions and on establishing monitoring methods are essential.

【Information dissemination on study outcome through actual Project Activities】

It is increasingly important in the future for information on the fruits of activities at the stage of a feasibility study and at a more advanced stage of demonstrative studies to be actively communicated, in order to contribute to promoting capacity building at a local level and enhancing local awareness on and understanding of JCM.

End