

Country Name	The Project for Carbon Dynamics of Amazonian Forests
Brazil	

## I. Project Outline

Background	<p>Amazon tropical forests have the largest scale in the world, of which 60% of them are located in Brazil. It is said that 20% of global green gas emission has been attributed to the disappearance of the tropical forests in the world. Conservation of Amazon tropical forests, where the drastic deforestation has been progressing, became one of the primal global issues from the aspect of climate change control. Brazil established several forests monitoring system using satellites, and the collected data by the systems have been utilized for the forests conservation. On the other hand, to maximize the effects of climate change mitigation by forests conservation, it was necessary to conduct impact assessments of the forests on the the amount of CO<sub>2</sub> in the air and to reflect the results into the forest conservation efforts. However, Amazon tropical forests cover a vast area and there were technical challenges to have accurate quantitative evaluation of carbon dynamics in whole Amazon region.</p>				
Objectives of the Project	<p>Through development of the continuous Forest Inventory (CFI) system, development of analytical and methodology for estimating forest's carbon stock in Brazilian Amazon as well as sharing research outputs, the project aimed at development a evaluation technique on a large-scale carbon dynamics in Brazilian Amazon forests</p> <ol style="list-style-type: none"> <li>1. Expected Overall Goal: N/A</li> <li>2. Project Purpose: An evaluation technique on a large-scale carbon dynamics of Brazilian Amazon forests is developed.</li> </ol>				
Activities of the Project	<ol style="list-style-type: none"> <li>1. Project site: Brazil/Amazon</li> <li>2. Main activities: 1) establishment of a continuous forest inventory (CFI) system, 2) development of analytical methodology for estimation of forest's carbon stock of Brazilian Amazon forests, 3) development of carbon accumulation maps for Brazilian Amazon, 4) sharing research outputs</li> <li>3. Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Japanese Side</p> <ol style="list-style-type: none"> <li>1) Experts: 14 persons</li> <li>2) Trainees received: 12 persons</li> <li>3) Equipment: 2 Pick-up tracks, satellite images, 2 Unmanned aerial vehicles (UAVs), etc</li> <li>4) Local Cost: Cost for local staff, travel expenses, procurement cost for equipment/materials, development costs for CFI, etc.</li> </ol> </td> <td style="width: 50%; vertical-align: top;"> <p>Brazilian Side</p> <ol style="list-style-type: none"> <li>1) Staff allocated: 18 persons</li> <li>2) Land and facilities: Project office (Forestry Research Lab in INPA)</li> <li>3) Local cost: O&amp;M costs for the project office (electricity, water, telecommunication, etc.), field survey costs</li> </ol> </td> </tr> </table> </li> </ol>			<p>Japanese Side</p> <ol style="list-style-type: none"> <li>1) Experts: 14 persons</li> <li>2) Trainees received: 12 persons</li> <li>3) Equipment: 2 Pick-up tracks, satellite images, 2 Unmanned aerial vehicles (UAVs), etc</li> <li>4) Local Cost: Cost for local staff, travel expenses, procurement cost for equipment/materials, development costs for CFI, etc.</li> </ol>	<p>Brazilian Side</p> <ol style="list-style-type: none"> <li>1) Staff allocated: 18 persons</li> <li>2) Land and facilities: Project office (Forestry Research Lab in INPA)</li> <li>3) Local cost: O&amp;M costs for the project office (electricity, water, telecommunication, etc.), field survey costs</li> </ol>
<p>Japanese Side</p> <ol style="list-style-type: none"> <li>1) Experts: 14 persons</li> <li>2) Trainees received: 12 persons</li> <li>3) Equipment: 2 Pick-up tracks, satellite images, 2 Unmanned aerial vehicles (UAVs), etc</li> <li>4) Local Cost: Cost for local staff, travel expenses, procurement cost for equipment/materials, development costs for CFI, etc.</li> </ol>	<p>Brazilian Side</p> <ol style="list-style-type: none"> <li>1) Staff allocated: 18 persons</li> <li>2) Land and facilities: Project office (Forestry Research Lab in INPA)</li> <li>3) Local cost: O&amp;M costs for the project office (electricity, water, telecommunication, etc.), field survey costs</li> </ol>				
Project Period	May 2011 – May 2015	Project Cost	(ex-ante) 390 million yen, (actual) 410 million yen		
Implementing Agency	National Institute of Amazonian Research (INPA), National Institute for Space Research (INPE)				
Cooperation Agency in Japan	Forestry and Forest Products Research Institute (FFPRI), Institute of Industrial Science, the University of Tokyo (IIS), Remote Sensing Technology Center of Japan (RESTEC)				

## II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

[The Expected Overall Goal (utilization of research outcomes)]

The Overall Goal was not set for this SATREPS project. However, according to the JST project completion report, the Director of the International Cooperation, INPA, a negotiator for the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC-COP) indicated an intension to use the research outputs of this SATREPS project (Amazon forests carbon stock map) as reference data for the REDD+ negotiation. Since the research outputs have been expected to be utilized for Amazon tropical forests conservation policy as well as climate change control, this ex-post evaluation tried to verify utilization status of the research outputs by this SATREPS project at the policy level. Namely, "The outcome of evaluation on large-scale carbon dynamics of Amazon forests is utilized for Amazon tropical forests preservation and climate change countermeasures" is considered as the Expected Overall Goal (utilization of the research outcomes). . It should be noted that the achievement level of the Expected Overall Goal is considered as a part of expected positive impact.

### 1 Relevance

<Consistency with the Development Policy of Brazil at the Time of Ex-Ante Evaluation and Project Completion>

The project was consistent with the Brazil's development policies at the time of ex-ante evaluation and project completion such as "Multi-Year Plan (Plano Plurianual: PPA)" (2008-2011), (2012-2015) prioritizing the environmental preservation and focusing on climate change control, and the "Plan for Prevention and Control of Deforestation in Amazon (Plano de Prevenção e Combate ao Dematamento na Amazonia Legal)" (2013 Presidential Degree) aiming to take measures for issues related to deforestation in Amazon.

<Consistency with the Development Needs of Indonesia at the Time of Ex-Ante Evaluation and Project Completion >

The project was consistent with the Brazil's and the global development needs to evaluate the forests' impact to the amount of CO<sub>2</sub> in the air, and to reflect the evaluation results into the forest preservation activities for maximizing the effects of climate change mitigation by forests preservation in Amazon tropical forests considering the huge impact on the climate change by deforestation of Amazon tropical forests.

<sup>1</sup> SATREPS: Science and Technology Research Partnership for Sustainable Development

<Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation>

The project consistent with the Japan's ODA policy for Brazil to support the environment sector, as one of the five prioritized sectors, which was agreed during the visit of President Lura to Japan in May 2005<sup>2</sup>.

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the time of Project Completion>

The Project Purpose was partially achieved by the time of project completion. Through this SATREPS project, INPA and FFPRI jointly established a forest inventory system for Amazon based on ground observation data and INPE and the University of Tokyo jointly developed analytical methodology for carbon stock parameters by using remote-sensing technologies as well as carbon stock mapping. Those developments enabled to evaluate large-scale carbon dynamics by integration of ground observation data (the forest inventory) and remote sensing data (the carbon stock mapping) (Indicator 1). The seminar was held for the Climate Change Department of the Ministry of Environment and the persons in charge of the Intergovernmental Panel on Climate Change (IPCC) in April 2014 and the representatives of the Ministry and IPCC also joined in the seminar. The benefits for both inside and outside of Brazil on this cooperation outcome, such as the forests inventory, was brought up and evaluation technique on carbon dynamics developed by the project was recognized. However, results of questionnaires to the stakeholders regarding evaluation technique was not confirmed (Indicator 2). The forests inventory technique of INPA developed by the project were utilized and contributed to the implementation of REDD+<sup>3</sup> initiative in the states of Acre, Amapá and Amazonas which are located in Amazon (Indicator 3).

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects have been continued by the time of ex-post evaluation. The techniques and research outcome developed by the project has been utilized for carbon dynamics measurement in Amazonas and Acre by INPA and private companies, and the preparation for participating in the REDD+ market by Brazil including Japanese private companies was progressing. Also, INPE has been planning to implement an image analysis project by utilizing airborne LiDAR<sup>4</sup>, a remote sensing technology for forests measurement introduced by this project. Moreover, INPA has continued their research through introduction of the Quality Assurance and Quality Control (QA/QC) for collecting carbon dynamics data in order to scaleup the research outcome of the project. In terms of the forest carbon stock mapping and the remote sensing methodology developed by the SATREPS project, the related research activities have been integrated into the activities conducted by INPA and continued as a part of the INPA's research activities.

The UAV LiDAR system, a remote sensing system, for forests measurement, which was provided by the project has been utilized and maintained by INPA. A battery of UAV has been out of order, but it has been under repaired and as of ex-post evaluation, available battery was used for minimum usage.

Although a system for sharing a part of CFI data base and remote sensing data through free access of the stakeholders to the websites of INPA, FFPRI and the University of Tokyo was established by the project, the information has not been shared to the relevant organizations through free access to INPA and INPE website at the time of ex-post evaluation. However, the data has been accessible to the external organization for free based on their requests. In particular, the information has been shared with the Amazonas branch of the Federal Police which is in charge of control of illegal deforestation.

<Status of Achievement for the Expected Overall Goal at the time of Ex-post Evaluation>

The Expected Overall Goal was achieved at the time of ex-post evaluation. Two Japanese companies have been conducting a survey on carbon dynamics in Amazonas and Acre by using the research outputs of the project, and the activities has been proceeded for the implementation of REDD+ project

Moreover, activities related to the research outcome of the project have been sporadically implemented by the government of Brazil, and INPA has been supporting initiatives of the private sectors for carbon dynamics observation, such as implementation of carbon dynamics inventory for Brazilian private companies together with Precious Woods to carry out sustainable forest resources recovery.

<Other Impacts at the time of Ex-post Evaluation>

There has been no positive or negative impacts of the project observed at the time of ex-post evaluation.

<Evaluation Result>

Therefore, the effectiveness/impact of the project is high.

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) An evaluation technique on a large-scale carbon dynamics of Brazilian Amazon forests is developed.	(Indicator 1) By the project end, a continuous evaluation of large-scale carbon stock and carbon stock change, using field and remote sensing data becomes possible at INPA and INPE.	Status of the Achievement: Achieved (Continued) (Project Completion) <ul style="list-style-type: none"> <li>● In the SATREPS project, INPA and FFPRI jointly established the forest inventory system for AMAZON based on the ground observation data and INPE and the University of Tokyo jointly developed the methodology to analyze carbon stock parameters by using the remote sensing technologies as well as the forest carbon stock mapping.</li> <li>● Evaluation of large-scale carbon dynamics integrating ground observation (the forest inventory) and remote sensing data (the forest carbon stock mapping) became possible by the project.</li> <li>● INPA, which is responsible for research on the Amazon tropical areas, has planned continuous evaluation for the post project period.</li> </ul>

<sup>2</sup> Ministry of Foreign Affairs of Japan "Japan's ODA Data by Country" (September 2009)

<sup>3</sup> It is international initiatives of reducing emission from deforestation and forests degradation which was proposed during UN framework Convention on Climate Change (COP11).

<sup>4</sup> Light Detection and Ranging, Lase Imaging Detection and Ranging

		<p>(Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>● The research activities related to the forest carbon stock mapping and the remote sensing technologies have been integrated into research activities under INPA and implemented as a part of the INPA's research activities since the project completion</li> <li>● INPA has conducting measurement of carbon dynamics in Amazonas and Acre.</li> <li>● INPA has continued the research by introducing QA/QC for collecting data on carbon dynamics to scaleup the research outcome.</li> <li>● INPE has planned to implement the image analysis project by using the airborne LiDAR, which is the remote sensing technique introduced by the SATREPS project.</li> </ul>
	<p>(Indicator 2)</p> <p>More than 50% of the related organizations to REDD+ and environmental conservation in Brazil that participated in the final workshop/seminar organized by the Project, such as ICM-BIO Embrapa, private sector, etc. recognize that the evaluation technique is useful.</p>	<p>Status of the Achievement: Partially achieved. (Continued)</p> <p>(Project Completion)</p> <ul style="list-style-type: none"> <li>● Questionnaire survey for the related organizations were not conducted.</li> <li>● The final seminar for the related organizations was held on April 27 to 29, 2014.</li> </ul> <p>(Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>● INPA and private companies have utilized the technology in Amazonas and Acre.</li> </ul>
	<p>(Indicator 3)</p> <p>More than 50% of the above organizations express their interests in utilizing the evaluation technique.</p>	<p>Status of the Achievement: Partially achieved. (Continued.)</p> <p>(Project Completion)</p> <ul style="list-style-type: none"> <li>● INPA's forests inventory technique contributed to the implementation of REDD+ initiatives in Acre, Amapá and Amazonas.</li> </ul> <p>(Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>● Refer to the Indicator 1</li> </ul>
<p>(Overall Goal)</p> <p>The evaluation result on a large-scale carbon dynamics in Amazon is utilized for Amazon tropical forests preservation and climate change mitigation.</p>	<p>(Indicator 1)</p> <p>Case study of utilizing the research achievement of this project to Amazon tropical forests preservation and climate change mitigation such as REDD+</p>	<p>Status of the achievement: Achieved</p> <p>(Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>● Utilization of the research outputs by Two Japanese companies for their carbon dynamics survey for a REDD+ project.</li> </ul>

Source : Terminal Evaluation Report, Data and information provided by INPA and INPE

### 3 Efficiency

Although the project period was as planned (the ratio against plan: 100%), the project cost slightly exceeded the plan (the ratio against plan: 105%). The project outputs were produced as planned. Therefore, the efficiency of the project is fair.

### 4 Sustainability

#### <Policy Aspect>

In Brazil, the National REDD+ Strategy Program (ENREDD+) was formulated. Evaluation of large-scale carbon dynamics in Amazon tropical forests and utilization of the evaluation results is essential for promotion of the REDD+ initiative.

#### <Institutional Aspect>

Since the project completion, the organizational structure to evaluate large-scale carbon dynamics in Amazon tropical forests and to utilize the evaluation results has been maintained. INPA has sustained the research staff including 4 researchers, 2 engineers, 5 postdoctoral researchers, and 7 postgraduate students. Also, for the utilization of the research outcomes of the project, INPA has supported REDD+ projects by the private sector and Amazon tropical forests preservation activities as mentioned above.

INPE has researchers for the research activities related to the project. They have expanded their activities such as gaining an approval on the airborne LiDAR image analysis project from the Amazon Foundation.

In terms of the institutional arrangement for utilization of the research outputs and the research outcomes, as mentioned above, the data related to carbon dynamics are freely accessible for the external institutions on a request basis though the data have not been shared with them on the websites of INPA and INPE with free access. In particular, the data have been shared with the Amazonas Office of the Federal Policy, which is responsible for monitoring illegal logging.

#### <Technical Aspect>

INPA improved their capacity on preparing academic papers through the project. In relation to the research outputs of the project, INPA has actively had interactions with other academic institutions in and outside of Brazil. INPA has absorbed further advanced technology from these institutions and shares their research outputs. According to INPA, the Forests Management Lab (LMF) has a rule that each staff member should become an expert in an area in charge. Also, since the project completion, since each researcher has continuously made their efforts for their self-development, and actively cooperated with other organizations, necessary knowledge and skill for operation and maintenance for research facilities and equipment have been sustained.

As mentioned above, INPE has developed their activities such as gaining the approval from Amazon Foundation on the airborne LiDAR image analysis project. INPE has sustained the necessary capacity for their activities utilizing this project research outputs.

On the other hand, for the utilization of the research outcomes, although INPA has been addressing to the new Minister of Science and Technology appointed in 2019, due to the personnel transfers in the federal government after the new presidency started in 2019, scientific literacy in the government authorities on the research outputs by the project has not been improved. It is necessary to pay attention for

future prospect under the situation where the new administration has revealed their skeptical view on the roles of INPA and INPE and proposed to delegate a part of their responsibilities to the private sector. In addition, there have been issues to improve literacy of the government authorities on the research outputs since the Ministry of Environment and the research institutes of INPA and INPE have not necessarily had same positions on the forest conservation in Amazon.

<Financial Aspect>

Both research budget for the forest inventory and the maintenance budget for research equipment comes the research budget allocated by the National Science Technology Council. Since 2015, 60 million reals has been allocated annually, and the same amount is expected to be allocated in 2020. Also, regarding INPE, they have received an approval of the project from the Amazon Foundation. Other than those, INPA and INPE have secured their budget from the Coordination for the Improvement of Higher Education Personnel (CAPES) and the Amazonas State Foundation of Research Assistance (Fundação de Amparo à Pesquisa do Estado do Amazonas: FAPEAM) for the utilization of research outcomes. However, there are critical conditions on the budgets of INPA and INPE under the new administration. In particular, it is essential for INPA and INPE to ensure their budget continuously because FAPEAM has suspended disbursement of their fund due to the forest fires in Amazon since January, 2019. In addition, it is necessary to pay attention to actions by relevant institutions related to their future budgets of INPA and INPE under the situation where the federal government promoted to reduce budgets for public and educational institutions.

<Evaluation Result>

Since there are some issues observed in the technical aspect, the sustainability of the project effects through the project is fair.

5 Summary of the Evaluation

The project was partially achieved the Project Purpose through the establishment of evaluation technique on carbon dynamics including the forests inventory and achieved the Overall Goal through the utilization of established techniques. As for sustainability, although it has not reached to the improvement of scientific literacy for the utilization of research outcome of the project towards actions to be taken in the federal level, the implementing agencies have sustained their organizational structure and capacity for continuing the related research activities as well as necessary research budget. As for efficiency, the project cost slightly exceeded the plan.

Considering all of the above points, this project is evaluated to be satisfactory.

### III. Recommendations & Lessons Learned

Recommendations for Implementing Agency:  
(INPA and INPE)

INPA and INPE did not well organize the achievements (materials for the seminars) from this project, and during the survey for this ex-post evaluation, it took time to provide the necessary information. It is required for INPA and INPE to reorganize the achievements for reviewing them and promptly sharing information. At the same time, it is necessary for them to actively share the organized information with the relevant public and private organization as well as research institutes in order to strength the efforts for the utilization of research outcomes as the SATREPS projects aim at utilization of research outcomes based on their research outputs.

Lessons Learned for JICA:

In case of Brazil, implementation of projects in the environment sector require to make involvement many organizations including the Ministry of Environment in federal level, government offices in the states and municipal level, and research institutes such as INPA and INPE. In this project, other than INPA and INPE which were directly involved in the research, cooperation with the Ministry of Environment and each state was necessary, and INPA as a main actor collaborated with the other organization. This brought about the smooth implementation of the project. A SATREPS project, which aims for utilization of the research outcome, it is essential to promote effective information sharing and cooperation between relevant organization including different level of government organizations, research institutes and private sector at the stages of project preparation and implementation. Currently, the politics for the conservation of Amazon under the new administration have been carefully watched since the pressure on development of Amazon has increased in Brazil after the change of the government in January 2019 and the large scale forest fires have frequently occurred. JICA has provided technical cooperation for the conservation of Amazon by using scientific methodologies, including this SATREPS project. It is desirable to jointly compile and organize them with the implementing agencies as JICA's institutional memories not only for presentations by seminars for the implementing agencies and other stakeholders at the time of project completion but also for effective and timely dissemination to the stakeholders even in the post project period in order to adequately use them as scientific evidences.



The staff of INPA continuing the research activities since the SATREPS project



Functional equipment provided by the SATREPS project