# Ex-Post Project Evaluation 2016: Package II-8 (SATREPS)

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### JAPAN INTERNATIONAL COOPERATION AGENCY

**OPMAC** Corporation



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#### Republic of Indonesia

FY2016 Ex-Post Evaluation of Technical Cooperation Project (SATREPS<sup>1</sup>)

"Wild Fire and Carbon Management in Peat-forest in Indonesia"

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#### 0. Summary

The purpose of the project was to promote the implementation of  $\text{REDD}^{+2}$  in Indonesia by developing a fire detection and fire prediction system, remediation of peatlands and forest through efficient water management, and establishing effective absorptive and storage capacity for greenhouse gas, and particularly CO<sub>2</sub>.

The importance of forestry management for reduction of greenhouse gas generation and the regional importance of Kalimantan, are consistent with Indonesian development policy. Further, they have been consistent with the need for the management and remediation of peatland which has grown in recent years. In Japanese development assistance policy, importance is assigned to the field of climate change and conforms to the policy of promoting a comprehensive approach. Therefore, the relevance is high. Regarding effectiveness, as a study of assessment of carbon emission, as well as that of carbon management methods, have been specifically engaged from various perspectives, it has been partially accomplished. However, regarding the establishment of a system for appropriate management of peatland and forests, to be shared with the government of Indonesia as well as the international community, as well as building a system for prevention of global warming, were not achieved because the planned activities during the project period were not carried out. Regarding impact, efforts for actual application are continuing towards a functional system of Measuring, Reporting, and Verification (MRV)<sup>3</sup>. Note that because no overall goal was set, this is not included in the evaluation of the project impact. Another collateral impact is the achievement of efficiency in broad-area water management by the system to measure hydrological data procured by the project. Therefore, effectiveness and impact are fair. The project was completed within the time provided and project cost exceeded the planned amount so that efficiency is fair. Sustainability is judged to be high, as the necessary policy rationale for continuation of the results of the project, its institutional arrangements, technical aspects, and financial aspects are still in effect, reflecting the need for peatland recovery in Indonesia.

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

<sup>&</sup>lt;sup>2</sup> The addition of the concept of preserving the carbon stock of forests, management of forests for sustainability, and improvement of the forest carbon stock in accordance with COP13 (The 13<sup>th</sup> Conference of the Parties, 2007) to the proposal at COP11 (2005) for "Reducing Emissions from Deforestation and Forest Degradation in Developing Countries" (REDD) resulted in what is known as REDD+. Up to this time, REDD+ had not been formally positioned in accordance with the Kyoto Protocol, but was formally recognized at the COP21 (effective November 2016, applicable 2020 onwards) by *Article 5, Paragaph1 of the Convention, "Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases (snip) including forests,"* and a following Paragraph 2 indicates the REDD+ was officially positioned as "*Parties are encouraged to take action to implement and support(snip).*"

<sup>&</sup>lt;sup>3</sup> That is, an integrated system of Measuring, Reporting, and Verification, that would scientifically assess volume of greenhouse gas, facilitate reduction of emissions, and be the basis for ensuring effective environmental management measures.

In light of the above, this project is evaluated to be satisfactory.

#### 1. Project Description



**Project Location** 



Ecological analysis of peatland by using a reagent

#### 1.1 Background

There has been rapid, intensive development of marshland in Indonesia since the end of the 20<sup>th</sup> century. As one result, tropical peatland has been destroyed, and immense volumes of greenhouse gas have been released into the atmosphere by fires and microbial degradation<sup>4</sup>. In particular, during the Suharto administration, through the Mega-Rice Project, efforts were made at agricultural reform for peatland in Central Kalimantan. But it ended in failure because the high acidity of peatland was found to be unsuitable for agricultural cultivation, and the developed area was left further desolated. In the meantime, construction of irrigation facilities led to the extraction of water from marshland areas, causing a decrease in groundwater level that raised the risk of fires. Further, in years of El Nino<sup>5</sup> wildfires, especially in peatland areas, are believed to have caused the release of large volumes of greenhouse gas into the air. Smoke haze has had the effect of damaging the social and economic welfare of local residents living near peatland areas, and the deterioration of peatland has caused serious problems of landslides during the rainy season.

The above-mentioned issues of global warming and development have been studied by university researchers in Indonesia and at Hokkaido University, specifically concerning matters of tropical peatland mainly in the peatland regions of Central Kalimantan. It was discovered that proper control of groundwater was the key to preventing peatland fires, and on the basis of this

Source (Japan Meteorological Agency: as of August 2017):

 $<sup>^4</sup>$  A majority share of the world's tropical peatland is said to be in the Southeast Asia region: 68% and of this 85% is in this country.

<sup>&</sup>lt;sup>5</sup> The El Nino effect increases in sea surface temperature above normal year from the vicinity of the Equator and International Date Line towards the Pacific Coast of Latin America, lasts for about a year, and occurs every few years. Major occurrences since 2000 were in 2002-2003, 2009-2010, and 2014-2016.

http://www.data.jma.go.jp/gmd/cpd/data/elnino/learning/faq/elnino\_table.html. (as of Aug 2017)

finding, the Indonesian government has sought to establish a strategically realizable method for achieving this.

This project has been adopted as an undertaking in the SATREPS program and was implemented with cooperation by the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). This program undertakes joint research with institutions in developing countries on global issues such as the environment, energy, disasters, and on measures to combat infectious disease, while also contributing to the improvement of the capabilities of those institutions.

#### 1.2 Project Outline

At the time of the ex-ante evaluation of the project, the preparation of a Project Design Matrix (PDM) was not required for SATREPS projects, and the basic plan for the project was agreed as stated in the Record of Discussion (R/D). Subsequently, at the time of the mid-term review, the indicators and their target values, as well as the action plan, were re-examined and revised. The evaluation was done on the basis of these revisions. At the time of the terminal evaluation, an agreement was reached in accordance with the revised basic plan, project purposes and each achievement for output as per the conventional PDM. Because no overall goal had been set for the project, the project impacts were taken up at the time of the terminal evaluation. The ones which could be positioned as working to achieve "utilization of research outcome" were considered to be "expected impacts (overall goal)", and the situation for those after completion of the project was confirmed. What to set as the "expected impact" was determined by the evaluator, and not formally agreed upon by concerned parties on both sides of the project and therefore was not taken into account in judging the degree of accomplishment of an overall goal but was separately verified, provisionally, as part of the impact.

Overall Goal		Not specified		
Project Purpose		Peat-forest management method to reduce carbon emission is developed		
Output(s)	Output 1	Fire Detection and Fire Prediction System are established		
	Output 2	Carbon Assessment System is established		
	Output 3	Carbon Management System is established		
	Output 4	Integrated Peatland Management System is developed		
Total o (Japanese	cost e Side)	384 million yen		
Period of Co	operation	November 2009 – March 2014		
Implementing Agency		At start of project (R/D signed) the National Standardization Agency of Indonesia (BSN) At completion of project: Agency for the Assessment and Application of Technology (BPPT)		
Other Relevant Agencies / Organizations		University of Palangkaraya (UPR) (Primarily engaged in Output 3) Indonesian Institute of Sciences (LIPI) (Primarily engaged in Output 2) Indonesian National Institute of Aeronautics and Space (LAPAN) (Primarily engaged in Output1) Forestry Research and Development Agency (FORDA <sup>6</sup> ) Note: It was expected that all the institutions would be involved in Output 4		
Supporting Agency/Organization in Japan		Supporting Organization in Japan: Hokkaido University Cooperating institutions: Ehime University, University of Tokyo, Japan Aerospace Exploration Agency (JAXA)		
Related Projects		<ul> <li>[Technical Cooperation]</li> <li>Forest Fire Prevention Project by Initiative of People in Buffer Zone (2006-2009)</li> <li>The Project for the Support on Forest Resources Management through Leveraging Satellite Image Information (2008-2011)</li> <li>Project for facilitating the implementation of National Forestry Strategic Plan (2009-2012)</li> <li>Program of Community Development of Fires Control in Peat Land Area (2010-2015)</li> <li>Indonesia-Japan Project for Development of REDD+ Implementation Mechanism (IJ-REDD+) (2013-2016)</li> <li>[Others (private sector partnership)]</li> <li>Governmental Commission on the projects for ODA overseas</li> <li>Economic Cooperation in FY2013</li> <li>Project Formulation Survey for Dissemination of the Real-time Monitoring System Using a Mobile Communication Network in the Republic of Indonesia</li> <li>Verification Survey with Private Sector for Disseminating Japanese</li> <li>Technologies in FY2015</li> <li>Survey on Real-time Monitoring System (SESAME system) for Improving Data Collection Efficiency for Multipurpose Dam Management and Climate Change Countermeasures in the Republic of Indonesia</li> </ul>		

<sup>&</sup>lt;sup>6</sup> After completion of the project, the Widodo administration starting in Oct 2014, combined the Environment and the Forestry ministries to form the Ministry of Environment and Forestry, and FORDA that had been under the Forestry Ministry was reorganized under the Ministry of Environment and Forestry, and at the time of the ex-post evaluation had been renamed FOERIDA.

#### 1.3 Outline of the Terminal Evaluation

The project purpose as stated in the ex-ante evaluation sheet and the terminal evaluation report, "construction of a model for fires and carbon management in peatland forest areas," was defined as to make clear "the carbon balance in peatland forests (carbon emissions and absorption)," study of measures and methods for proper control of peatland forests, share the information, measures and methods acquired with the Indonesian government and the international community, and build an institutional framework for contributing to concerted efforts to mitigate global warming.

Four indicators for this were adopted and are as follows. (1) Clarification of the carbon balance in peatland forests (carbon emissions and absorption), (2) Investigation of methods and means for appropriate management of peatland and forests, (3) Establishing a system for sharing information, methods, and means with the Indonesian government and international community, and (4) Building a system by the counterpart for mitigation of global warming.

Regarding indicators (1) and (2) there had been planning in coordination with the content of the project activities. However, as for indicator (3) and (4), despite that there were no specific activities assigned under the indicators as well as no guideline given as to how to achieve the objectives, those indicators were set to be accomplished during the project period.

#### 1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The terminal evaluation states that "it is expected that the project purpose will be accomplished by the time of project completion. However, it is believed that accuracy was lost because it was judged that the project purpose of building "a model" was misinterpreted to be establishing "methods" instead. It was deemed that lack of clarity of the plan caused this issue of lack of accuracy.

#### 1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation

No overall goal was set at the time of the ex-ante evaluation. However, two points were indicated as goals to be achieved at the time of project completion in line with an engaging utilization of research outcome, namely (1) the building of a carbon reduction model that would contribute to promoting REDD+ in Indonesia, and (2) actual deployment of an MRV system for peatland<sup>7</sup>. In addition, in the terminal evaluation, the range of "impact" of joint public-private research activities derived from research work of the project, indicated a deepening of bilateral relations between Indonesia and Japan.

<sup>&</sup>lt;sup>7</sup> This is the major issue in carrying out the work of REDD+ in Indonesia. To assess actual volume of emission, it requires regularly scheduled monitoring of the status of peatland and forest reduction and degradation (change in area and in carbon storage volume). It is widely recognized that monitoring is effectively done by remote sensing plus surveys on the ground, but attention must be given to many issues in order to establish a feasible means of accurately monitoring of the widespread area at the national or regional level.

## Building a model of a carbon reduction system, in contribution to the promotion of the Indonesian REDD+ program

The outlook for achievement was not discernable at the time of the terminal evaluation. It was intended that in conjunction with Output 1, Fire Detection and Fire Prediction System was to be established, and Output 3 Carbon Management System was to be established, it would be able to build a practical-use model. At the time of the ex-post evaluation, as the way towards accomplishing utilization of research outcome was postulated as seeking promotion of REDD+ through peatland remediation in Central Kalimantan through the practical application of each output in regional society.

#### Introduction of an MRV system for peatland

At the time of the terminal evaluation, the outlook for achievement by the time of project completion was not discernable at the time of project completion. Concerning the research results for Output 2, Carbon Assessment System is Established, which was to be an important part of the MRV System, the outlook was that there would be the establishment of an evaluation system workable in the project area where the actual measurement was possible. In the ex-post evaluation, it was expected that in the event that an MRV System was put to use, the final user would be the present Ministry of Environment and Forestry that is in charge of REDD+ in the central government.

#### 1.3.3 Recommendations from the Terminal Evaluation

#### Points for caution in explaining project outputs

Their understanding of the project results is not enough so that it does not reach the stage to utilize them for policy/decision-making process. Thus, it is necessary to translate the peat-forest management method and MRV system for policy-formulators to understand easily in order to apply the research outcomes. It is also recommended that the project will prepare official brief policy paper to policy/decision makers.

#### Consideration of both project goals and socio-economic aspects

Simulating future land use change is one of the major concerns of the provincial government of Central Kalimantan. In that context, the team would like to re-emphasize the importance of the socio-economic aspects to achieve the project purpose, i.e. "development of peat-forest management method to reduce carbon emission.

#### Specific aspects of users of project outputs and preparation of a manual

The organization which will take over each project outcome after the project should be designated, and the operation manuals of activities, e.g. peat-fire control and tree planting, should be prepared by the end of the project.

### Re-confirmation of information and data regarding degree of attainment of each indicator

As examined the achievement of the indicators set by the PDM for the project, the team found that the achievements of some quantitative indicators are not well verified and recommended that preparations be made for the achievement of the quantitative indicators by the end of the project.

#### Thoroughness related to management of supplied equipment materials

The evaluation team confirmed the utilization and maintenance of research equipment provided by the project was considered largely appropriate. Some of the equipment that had transported from Japan was not on the list of the equipment. The team hence requested to add the equipment to the list immediately.

#### 2. Outline of the Evaluation Study

2.1 External Evaluator

Miho KAWAHATSU, OPMAC Corporation

#### 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule. Duration of the Study: September 2016 to January 2018 Duration of the Field Study: January 2, 2017 to January 17, 2017 May 1, 2017 to May 8, 2017

#### 3. Results of the Evaluation (Overall Rating: B<sup>8</sup>)

- 3.1 Relevance (Rating: <sup>(3)</sup>)
  - 3.1.1 Consistency with the Development Plan of Indonesia

At the time of the ex-ante evaluation, although Indonesia had not taken on an obligation to reduce the emission of greenhouse gas, in 2007 at the COP13 meeting of the United Nations Framework Convention on Climate Change (UNFCCC) declared its adoption of the *National Action Plan Addressing Climate Change* as its international commitment to curb the emission of the gas. Further, reflecting the strategic importance of the peatland areas of Central Kalimantan, that is the object of this project, in 2007 the *Presidential Decree No. 2/2007 on the Acceleration of Rehabilitation and Revitalization of the Peatland Development in Central Kalimantan* was issued and a major initiative at restoring peatland in Central Kalimantan was begun. At the time of project completion, in 2009 at COP15, President Yudhoyono announced continued support for the reduction of greenhouse gas by 2020. In 2011 including "natural forests and peatlands" as its target<sup>10</sup>, *Presidential Decree No. 61/2011* established a national

<sup>&</sup>lt;sup>8</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>&</sup>lt;sup>9</sup> ③: High, ②: Fair, ①: Low

<sup>&</sup>lt;sup>10</sup> There is not necessarily internationally common consensus on making peatland an objective of REDD+ but in Indonesia's REDD+ strategy it is clearly stated that "natural forests and peatlands" is an objective.

action plan for reducing the generation of greenhouse gas, *Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca (RAN-GRK)*, and each provincial government formulated its own plan (*Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca (RAD-GRK)*). With the growing awareness of the strategic importance of effective management of peatlands, the nation strengthened its state implementation arrangements to deal with the issue, as *Presidential Decree No. 62/2013* of 2013 enabled the REDD+ agency to be established. Further, in Central Kalimantan Province, acting according to a directive of the REDD+ agency, it took the initiative and declared it to be a pilot province for REDD+<sup>11</sup>.

From the time of the ex-ante evaluation to project completion, in terms of achievement of the reduction target of greenhouse gas in Indonesia as state development policy, the importance of peatland management and, in particular, the regional importance of Central Kalimantan Province where peatlands are widely distributed, was addressed. Thus, this project is highly consistent with Indonesia's national policy.

#### 3.1.2 Consistency with the Development Needs of Indonesia

At the time of the ex-ante evaluation, there had been many forest fires around the nation caused by the conversion of the use of forest land to agriculture and large-scale development of oil palm plantations. As a result, there was a serious decrease in the area of forest land and awareness of the gravity of the large-scale release of greenhouse gas into the atmosphere had risen. The country's emission of greenhouse gas, considering the influence caused by the deforestation and changes in land utilization, made Indonesia the third-greatest source of the gas, after the USA and China, and more than 80% of the emission was caused by a fire in forest and peatland areas. Also, at the time of the project completion, there were human-caused fires during the dry season, as well as the fire-causing effect of El Nino. In particular, the fires caused after the completion of the project by cyclical El Nino effects in 2015 were a disaster of hitherto unexperienced proportions; as much as approximately 250 ha of forest and peatland burned.

From the ex-ante evaluation to the completion of the project, the development need of peatland management was consistently high. Particularly in Indonesia, the need for the recovery of fragile fire-prone peatland and the carbon management has been at an all-time high and they have even grown into more serious problems.

<sup>&</sup>lt;sup>11</sup> In 2010 Indonesia formed its National REDD+ Task Force, and in 2012 the Task Force selected Central Kalimantan as the pilot area. Source: http://theredddesk.org/countries/indonesia (as of August 2017).

#### 3.1.3 Consistency with Japan's ODA Policy

In Japan's Official Development Assistance Charter as formulated in 2003, while basically positioned on the viewpoint of "human security" it took up the matter of the coexistence of the environment and development, as the basic principle for the provision of development aid. In the Country Assistance Program for Indonesia, formulated in November 2004, protection of the environment was included in one of the priority subjects of "building a democratic and fair society." With international concern over global environmental issues and especially climate change increasing, the *Country Assistance Policy for Indonesia* (in April 2009) in the priority aid section for "environment" and the development subject "environment" had "Assistance Program for Countering Climate Change" and "Cooperation Program for Environmental Protection" whereby a comprehensive approach was planned to be demonstrated. Therefore, at the time of the ex-ante evaluation, the project was consistent with Japanese aid policy.

#### 3.1.4 Appropriateness of the Project Plan and Approach

In connection with the building of an MRV system for the peatlands, a final goal of the project, because of the need for measuring and monitoring work in the field over a period of years, and joint research to scientifically elucidate relevant phenomena through validation in Indonesia, it is believed appropriate for implementation of the project to be included in SATREPS as one that initiated support for joint research work with personnel of the implementing agency. However, as stated in section 1.3, Outline of the Terminal Evaluation, some of the indicators of achievement of the project did not include specific activities, an implementation schedule, and so on, and allocation of responsibility in the organization was not clear. Because research institutions were implementation bodies, it may be that there was a confusion between their own research goal to be realized in the medium to long-term, and the project purpose which was to be accomplished within the project period. Further, in addition to the situation of testing of hypotheses through trial and error in conventional research activity, and the presumption that the trajectory of a research plan had been adjusted in accordance with acquisition of quantitative data, considering that in the present field, in particular, the possibility of forecasting conditions in the country and elsewhere in the framework of climate change is low, it is understandable that it is difficult to obtain an outlook for the achievement of the project purpose.

In view of the above, the implementation of this project conforms to development policy based on Indonesia's international commitments, the development needs related to the recovery of peatlands and carbon management, as well as Japanese ODA policy. Moreover, regarding the appropriateness of the project's plan and approach and so on, while there was a need for specificity in the plan of activities for autonomy and sustainability of the local implementing agency, in this field, the implementation of the project through joint research was appropriate. Therefore, relevance is high.

#### 3.2 Effectiveness and Impact<sup>12</sup> (Rating: 2)

#### 3.2.1 Effectiveness

#### 3.2.1.1 Project Output

Because it was indicated in the terminal evaluation report that in the implementation of this project it was necessary to ① verify the carbon dioxide flux<sup>13</sup>, and its density ② make observations of hotspots<sup>14</sup>, ③ undertake a mapping of forest degradation and inhabitant species, ④ ascertain the deforestation and decrease of biomass, ⑤ ascertain groundwater level and soil water, ⑥ identify peat domes<sup>15</sup> and estimate the thickness of the peat layer, ⑦ determine the peat subsidence and ⑧ determine the amount of water-soluble organic carbon, the effectiveness of the project is judged based on the achievement of the related activities of results of data measured and analyzed of the 8 elements together with implementing agencies in Indonesia by the project completion, as they were aligned under each output. As a result of the collection of information from questionnaire responses from the implementing agency and interviews, the status of achievement of each output was as follows at the time of project completion.

#### < Output 1 > Fire Detection and Fire Prediction System<sup>16</sup> are established

For actual application of the system in Indonesia, a policy measure must be adopted by the Central Kalimantan government, and although there are unresolved issues, from the viewpoint of the building of a technical system mostly using algorithms and design of a tool based on it, the output has almost been achieved.

#### < Output 2 > Carbon Assessment System<sup>17</sup> is established

Although at the time of project completion there had been validation regarding the assessment of carbon volume generated by fires, this was not at the stage of completion. The Indonesian response was that there had been insufficient efforts regarding the influence of the system on the ecosystem. As for this output, research is being continued and an assessment model is being created based on collected data, but the initial target value was

<sup>&</sup>lt;sup>12</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

<sup>&</sup>lt;sup>13</sup> Measures movement of CO<sub>2</sub> in units of hours.

<sup>&</sup>lt;sup>14</sup> A potential place of huge volume of CO<sub>2</sub> emission such as by fire etc.

<sup>&</sup>lt;sup>15</sup> Tropical peatland often forms domes in lowland areas.

<sup>&</sup>lt;sup>16</sup> Methods and tools (such as maps) is to be developed for detection and forecasting of fires; these are supposed to be used in Indonesia, indicating that there is capability to engage in activity for fire detection and forecasting.

<sup>&</sup>lt;sup>17</sup> A method is to be developed for assessing carbon balance of peatlands and/or forests (the volume of emission and storage).

not achieved at the time of project completion.

#### < Output 3 > Carbon Management System<sup>18</sup> is established

In connection with verification of groundwater level, it is believed the output has been achieved as a result of empirical research using the SESAME system<sup>19</sup> (a system for transmission of field data) developed by a Japanese company. Regarding development of a vegetation remediation plan and a fire prevention strategy, however, considering that those issues had not yet been incorporated in the local implementation arrangements, the objectives were not achieved, so some issues remained outstanding regarding the manifestation of effects.

#### < Output 4 > Integrated Peatland Management System is developed

The definition of "foundation for comprehensive carbon management" and standard for judging the degree of accomplishment have not been made clear. Regarding judgment of the degree of accomplishment of this output, therefore, the basis for judging activities related to the status of Outputs 1, 2, and 3 at the time of project completion, for sustaining the "foundation" indicated as the content of Output 4. From this viewpoint, since the operation and maintenance of a database and so on had been halted, some issues remained outstanding from the time of terminal evaluation to the time of project completion. Nevertheless, a start has been made during the project period at building a model that, by means of this project, would attempt to assess emission volume based on the correlation between carbon emission volume and the level of groundwater, research and development of which was confirmed ongoing at the time of the ex-post evaluation, so there has been the partial accomplishment of this output.

#### 3.2.1.2 Achievement of Project Purpose

At the ex-post evaluation, the relationship of each output and project purpose was realigned as shown in Figure 1. Output 4 was presumed to establish a comprehensive system incorporating the above-mentioned Outputs 1, 2, and 3. As assumed to be the next step from Output 3, Output 4 contains "introduction of a fire system for peatland and forests and carbon control system are to be included in policy formation and institution building processes," but specific activities for this were not in the basic plan. Further, when a check was made with

<sup>&</sup>lt;sup>18</sup> A carbon management system (to curb the emission) is to be established by the partnership with related parties such as local administration, research institutes, communities through information collection and data analysis of vegetation activities on a trial basis.

<sup>&</sup>lt;sup>19</sup> There is a telemetric system using cloud services that collect field data by use of sensors for groundwater, rainfall and so on, recording the data on the spot, transmitting data by means of a mobile telephone network to a server installed at some remote location, recording the transmitted data and outputting it for analysis, and sending the results to a client computer. Particularly, it enables to show data in real time as graphs and maps, providing benefit in displaying the result of broad-area monitoring at a distant location.

the implementing agency on the Indonesian side, it was found that no substantial action has been taken in this regard during the project.



Figure 1: Relationship of Project Outputs to Project Purpose

According to results of questionnaires sent to the University of Palangkaraya and other implementing agencies regarding accomplishment of project purpose, there were a number of issues requiring verification in the "peatland and forest fire and carbon management model," indicating that the model was still in the stage of development. In particular, research issues remained concerning the magnitude of the carbon balance and peatland fires. However, as stated above for Output 4, progress during the project in research on assessment of the volume of carbon emission was in the process of clarifying the effectiveness of the methodology. Further, as stated for Outputs 1, 2, and 3 although progress to the stage of actual use had not been made, there had been multifaceted, tangible research on the abovementioned eight elements that were subjects of project research for validation of carbon management and assessment. Therefore, it is believed that in relation to project Indicators ① and ② goals had been accomplished.

As described above, in the case of Indicators (3) and (4), specific activities and indicators for evaluation had not been included in the plan. Further, these indicators are essential not only for Central Kalimantan Province but also for objective policy formation by the central government and it was also confirmed that because the organizational mission of the implementing agencies of the project is primarily on research, it was inherently on a different dimension from such activities, specific activities thus were neither carried out nor planned. Therefore, it is considered that related issues had not been accomplished with regard to Indicators (3) and (4).

Purpose	Indicator	Achievement
Peat-forest management method to reduce carbon emission is developed	Indicator ① Clarification of the carbon balance (emission volume and absorption volume) in peatlands and forests	During the project, activities related to Outputs 2 and 3 engaged in the main validation. Although a model for the mechanism of the carbon balance in the target region had not been built by the time of completion, valuable information had been collected and analyzed through the activities, so there was a partial achievement.
	Indicator ② Investigation of methods and means for appropriate management of peatland and forests	Validation was done from the viewpoint of recovery of vegetation and prevention of fires, mainly through activities for Outputs 1 and 3 in the target region.
	Indicator ③ Establishing a system for sharing information, methods, and means with the Indonesian government and international community	The planned activities were not performed during the project and a system for sharing was not established.
	Indicator ④ Building a system by the counterpart for mitigation of global warming	The planned activities were not performed during the project and a system for mitigation of global warming was not built.

Table 1: Achievement of Project Purpose

As stated above, because there were indicators with no specific planned activities required for the project purpose, it was difficult to fully achieve the purpose by the activities done for the project. Thus, some parts of the project purpose were not achieved.

#### 3.2.2 Impact

The evaluation was done by taking up the content of the lessons learned in the terminal evaluation as the shared understanding of the concerned parties and with the evaluator's use of "expected impact" in place of an overall goal. Because the project did not specify an overall goal, the degree of achievement of the "expected impact" was not added to the evaluation judgment.

In SATREPS projects, not only to have the academic achievement, but it is also required that there be an approach to the utilization of research outcome in the



overall goal or expected impact, but as stated in section 1.2, Project Outline, above, there was no overall goal set for this project. However, as stated in section 1.3.2, Achievement Status of Overall Goal at the Terminal Evaluation, although not specified the timeframe for the achievement, "Building a model of a carbon reduction system, in contribution to the promotion of the Indonesian REDD+ program" and "Introduction of an MRV system for peatland" were indicated to be objectives to aim for, and hence were provisionally used as the overall goal of the project and the status of their achievement was verified for the ex-post evaluation.

#### 3.2.2.1 Achievement of Overall Goal (For reference)

As stated above, although no overall goal had been set for the project, of the impact given in the terminal evaluation, "Introduction of an MRV system for peatland" and "Building a model of a carbon reduction system, in contribution to the promotion of REDD+ in Indonesia" that can be positioned as being an approach to "utilization of research outcome" were provisionally verified as the equivalent of an overall goal.

First of all, "Introduction of an MRV system for peatland" is provisionally taken as the establishment of an effective MRV system that can confirm from a scientific standpoint effort at advances in carbon reduction by the utilization of the REDD+ framework. From this perspective, by means of activities primarily for Output 2 of the project, using the "carbon assessment model" developed by a combination of the model of forecasting groundwater levels and data of actual groundwater levels obtained by use of the SESAME system, the research stage has been reached at which it is possible to quantifiably assess the effect of carbon reduction when the water level is being managed to maintain it at a certain level. The project's implementing agency is participating in the Indonesia Japan Project for Development of REDD+ Implementation Mechanism: IJ-REDD+<sup>20</sup>, now being implemented as a technical cooperation project. With actual execution in mind, a manual<sup>21</sup> has been drafted and training has been carried out for strengthening the capability of MRV at the level of the province.

On the other hand, the "Building a model of a carbon reduction system, in contribution to the promotion of the Indonesian REDD+ program" is being implemented by the abovementioned IJ REDD+ in West Kalimantan Province; it is not limited to the peatlands targeted by the project, but rather has the general framework for forest management in Indonesia and is not directly related to Output 3 of the project.

<sup>&</sup>lt;sup>20</sup> In order to utilize the international framework of REDD+ to the maximum extent, and to contribute to efforts for Indonesia's achieving its greenhouse gas emission reduction target, this technical cooperation project aims at working to operate and institutionalize REDD+ mechanisms at the provincial level, by developing methodology for limiting forest shrinkage and degradation, through demonstration in the field by giving support for building workable REDD+ mechanism in West Kalimantan Province and Central Kalimantan Province. With the intent that the results of that is expected be reflected at the central government level in the national REDD+ mechanism. From the viewpoint of the follow-up of the SATREPS project, collaboration is continued to be made for the Output 4 "Strengthening the capacity for MRV in Central Kalimantan" of the related technical cooperation project.

<sup>&</sup>lt;sup>21</sup> IJ REDD+ Project, Guidebook for Estimating Carbon Emissions from Tropical Peatlands in Indonesia, Feb. 2016.

Expected Impact	Present status
Actual use of an MRV system for peatland	- Regarding Output 2, at the time of the ex-post evaluation, a manual etc., for measuring carbon emissions at the level of the province had been made as a part of the specific activities of the technical cooperation project Indonesia-Japan Project for Development of REDD+ Implementation Mechanism (IJ-REDD+).
	- Through 2018, the research result of this project will be evolutionarily used in the current extension phase of IJ-REDD+. There are scientifically unresolved issues, however, regarding the evaluation of the carbon emission volume caused by peatland fires, and it is planned to be validated by using methods such as PALSAR. <sup>22</sup>
Building a model of carbon reduction system, in contribution to the promotion of the Indonesian REDD+	- Regarding Output 3 of the project, ever since the disastrous tropical peatland and forest fires in August 2015 in Central Kalimantan, details of organized activity at the implementing agency for the method of measurement of reduction of carbon emission have remained obscure. However, all researchers at the implementing agency are monitoring the condition of the peatland and continuing their studies.
program	- It was reported that as the cause for interrupting activities other than natural disasters, according to the response from the implementing agencies, as for the establishment of a method of reducing carbon, despite the need for active mobilization of local stakeholders in Central Kalimantan, in the absence of a person responsible for implementation or a leader, it was difficult to carry out such social services without payment.
	- There was no response to the situation implied by the recommendation in the terminal evaluation that "the organization which will take over each research component after the project should be designated, and the operation manuals of activities, e.g. peat-fire control and tree planting, should be prepared by the end of the project," and it was not possible to ascertain the status by field study.

Table 2: Degree of Achievement of Expected Impact

Source: Questionnaires returned from the implementing agencies, and interviews

Development is proceeding for application of an MRV system for peatlands that was being tested in Central Kalimantan Province, as the pilot region. Meanwhile, there has been hardly any progress since the completion of the project entailing building a model of a carbon reduction as a contribution to the promotion of the Indonesian REDD+ program and organized activity has not been confirmed.

In light of the above, the overall goal that has been provisionally set for verification has not been partially achieved.

#### 3.2.2.2 Other Positive and Negative Impacts

(1) Impact on the natural environment

No impact has been confirmed at the time of both the terminal evaluation and the ex-post evaluation. Observation equipment such as a flux tower has been installed during the project, but this is within the premises of the implementing agency and has not had any effect on the natural environment. Also, there were boring surveys to substrate levels of peatland during

<sup>&</sup>lt;sup>22</sup> Phased Array type L-band Synthetic Aperture Radar (PALSAR) equipment is installed in the Japanese satellite Daichi. It uses a mechanism that penetrates clouds to make observations to acquire ground-level information, and is thought to have the ability of determining change in forests tropical regions. Analysis of PALSAR data uses sophisticated technology and by the development of a monitoring method supplementing optical sensor data is expected to contribute to the advance of REDD+.

Source: http://www2.ffpri.affrc.go.jp/labs/palsar/index.html (as of August 2017).

the project, with no negative influence on the natural environment.

#### (2) Relocation of residents; land acquisition

Because the project was realized on the existing premises of the implementing agency, no residents were relocated and no land was acquired. Because there were no activities having a negative influence on residents of the subject area, there was no need for explanations for local people.

#### (3) Improvement of water management by the SESAME system

According to the interviews at BPPT, equipment produced in Indonesia based on the concept of the SESAME system for water level observation in this project are being utilized in various places in Indonesia as the BPPT-SESAME System for visualization of hydrological data and as shown in the photos below. Hydrological data is sent in real time from rural areas to the BPPT head office in Jakarta where it is displayed, enabling visualization of the water level and its change in various places in Indonesia. According to BPPT, the equipment is installed at the major dams<sup>23</sup>, making visualization of water levels possible, helping to both optimize water management and the efficient distribution of agricultural and domestic use of water.

Further, when a questionnaire survey<sup>24</sup> directed at the 18 Indonesians doing research work for the project at the implementing agency was made although there is variation in opinions depending on the research field, most of them agreed on the point that the quality of the plan for management of groundwater in peatlands, and natural resources, and land use had been improved. Further, almost all agreed that general interest in peatland management had risen, and the reason for this was the increased publication of scholarly papers by the Indonesian researchers. Especially it was deemed that individual researchers who had obtained a degree by publishing papers were influenced in terms of their career paths and motivation. It has thus contributed to the continuation of research work after the project completion.

 $<sup>^{23}</sup>$  The SESAME system has been introduced at Jatiluhur dam located in a suburb of Jakarta, the largest dam in Indonesia.

<sup>&</sup>lt;sup>24</sup> Questions were posed to the Indonesian side whether any impact was perceived through the project from 3 major perspectives with regard to the peatland summarized by the ASEAN secretariat: policy and institutional issues / community based issues / peatland management issues).

Source: http://www.aseanpeat.net/index.cfm (as of February 2017).



<BPPT-SESAME installed in the vicinity of Palangkaraya in Central Kalimantan>

As for the project purpose, although there were no planned activities regarding the establishment of a system by the counterpart for sharing information, methods, and means among the Indonesian government and the international community, and building of a system for prevention of global warming, so that these were not realized, during the course of the project, the progress of studies is elucidating the assessment of carbon emission, and multifaceted and specific investigation of carbon management methods has been made, whereby it can be thought that there has been some achievement. Thus, effectiveness is fair. It was confirmed that as positive impact there has been, inter alia, the nationwide use of the SESAME system of water management and increased recognition through scholarly contributions by Indonesian researchers.

The manifestation of certain effects of implementing the project is confirmed and it is judged that the effectiveness and impact are fair.

In verifying the achievement of the provisional overall goal, while activities from the project implementation have been continued, and the progress was observed in building a model of a carbon reduction system that would be a contribution to the advancement of REDD+, and efforts were made at the application of an MRV system for peatlands, it is however judged that the overall goal has not reached its target itself.

- 3.3 Efficiency (Rating: 2)
  - 3.3.1 Inputs

Project inputs (planned and actual) are as shown in the table below.

Inputs	Plan	Actual
(1) Experts	1 Long-Term expert 94 Short-Term experts	Total expert dispatch (148.7MM) - 2 Long-Term experts - 239 Short-Term experts - Breakdown by activity: Output 1: 426 days Output 2: 310 days Output 3: 2,488 days Output 4: 1,237 days
(2) Trainees received	3 persons/year	<ul> <li>20 persons</li> <li>JICA counterpart training</li> <li>Long-term: 5 persons (Ph.D. course: 3 persons, Master course: 2 persons)</li> <li>Short-term: 10 persons</li> <li>Breakdown by the organization: UNPAR (6 persons), LIPI (5 persons), BSN (1 person), BPPT (4 persons), LAPAN (2 persons), FORDA (1 person), Central Kalimantan Government (1 person)</li> </ul>
(3) Equipment	N.A.	Procurement in Japan: 31 million yen Procurement in Indonesia: 59 million yen
(4) (Others)	N.A.	71 million yen (major items are: purchase of PCs and Cameras, Airfare, Allowance, Accommodation fee, Outsourcing etc.)
Japanese Side Total Project Cost	215 million yen	384 million yen
Indonesian Side Total Project Cost	N.A.	Allocation of Counterpart Personnel: UPR, LIPI, LAPAN, BSN, BPPT, FORDA Local cost: Running costs for office use (e.g. costs for water, electricity and landline phone, internet), and administrative operating cost for the project (travel cost and allowance)

able 5. Inputs of the Floject (Flair and Actual)	Fable 3:	Inputs o	f the	Project	(Plan	and A	ctual)
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\* MM stands for man-month.

Source: Ex-ante evaluation sheet (Aug. 2009), Terminal Evaluation Report (Feburary2014) and survey results from the implementing agencies

#### 3.3.1.1 Elements of Inputs

There was a substantial increase in the number of people for the short-term dispatch of research experts than planned. The composition of the total number of days spent for each activity shows that Output 3 accounted for the greatest length of time during such dispatches. According to interviews with a long-term dispatched expert, the transportation of firefighting hose (about 3,000 in number) from Japan and boring surveys to the layer below the substrate were the activities not in the original plan. Although there was no increase in the outputs from such activities it was reported that the nature of activities for Output 3 of the



project promoted a more concrete image among local stakeholders.

Concerning the content of training of trainees, and roles and contributions regarding each output of the project, at the implementing agency, there were many researchers who previously had had the experience of studying at Hokkaido University, and ordinarily there was smooth communication between research experts of the project who are academic advisors and the long-known researchers, that performed a role in making joint work more efficient.

#### 3.3.1.2 Project Cost

Project cost exceeded the planned amount by a wide margin, owing to the dispatch of more short-term experts than that had been planned, as well as research activities and the cost of shipping fire hose for firefighting activities that had not been anticipated at the outset. Although the procurement of additional materials, in particular, may have had the effect of making local activities more specific and thus easier to share the image at the sites in Kalimantan, it is not judged that the increased costs rightly matched the output. As for acceptance of trainees, it is thought that from the viewpoint of ensuring the continuation of research work and maintaining sustainability, the effects of acceptance by the form of obtaining of higher degrees are considered high.

Whereas the amount of the project cost was planned to be 215 million yen, the actual cost was 384 million yen. It was significantly higher than the planned amount (178% of the planned amount).

#### 3.3.1.3 Project Period

The project was implemented from November 2009 to March 2014 as planned (100% of plan).

As indicated above, although the project period was within the plan, the project cost exceeded the plan. Therefore, the efficiency of the project is fair.

#### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

International commitments of the Indonesian government concerning the reduction of greenhouse gas, at the time of the ex-post evaluation, is expressed in the *Intended Nationally Determined Contribution*, 2015-2019 (INDC) submitted to the UNFCCC the *National Determined Contribution* (NDC) after the ratification of the Paris Agreement<sup>25</sup> meeting in

<sup>&</sup>lt;sup>25</sup> The remarkable point of the REDD+ mechanism as per the Paris Agreement of 2016 is that while in CDM emission reduction credits are given only for the net increase in reduction caused by afforestation or forest remediation, it addresses an arrangement where credits are also given to the result of control in deforestation, which incentivizes developing countries to proactively participate such as Indonesia that has vast areas of forest.

November 2016 and the Biennial Update Report (BUR) in 2015 all of which are consistent in this respect and consists of a target of 26% reduction the volume of greenhouse gas emission by the nation's own efforts by 2020, and a reduction of 41% if assistance is received from abroad. Further, as disclosed policy related to the project, in November 2015 President Joko Widodo made a speech at the heads of state meeting at COP21. Regarding the importance of measures for the recovery of peatlands, more than 80% of the natural disasters afflicting Indonesia are related to climate change, and the tragedy in the forest and peatlands in 2015 as mentioned above is viewed as having been caused by fires that originated in extraordinary weather conditions caused by El Nino, and this has indicated the necessity for all countries to unite in confronting climate change. As for the target reduction, President Widodo has stated it will be achieved by the promotion of the peatland control measures.<sup>26</sup> As a specific measure, the president established the Peatland Restoration Agency (BRG), that was given direct control over the restoration of peatland degraded by forest and peatland fires in Sumatra and Kalimantan, and of the management and use of peatland. Assistance has been received from a Norwegian government fund<sup>27</sup> the BRG was established under the Ministry of Environment and Forestry for the limited period of 2016 to 2020. The REDD+ Agency, established under the previous administration in 2013, was merged into the Ministry of Environment and Forestry when the government ministries were reorganized in keeping with a change of the administration, and at present the locus of responsibility for policies and implementation related to REDD+ is the Directorate General of Climate Change Control of the Ministry of Environment and Forestry.

As stated above, at the time of the ex-post evaluation, as peatland control within a framework of promotion of REDD+ is an urgent policy agenda in Indonesia, through the efforts of establishing the MRV system for peatlands in the project, it is expected to visualize the results of the measures for climate change comprehensively as well as objectively. As such it continues to be an important maneuver for Indonesia to benefit fully from the prospective REDD+ mechanism.

#### 3.4.2 Organizational Aspects for the Sustainability of Project Effects

As shown in the table below, the responsible implementing agency changed at the time of planning, ex-ante evaluation, terminal evaluation, and ex-post evaluation. However, the above changes did not cause any real confusion in terms of the implementation of the project as the

<sup>&</sup>lt;sup>26</sup> An increase of 23% by 2025 of the ratio of renewable energy to electric power is included.

<sup>&</sup>lt;sup>27</sup> The Letter of Intent (LOI) signed by the Norwegian and Indonesian governments states that for several years starting in 2010 up to 1 billion USD will be provided, in accordance with results of an activity for reduction of greenhouse gas emission generated by forest degradation and emission from peatlands.

Source: https://www.regjeringen.no/globalassets/upload/SMK/Vedlegg/2010/Indonesia\_avtale.pdf (as of February 2017).

transfer of principal investigator was made between the implementing agencies. Although there were some changes of the names of the cooperating agencies, basically it was the same institution and, further, because the project site was Palangkaraya in Central Kalimantan, the actual research activities in terms of the outputs of the project, were continued to be engaged by UPR researchers throughout the project.

	Ex-Ante evaluation	Terminal evaluation	Ex-Post evaluation
Responsible agency	BSN (as of the signing of an R/D)	BPPT (changed as a principal investigator was transferred from BSN)	RISTEK (Ministry of Research, Technology and Higher Education) BRG
Cooperating agency	- UNPAR - LAPAN - LIPI - FORDA	- UNPAR - LAPAN - LIPI - FORDA	<ul> <li>BPPT</li> <li>UPR <ul> <li>(changed from UNPAR since</li> <li>there is another university with</li> <li>the same abbreviation)</li> </ul> </li> <li>LAPAN</li> <li>LIPI</li> <li>FOERIDA <ul> <li>(changed from FORDA as a</li> <li>merger of the Ministry of Forestry</li> <li>and the Ministry of Environment)</li> </ul> </li> </ul>

Table 4: Organizational change of the implementing agencies, and of its name

Within UPR, the Center for International Cooperation in Sustainable Management of Tropical Peatland (CIMTROP) was in charge of the project. It had been unchanged at the time of the ex-post evaluation. At present, relatively young researchers of the CIMTROP have continued doing joint research with Japanese researchers and have engaged in



coordination work in Central Kalimantan Province with the above-mentioned corollary project, IJ-REDD+.

Further, LAPAN and LIPI are public entities specialized in research activities and are intent on continuing to raise the level of their foundation of research through joint projects with domestic and foreign bodies.

Moreover, the above-mentioned BRG that has the exclusive mandate for peatland recovery was established in 2016 and is intent on making use of scientific, practical research results. According to interviews at BRG, under the "3R" slogan of "Re-wetting, Re-vegetation, and Re-vitalization" it is creating institutional arrangements whereby the president himself is able to visit parts of the 2 million ha of peatland being studied, for observations every three

months<sup>28</sup>. It has exchanged memoranda with universities in and outside Indonesia doing research on peatlands, including UPR, and is working on the collection of practical, scientific data to serve peatland recovery.

In light of the above, at the time of the ex-post evaluation, the arrangements for research at the cooperating implementation agencies were being continued, and by means of establishment of a specialized entity concerned with peatland recovery, the arrangements for use of research output has been strengthened, and in general, no serious problems are observed.

#### 3.4.3 Technical Aspects for the Sustainability of Project Effects

It is important, regarding technical aspects, to continue improving research activities and capabilities with an orientation toward the practical application of project outputs by the implementing agency.

At the time of the ex-post evaluation, the principal researchers concerned with the improvement of research capacity and main researchers involved in the status of its use were persons who have had the experience of studying in Japan. In order to obtain a degree by studying in Japan, they were trained in the use of analytic equipment and are already familiar with the operation and maintenance of such equipment and are using it for their current work. Further, they are currently in the position of leaders and are instructing young researchers in matters such as the methods of analysis using the equipment that has been provided. At the time of the field study for evaluation, they were continuously using a spectrometer, provided by the project and the only one at a university research center in Indonesia. It was reported that researchers from other universities have visited in order to be instructed in its use for research. Because UPR is continuing to collect data as requested for joint research with Hokkaido University, UPR can have a continuous supply of reagents necessary for analysis, and academic advice, from Hokkaido University. In 2016, after project completion, a multiauthored "Tropical Peatland Ecosystems"<sup>29</sup> by Indonesian and Japanese researchers was published as a notable academic accomplishment. Acquisition of opportunities to internationally report on research and publish would lead to success in securing funds for future research and the continuation of research activities by individual scientists.

Moreover, LAPAN, one of the cooperating implementing agencies, specializes in data from satellite observations and they have a strong belief that it is indispensable for doing international joint research with industrialized nations. LAPAN itself possesses remote sensing technology, and in line with its mandate to respond to a variety of requests from society, it provides feedback of the results of research analysis on peatland fires obtained by the project

<sup>&</sup>lt;sup>28</sup> According to BRG, acquisition of more than 200 sets of SESAME System equipment is planned.

<sup>&</sup>lt;sup>29</sup> Osaki M, Tsuji N (eds.) (2016) "Tropical Peatland Ecosystems." Springer Tokyo.

to the Indonesian National Carbon Accounting System (INCAS)<sup>30</sup> of the Ministry of Environment and Forestry. And it is recognized their role to improve the accuracy and quality of the data it supplies.

In light of the above, at the time of the ex-post evaluation, with regard to technical sustainability, through the joint research work, the capability to publish international academic papers has been improved, analytic equipment is being used independently, and maintenance capability has been augmented. Generally, there are no technical problems in terms of its sustainability of research.

#### 3.4.4 Financial Aspects for the Sustainability of Project Effects

Regarding finance, budgeting has been done for studies and activities aimed at the application of the outputs and it is important that the effects continue to be evident.

For external financing of research, the arrangement for UPR is to secure funds from RISTEK, the part of the Ministry of Research, Technology and Higher Education, that oversees university research centers. Funds are supplied in relatively small amounts and in response to applications by individual researchers, and with the exception of research subjects chosen by the national government, research fund is not provided for joint research proposed by universities. As such, with regard to the operation and maintenance of relatively expensive analytical equipment procured by the project, research funds for individual researchers are allocated. For this reason, financing of joint projects beyond a certain scale must rely on donors in Japan and foreign countries. On the other hand, at UPR a researcher, as an individual consultant, can apply for study projects commissioned by donors; in this case, that individual has a great deal of freedom. Below is a current list of funds to which UPR researchers can apply for joint research financing.

- Indonesia Climate Change Trust Fund<sup>31</sup>
- Indonesia Toray Science Foundation<sup>32</sup>
- USAID Sustainable Higher Education Research Alliances<sup>33</sup>

<sup>&</sup>lt;sup>30</sup> In the ICCSR roadmap for sector-wise climate change in Indonesia, written in 2010, REDD is defined as including (1) building of a national REDD, (2) reference emission level, and (3) Indonesian National Carbon Accounting System (INCAS). INCAS is vital for this context because by accumulating information and data on forest diminution and degradation of the national as well as provincial levels, and the volume of carbon emitted by peatland fires, it can add strength to capacity related to the forest carbon monitoring account. See the final report for the Project for facilitating the implementation of National Forestry Strategic Plan, from JICA, 2011, p. 3-7, p. 4-5 (in Japanese).

<sup>&</sup>lt;sup>31</sup> A fund administered by the sole domestic Indonesian NPO officially authorized to undertake activity in the field of climate change. At the beginning of the establishment, UNDP took part in setting up the framework. Source: http://icctf.or.id/ (as of August 2017).

<sup>&</sup>lt;sup>32</sup> A research funding entity established by Toray Industries Indonesia. Source: http://www.itsf.or.id/en/ (as of August 2017)

<sup>&</sup>lt;sup>33</sup> Applications for USAID funds for higher education research in Indonesia was accepted up to November 2016, and in 2017 five awards of up to 3,000,000USD each were announced.

- Dana Mitra Gambut Indonesia<sup>34</sup>
- Indonesia Science Fund<sup>35</sup>

Although there were no financial statement reports readily available about LIPI, LAPAN, and other cooperating implementing agencies, these are public research entities specialized in research, and at interviews they said that research budgets and disbursements were made as planned in the national budget and that they had no financial difficulties affecting the continuation of research projects or the operation and maintenance of supplied equipment.

In view of the above, there are almost no financial problems associated with the precision equipment supplied to the implementing agency or its operation and maintenance and in as much as UPR is continuing to seek funding to support its research, essentially no problem is observed.

In view of the above, no major problems have been observed in the policy background and the organizational, technical, financial aspects. Therefore, sustainability of the project effects is high.

#### 4. Conclusion, Lessons Learned and Recommendations

#### 4.1 Conclusion

The purpose of the project was to promote the implementation of REDD+ in Indonesia by developing a fire detection and fire prediction system, remediation of peatlands and forest through efficient water management, and establishing effective absorptive and storage capacity for greenhouse gas, and particularly  $CO_2$ .

The importance of forestry management for reduction of greenhouse gas generation and the regional importance of Kalimantan, are consistent with Indonesian development policy. Further, they have been consistent with the need for the management and remediation of peatland which has grown in recent years. In Japanese development assistance policy, importance is assigned to the field of climate change and conforms to the policy of promoting a comprehensive approach. Therefore, the relevance is high. Regarding effectiveness, as a study of assessment of carbon emission, as well as that of carbon management methods, have been specifically engaged from various perspectives, it has been partially accomplished. However, regarding the establishment of a system for appropriate management of peatland and forests, to be shared with the government of Indonesia as well as the international community, as well as building a system for prevention

Source: https://www.iie.org/Programs/SHERA (as of August 2017).

<sup>&</sup>lt;sup>34</sup> A fund recommended by BRG. Grants are made to provinces having peatlands, Riau, Jambi, South Sumatra, and Central Kalimantan for up to 24 months and the limit of 300,000,000 rupiahs. Source:

https://indonesia.wetlands.org/id/publikasi/dmg-indonesia (as of August 2017).

<sup>&</sup>lt;sup>35</sup> A research support fund administered by the Akademi Ilmu Pengetahuan Indonesia (AIPI); Source: http://www.dipi.id/

of global warming, were not achieved because the planned activities during the project period were not carried out. Regarding impact, efforts for actual application are continuing towards a functional system of MRV. Note that because no overall goal was set, this is not included in the evaluation of the project impact. Another collateral impact is the achievement of efficiency in broad-area water management by the system to measure hydrological data procured by the project. Therefore, effectiveness and impact are fair. The project was completed within the time provided and project cost exceeded the planned amount so that efficiency is fair. Sustainability is judged to be high, as the necessary policy rationale for continuation of the results of the project, its institutional arrangements, technical aspects, and financial aspects are still in effect, reflecting the need for peatland recovery in Indonesia.

In light of the above, this project is evaluated to be satisfactory.

#### 4.2 Recommendations

#### 4.2.1 Recommendations to the Implementing Agency

Valuable observation data has been accumulated in the course of monitoring greenhouse gas emission in peatlands by the project. In Indonesia, in view of the need for an MRV system, its potential for promoting REDD+ and its contribution related to the issues of climate change, completion of the MRV system for peatland areas, based on the outputs of this project, is an urgent matter. It is desirable that hereafter the Ministry of Environment and Forestry, that is presumed to undertake the work of validation for MRV systems, builds an implementing organization for research projects that provide a clear exit strategy for research activities while continuing to impart issues to be resolved and research elements thereof, in terms of the effective and efficient application of the system at the working level. It is thought that for the establishment of a practical MRV system, it is necessary to have a multidisciplinary platform that enables to merge social science and natural science based on the industry-governmentuniversity partnership in Indonesia. So that the Indonesian government can work toward realistic practicality and transparency, and sharing of problem awareness. For the management of a multidisciplinary platform, it is desirable to make the procedures and milestones of system establishment as clearly visible to the participating organization and its members as possible and adopt an open innovation approach that enables to appreciate each contribution in every field by all participants.

4.2.2 Recommendations to JICA None.

#### 4.3 Lessons Learned

### Goal setting for SATREPS climate-change projects, with consideration given to possibility of achievement

The project purpose was to construct a model for carbon management of peatlands, and at the same time, it was intended to build a cooperative arrangement between developing countries and the international community regarding the subject of climate change. However, it became difficult to proceed research activities as planned regarding climate change measures, owing to the influence of discourse on the international framework, and the influence of a change of the administration as well as the reorganization of government ministries. Further, the research for the project included the ambitious plan of building a model for carbon emission management in peatland areas but the problem was the feasibility of carrying this plan out within only five-year project period to complete all the research needed. Particularly, it was a situation in which building a carbon volume assessment model required the collection of necessary data, its analysis, and validation that was not completed.

Within the limited project timeframe, for research results are produced as planned and for project purposes to be achieved, it is desirable that the hypothesis to be tested be clearly stated, that the necessary inputs be collected and put to use, and to make a plan of activities that includes alternatives in the event that the project does not proceed as planned. Further, regarding setting an overall goal, having reached a prior consensus among stakeholders on what should be the "utilization of research outcome", it should be specified as a "milestone" to be reached in about three-year period after the project. It is also desirable that the users or beneficiaries of this "utilization of research outcome" must be specifically identified, then they are to be incentivized during the project. It enables the examination of prospects for the realization of the utilization of research outcome during the project. In case that a certain outcome of research has been accomplished by project completion and the approach to "utilization of research outcome" has become clear, it is desirable to engage in follow-up activity to facilitate "utilization of research outcome" including coordination with other schemes and other donors.

#### Sustainability of research funding in Indonesia

Research funds for universities in Indonesia are basically obtained from RISTEK. This system distributes funds in relatively small amounts, to individual researchers. At present, there is no system comparable to the system at Japan's MEXT for making research grants for scientific research for large-scale projects. Therefore, in the case that the counterpart is a university research institution, the continuation of research after the end of a project is often influenced by whether or not the university has an external fund source such as an overseas donor. Therefore, if there is an exchange of memoranda or agreement between the two universities in Japan and Indonesia from the outset, it is relatively easy to ensure the post-project continuation of research. If there is

no such agreement, for the sake of sustainability of the research, it is desirable to plan the specific activities to make a joint research proposal to the international research fund of the relevant field during the project period.

#### Method of ex-post evaluation of a SATREPS project lacking a specified overall goal

When the project does not assign an overall goal, that is, there has not been an agreement with the counterpart regarding an overall goal of the project, information and data corresponding to a super goal of research and development, and results based on the degree of accomplishment of project purpose at the time of terminal evaluation can be adopted as the "expected impact." However, while the related information should be described in the verification of impact on a trial basis, as long as consideration is given to the outlook for actual utilization of results after project completion, it is not to be directly judged in the evaluation. On the other hand, it is necessary to examine whether there are any collateral impacts and the contents, including those that were not anticipated before the start of the project. Those thereby should be appraised as overall effectiveness and impact. Furthermore, the continuation of research activities related to the "expected impact" should be judged in the evaluation for sustainability.

End

#### Republic of Zambia

FY2016 Ex-Post Evaluation of Technical Cooperation Project (SATREPS<sup>1</sup>) "Establishment of Rapid Diagnostic Tools for Tuberculosis and Trypanosomiasis and Screening of Candidate Compounds for Trypanosomiasis"

External Evaluator: Miho Kawahatsu, OPMAC Corporation

#### 0. Summary

The objective of this project is to perform the research and development needed for a rapid diagnostic method for sustained use in identification of tuberculosis (TB) and trypanosomiasis,<sup>2</sup> and screening of candidate compounds for improvement of the treatment of trypanosomiasis, in Zambia. The diseases of concern, TB, and Trypanosomiasis, one of the Neglected Tropical Diseases (NTDs), are assigned high importance in Zambia's national development plans, and in the field of public health, they have had consistently high priority in health-related policies. Further, both infectious diseases are hence of great concern in connection with the issue of public health, and there has been a consistent need for rapid and accurate diagnosis in order that it can be controlled and treated is amply evident. In addition, concerning Japanese development assistance policy, this project is consistent with the public health concerns addressed in the Japanese Assistance Program for Zambia, Japan Action Plan in Combating Infectious Diseases in Africa, and the Tokyo International Conference on African Development (TICAD). Thus, relevance is high. Regarding effectiveness, it is believed that the project achieved advances in the capability for research and development needed for rapid diagnosis, but because no actual activities were implemented on the screening of candidate compounds for the treatment of trypanosomiasis, this latter objective was not achieved. Concerning impact, while work on improvement of a rapid diagnostic method is being continued in the laboratory of implementing agencies, progress has not been made in obtaining official approval of the method<sup>3</sup> by the Ministry of Health (MOH). However, because there has not been an overall goal assigned to this project, this has not been used in the evaluation of impact. As collateral impacts, research

<sup>&</sup>lt;sup>1</sup> Science and Technology Research Partnership for Sustainable Development.

<sup>&</sup>lt;sup>2</sup> Trypanosomiasis is a zoonotic disease, common to cattle, sheep and other animals as well as humans, and development of diagnostic techniques and therapeutic drugs for it are lagging compared to other infectious diseases. The protozoa causing the disease is parasitic, and transmitted by the tsetse fly. It is found in 36 African countries and it is thought that 50,000,000 persons are at risk of contracting the disease. Infection causes lymph node swelling, hepatosplenomegaly, headaches, deteriorating consciousness, lethargy, and anemia, and physical weakening through these effects can cause death. Many cases have been reported of misdiagnosis of malaria as having caused superinfection. Because this project targeted trypanosomiasis in human, the disease is properly called Human African Trypanosomiasis (HAT). In Africa, two parasites in different regions have been identified as the cause; in eastern and southern Africa including Zambia, following infection with the parasite Trypanosoma brucei rhodesiense the disease spreads to the nervous system, causing acute symptoms. As the project is concerned with trypanosomiasis in humans, it is called "trypanosomiasis" here.

Source: http://www.who.int/trypanosomiasis\_african/country/HAT\_rh\_2014.png?ua=1.

<sup>&</sup>lt;sup>3</sup> By international and/or national laboratory or public research institute in the fields of analytic chemistry and microbiological culturing, a method corresponding to or equal to specifications for qualitative analysis, quantitative analysis, culture and detection of microorganisms is determined as standard.

Source: https://www.jica.go.jp/topics/notice/20150318\_01.html.

achievements have been made by the University of Zambia School of Veterinary Medicine (UNZA-SVM), that the World Bank has designated as a center for advanced education in zoonotic diseases prevalent in Eastern and Southern Africa. It is expected to contribute to the advancement of education and research, and to the expansion of international collaborative research efforts in the center. Thus, the effectiveness and impact of the project are judged to be fair. Because the project was completed within the planned time frame and budget, it is judged to be highly efficient. As for sustainability, while the necessary policy and institutional measures for the continuation of the effect of the project are assured, there are issues remained in terms of organizational technical, and financial matters to specifically engage the utilization of research outcome in this project so that its sustainability is evaluated as fair.

In light of the above, this project is evaluated to be satisfactory.



**Project Location** 



A Rapid Diagnosis Toolkit (RDT) developed by the project

#### 1.1 Background

There has been a grave concern about the resurgence of TB as a superinfection accompanying the increase in the number of people with HIV/AIDS, and the rampancy of hard-to-treat multidrug-resistant and extensively-drug-resistant TB in Zambia and other African nations. Besides, as infection with TB transmitted to humans from animals has been widely reported in Africa, the transmitting path of the pathogen has been important to unravel to develop an effective control of TB as a zoonosis disease.

Moreover, malaria is the most serious disease affecting Zambia, and trypanosomiasis, a protozoan infection<sup>4</sup>, is often diagnosed as malaria that has symptoms similar to those of that disease, delaying treatment of trypanosomiasis; once the pathogen has spread to the spinal cord the situation is extremely serious and likely to cause death. The drug generally used to treat

#### 1. **Project Description**

<sup>&</sup>lt;sup>4</sup> Infectious disease caused by protozoa, including trypanosomiasis and borreliosis, brucellosis, and leptospirosis. Many of these are zoonosis diseases.

trypanosomiasis contains an organic arsenical compound, that has side effects that can be grave in the case of extremely ill patients, so that there is a need for a safer drug for treating this disease.

This project is a joint-research attempt to apply a high-sensitive as well as simple Loop-Mediated Isothermal Amplification (LAMP)<sup>5</sup> technique for diagnosis of TB and trypanosomiasis, for development of a sustainable method of rapidly diagnosing trypanosomiasis that can be used in rural Zambia, and, at the same time, to discover a candidate compound for improvement of the medication used to treat trypanosomiasis. The project also had the purpose of enhancing the research and development capabilities of UNZA-SVM and the University Teaching Hospital (UTH), the University of Zambia.

This project has been adopted as an undertaking in the SATREPS program and was implemented with participation by the Japan Science and Technology Agency (JST)<sup>6</sup> and the Japan International Cooperation Agency (JICA). This program is to promote joint research with developing countries on global issues such as the environment, energy, disasters, and on measures to combat infectious disease, with the associated objective of contributing to the improvement of the capabilities of those institutions.

#### 1.2 Project Outline

At the time of the ex-ante evaluation, preparation of a Project Design Matrix (PDM) was not required for SATREPS projects, but for this project, with the exception of an overall goal, project purpose, outputs, and indicators were specified and set for agreement with the implementing agencies. At the time of the mid-term review, the timing of achievement of output was specified by the PDM thereby agreed by the implementing agencies. Thus the ex-post evaluation was done on the basis of the PDM of the mid-term review. In the ex-post evaluation, ascribing the contents of the lessons learned reported at the time of the terminal evaluation, to the basis of shared views of related personnel, the status of the overall goal was provisionally taken as of the "expected impact" and it was verified accordingly. However, as above mentioned, because no overall goal was agreed on with implementing agencies achievement status of "expected impact" is not used in evaluation judgment.

<sup>&</sup>lt;sup>5</sup> For this project, the RDT was developed based on the LAMP method patented by the Eiken Chemical Co., Ltd.. LAMP uses loop isothermal amplification of DNA. It does not require special equipment, and easily facilitates the speed of amplification of target genes. This genetic testing method for TB developed by the company was recognized by the WHO in 2016.

Source: http://apps.who.int/iris/bitstream/10665/249154/1/9789241511186-eng.pdf.

<sup>&</sup>lt;sup>6</sup> The Japan Agency for Medical Research and Development (AMED) was established in April 2015 and from fiscal 2015 onward AMED has replaced JST to be the counterpart of JICA in work related to infectious diseases in the SATREPS program.

Overall Goal		Not specified		
Project Purpose		Research and development capacity of Zambian research institutes for rapid diagnostic tools and screening of candidate compounds for new drugs for trypanosomiasis are improved through collaborative research activities		
Outpu		Rapid diagnostic tools including a drug susceptibility test (DST) for tuberculosis to be developed as methods for practical use in laboratories in Zambia		
Output(s)	Output 2	A rapid diagnostic tool for trypanosomiasis is developed as a method for practical use in laboratories in Zambia		
	Output 3	Candidate compounds for non-clinical trials are produced with diversity-oriented synthesis method for trypanosomiasis		
	Output 4	Research system for the development of rapid diagnostic systems for tuberculosis and trypanosomiasis and screening of compounds for new drugs for trypanosomiasis are streamlined		
Total (Japanes	cost e Side)	332 million yen		
Period of Co	ooperation	November 2009-November 2013		
Implementing Agency		Ministry of Health (MOH) / the University of Zambia School of Veterinary Medicine (UNZA-SVM) / University Teaching Hospital (UTH)		
Supporting Agency/Organization in Japan		Supporting Organization in Japan: Hokkaido University, Cooperating Institution: Tottori University		
Related Projects		<ul> <li>Technical Cooperation Project [UTH]</li> <li>The University of Zambia, School of Medicine Project (1980-1989)</li> <li>Infectious Diseases Project (1989-1995</li> <li>Infectious Diseases Control Project (1995-2000)</li> <li>HIV/AIDS and Tuberculosis Control Project (2001-2006)</li> <li>[UNZA-SVM]</li> <li>The University of Zambia: Veterinary Education Project (I) (1985-1992)</li> <li>The University of Zambia: Veterinary Education Project (II) (1992-1997)</li> <li>Project for Surveillance of viral zoonoses in Africa (2013-2018)</li> <li>Grant Aid [UTH]</li> <li>Project for Improvement of the Department of Pediatrics and Child Health of the University Teaching Hospital (January 1996)</li> <li>The Project for the Improvement of the Medical Equipment of the University Teaching Hospital (December 2009)</li> <li>[UNZA-SVM]</li> <li>Construction of The School of Veterinary Medicine at the University of Zambia (for building construction G/A in August 1983, for ancillary facilities and main equipment G/A in July 1984)</li> </ul>		

Other Japanese institutions
Ministry of Education, Culture, Sports, Science and Technology,
Japan (MEXT)
Program of Founding Research Centers for Emerging and
Reemerging Infectious Disease (2005-2009)
<ul> <li>Hokkaido University Center for Zoonosis Control in Zambia (collaboration with UNZA-SVM)</li> </ul>
MEXT/ Japan Agency for Medical Research and Development
(AMED)
➢ J-GRID <sup>7</sup> : Japan Initiative for Global Research Network on
Infectious Diseases (2010-2014)
<ul> <li>International collaborative research for zoonosis control (Joint research with UNZA-SVM)</li> </ul>
International Collaborative Research Program for Tackling the
NTDs (Neglected Tropical Diseases) Challenges in African
countries (2015-2020)
• Establishment of the model for controlling neglected tropical
diseases based on the development of rapid diagnostic
methods and risk analysis <sup>8</sup> (collaboration with UNZA-SVM)

#### 1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

On the basis of achievement status of outputs at the Zambian research centers at the time of the terminal evaluation, the judgment was that project purpose would be achieved in that research capabilities for a rapid diagnostic method for TB and Trypanosomiasis had been improved, except for screening of a candidate compound for the treatment of trypanosomiasis. During the project implementation, Zambian researchers benefited from their work done for the project and from training received in Japan, thereby adding to their knowledge and skills. Equipment provided as part of the project was fully utilized, and results of the research were made available to others through international scientific meetings and other means, indicating that research capability had been improved.

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation (Including other impacts)

In view of this project not having specified an overall goal, and at the time of terminal evaluation merely "scientific output" was insufficient, a practical or tangible product had been sought. As such, at the time of terminal evaluation, the following three points have been taken as representing expected impact with the outlook for achievement. Although the status of

<sup>&</sup>lt;sup>7</sup> J-GRID is an international research program for infectious diseases control and strategic framework for reinforcement by Japan Agency for Medical Research and Development (AMED).

<sup>&</sup>lt;sup>8</sup> This research project of Hokkaido University, adopted by the international joint research program, is concerned with trypanosomiasis and Hansen's disease, and has the status of being largely a follow-up and most relevant undertaking of the project. As the cause of Hansen's disease, mycobacterium leprae is closely related to that of TB, developments in research on TB are known to be relatively easily applicable to Hansen's disease.

achievement should be duly reconfirmed at the time of the ex-post evaluation based on the outlook for achievement at the time of terminal evaluation, it was not considered in determining the sub-rating or overall evaluation.

#### Practical use of the LAMP Tuberculosis Rapid Diagnostic Tool (LAMP-TB RDT)

On the basis of scientific evidence of sensitivity and specificity, a swift, accurate, easy-touse, low-cost Point of Care (POC)<sup>9</sup> was developed by improving the testing for diagnosis applicable in rural Zambia where there are many suspected infections. However, as test results using a preprocessing method for sputum were still numerically low, it was recommended to continue tests after project completion, in order to accumulate scientific evidence of the efficacy of the diagnosis performance.

#### Practical use of the LAMP Trypanosomiasis Rapid Diagnostic Tool (LAMP-Tryps RDT)

LAMP-Tryps RDT had already been in use for diagnosis of trypanosomiasis, as in the case of TB, it was recommended that tests would continue after the project completion, in order to acquire scientific evidence of the tool's value.

#### **Other impact**

Through the development of drug susceptibility testing in TB during this project, a discovery was made of drug-resistance the tubercle bacillus that was expected to have a positive impact in optimizing TB treatment. Further, both LAMP-TB RDT and LAMP-Tryps RDT were intended to be developed as methods for diagnosing disease in humans. It was deemed to be possible that it can be applied also in surveillance of animal disease conducted at UNZA-SVM.

<sup>&</sup>lt;sup>9</sup> Defined as an examination at a medical and health care facility at the home or nearby to it. Rapid diagnosis at such examinations facilitates early treatment of disease, and help prevent infections.
## 1.3.3 Recommendations from the Terminal Evaluation

Use of the target Two RDTs in the project as national standards								
Zambia MOH	The MOH, together with UTH, UNZA, and other relevant institutions, should prepare and implement an action plan for approving the RDTs as national standards and putting them into practical use to serve the entire population.							
Dete	ction and reporting of cases of trypanosomiasis							
Zambia MOH	The MOH should enhance training of health care workers, raise awareness of residents, and strengthen the surveillance system for better detection and reporting of the cases of trypanosomiasis.							
Identification of candidate compounds for a new drag of Trypanosomiasis								
Hokkaido Univ. and UNZA-SVM	With regard to how to carry out collaborative research on the subject after the project completion, the details of collaboration should be discussed thoroughly between Hokkaido University and UNZA-SVM.							
	Budget for the BSL-3 <sup>10</sup> laboratory							
Zambia MOH	The necessary budget for using and maintaining the BSL-3 laboratory must be continuously secured by the Government of Zambia. The MOH should take note of the need to utilize it for detection and diagnosis if and when serious infectious diseases emerge, and prioritize budget allocation to the laboratory in the annual budget formulation process.							
Furthe	er academic development of Zambian researchers							
Related Ministries (MOH, Ministry of Higher Education, Ministry of Agriculture and Livestock, etc.)	In order for Zambian researchers to sustain the outputs of the project after the project completion, relevant ministries should consider providing opportunities for Zambian researchers at UTH and UNZA- SVM to obtain degrees at the graduate school level.							

## 2. Outline of the Evaluation Study

2.1 External Evaluator

Miho KAWAHATSU, OPMAC Corporation

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted within the following schedule.

Duration of the Study: September 2016 to January 2018

Duration of the Field Study: January 29, 2017 to February 14, 2017

May 21, 2017 to May 30, 2017

<sup>&</sup>lt;sup>10</sup> An abbreviation of Bio-Safety Level 3, that is also referred to as physical containment (P3). Depending on the risk level at the relevant pathogen there are four levels for the specifics of facilities handling it. WHO guidelines are very strict for levels 3 and 4; handling in an enclosed environment is required.

## 3. Results of the Evaluation (Overall Rating: B<sup>11</sup>)

## 3.1 Relevance (Rating: $3^{12}$ )

## 3.1.1 Consistency with the Development Plan of Zambia

At the time of the ex-ante evaluation, measures to counter TB had high priority in the health policy of the Fifth National Development Plan (FNDP; 2006-2010) adopted in 2006. Further, on the basis of the specific purpose of the National TB Control Programme (NTP), various measures were taken, notably by means of Directly Observed Treatment, Short course (DOTS),<sup>13</sup> measures for drug-resistant TB, and superinfections with HIV/AIDS, and support for research and development. Regarding trypanosomiasis, one of the NTDs, similar to instances of other parasitic diseases, measures for diagnostic techniques and therapeutic drugs were lagging and were on the priority agenda in the FNDP mentioned above.

At the time of project completion, among the objectives of the Sixth National Development Plan (SNDP, 2011-2015), improvement of the people's access to TB care was included in the strategy for "supply of highly cost-effective, high-quality health and medical care services." Further, as quantified targets in the National Health Strategic Plan (2011-2015), the government called for diagnosis of 70% of all persons suffering from TB, and target cure rate should be 85% of those diagnosed. Further, it was reported that in the southwestern regions of Zambia the incidence rate of trypanosomiasis was deemed to be as high as 25%. To tackle this, it was mentioned to reduce the incidence rates of major NTDs as its strategic target. Also, epidemiological mapping and improvement of clinical management and training for disease prevention of health care workers were covered as a part of the strategy in Zambia.

From the above, it is evident that the strategic priority of TB programs, and the needs of related research and development, are consistently high. Also in the case of trypanosomiasis, although no quantitative target was set, it presents a serious problem in that the disease is misdiagnosed as malaria especially in rural areas where there are few medical facilities. Further, there have been reports of incidence of the disease not only in Zambia but also in neighboring countries, making it imperative to take an international approach as the region-specific disease.

From the time of the ex-ante evaluation to project completion, TB and NTDs have been high-priority agenda in Zambia's national development plans, so this project is highly consistent with Zambia's national policy.

<sup>&</sup>lt;sup>11</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory.

<sup>&</sup>lt;sup>12</sup> (3): High; (2): Fair; (1): Low.

<sup>&</sup>lt;sup>13</sup> DOTS, refers to the overall therapeutic strategy for TB (for 2006-2015) as indicated by the WHO as necessary for strengthening the national public health system. (the Japan Anti-Tuberculosis Association; Source: [in Japanese] http://www.jata.or.jp/rit/rj/gtc99.html)

#### 3.1.2 Consistency with the Development Needs of Zambia

At the time of the ex-ante evaluation TB was spreading in Africa as an opportunistic infection accompanying the spread of HIV/AIDS, and in Zambia, in particular, the HIV/AIDS infection rate of TB patients was 70% -- a serious issue of public health. As for trypanosomiasis, although the number of patients was low relative to TB, in rural areas the potential number of sufferers of the disease was believed to be high. Thus, trypanosomiasis was one of the NTDs, characterized by lagging development and use of diagnostic techniques and therapeutic medicine. Further, need for the development of a high-specificity method of diagnosis of the disease was particularly high because of a high rate of misdiagnosis of other parasitic diseases.

At the time of the project completion, as well superinfection of TB and HIV/AIDS was recognized as a serious problem in Zambia, and need was perceived for a method of rapid diagnosis that could be used as a POC testing at local laboratories in the rural regions. Further, because of failure to administer or take proper dosages for TB patients undergoing treatment, the danger of multi-drug-resistant TB and super-multiple-resistant TB would emerge. Thus, development of a simple, easy-to-use test for drug susceptibility was also needed. Regarding trypanosomiasis, one of the NTDs, existing method of diagnosis was sputum smear microscopy, but this often resulted in misidentification of another disease-causing parasite such as malaria. In addition, there had been limited drug options, because the side effect of using a conventional drug-containing organic arsenical compound was oftentimes too severe to continue the treatment, there was an urgent need for the development of an effective, safer new drug for it.

From the time of the ex-ante evaluation to project completion, drug-resistance of TB patients became more serious and the importance of a method of accurate and rapid diagnosis was consistently high as a result of increased superinfection of HIV/AIDS patients, while in the case of trypanosomiasis although the number of cases was low relative to the incidence of TB, as morbidity was highly concentrated in rural areas, the cause of infection was difficult to accurately determine, and the disease was often misdiagnosed as malaria. These conditions indicate that there had been a high development need for acquiring and using a method of accurate and rapid diagnosis, that could enable better control and treatment of the disease.

## 3.1.3 Consistency with Japan's ODA Policy

In the Country Assistance Program for Zambia, issued in October 2002, improving the costbenefit ratio and the high quality of health and medical services was a priority area. for address control of infectious diseases. Notably, TB was one of the cross-cutting issues from perspectives of the nation's human resources and social capital. Further, in June 2005, the Japanese government announced the Health and Development Initiative (HDI) in the context of which the Action Plan in Combating Infectious Disease in Africa was formulated as a specific plan for assistance in May 2006, and this led to the promotion of concrete measures for combating Africa's three major infectious diseases and parasitic issues through South-South or Asia-Africa cooperation. Further, at the TICAD IV conference in May 2008 and after that the Toyako Summit, it specifically identified the need for TB countermeasures, as well as support for fighting NTDs. Therefore, at the time of the ex-ante evaluation, the project was consistent with Japanese development assistance policy.

From the above, the implementation of the project is judged to be highly consistent with development policy of Zambia, its public health and public health development needs, and Japanese development assistance policy. Thus, the relevance of the project is high.

## 3.2 Effectiveness and Impact<sup>14</sup> (Rating: ②)

#### 3.2.1 Effectiveness

3.2.1.1 Project Output

As a result of compilation of answered questionnaires and examination of information obtained at hearings at the implementing agencies, the status of achievements at project completion was found to be as follows.

# < Output 1. Rapid diagnostic tools including drug susceptibility test (DST) for tuberculosis and developed as methods for practical use in laboratories in Zambia. >

Successfully achieved in terms of introducing a technique of drug susceptibility testing at UTH. Although actual use of a rapid diagnostic method has been introduced, at the time of project completion, a result of comparative testing of the method suggested a need for further study, development of a practical-use method was not completed. It is noteworthy, in connection with the introduction of BSL-3 that was added to the research plans during the project, that UTH established a system for TB testing by a bio-safety standard manual drafted on schedule. Therefore, it is judged that Output 1 was mostly achieved.

## < Output 2. A rapid diagnostic tool for trypanosomiasis is developed as a method for practical use in laboratories in Zambia. >

During the project implementation, the effectiveness of LAMP-Tryps RDT was verified and developed as a practical method; thus, Output 2 is judged to be achieved.

## < Output 3. Candidate compounds for non-clinical trials are produced with diversityoriented synthesis method for trypanosomiasis. >

<sup>&</sup>lt;sup>14</sup> Sub-rating for Effectiveness is to be made with consideration of Impact.

UNZA-SVM has a chemical library of candidate compounds and is in the process of registering additional candidate compounds, but because no compound has yet been found to be sufficiently active in the stage *in vitro* prior to non-clinical trial *in vivo*, the tests have not been performed. Output 3 thus was not achieved.

## < Output 4. Research system for the development of rapid diagnostic systems for tuberculosis and trypanosomiasis and screening of compounds for new drugs for trypanosomiasis are streamlined. >

Apart from the Standard Operation Procedures (SOP) for the screening of candidate compounds for the treatment of trypanosomiasis, both UNZA and UTH have introduced, implemented, and put in place SOP for rapid diagnostic tools for TB and trypanosomiasis. It is recognized that through project implementation, research management capability has improved and is anticipated to contribute to effective performance in following research projects and daily research tasks. Therefore, Output 4 was mostly achieved.

## 3.2.1.2 Achievement of Project Purpose

At the time of the ex-post evaluation, having reexamined outputs of the project their relations to the project purpose are shown in Fig. 1. Regarding the project purpose of developing a rapid diagnostic tool for TB and trypanosomiasis, respectively, judgment was made based on the achievement status of Outputs 1, 2 and 4. Regarding development of a drug to treat trypanosomiasis, achievement was judged on the basis of Output 3 and the existence of Standard Operating Practices (SOP) related to its pertinent part of Output 4.

Research and development of rapid diagnostic methods	Research and development of candidate							
for tuberculosis and trypanosomiasis	compounds for the treatment of trypanosomiasis							
Output 1: Rapid diagnostic tools including drug	Output 3: Candidate compounds for non-clinical							
susceptibility test (DST) for tuberculosis	trials are produced with diversity-							
and developed as methods for practical use	oriented synthesis method for							
in laboratories in Zambia	trypanosomiasis.							
Output 2: A rapid diagnostic tool for trypanosomiasis								
is developed as a method for practical use								
in laboratories in Zambia								
Output 4: Research system for the development of rapid d	agnostic systems for tuberculosis and							
trypanosomiasis and screening of compounds for	r new drugs for trypanosomiasis are streamlined.							
Project Purpose:								
Research and development capacity of Zambian research	n institutes for rapid diagnostic tools and screening of							

Research and development capacity of Zambian research	institutes for rapid diagnostic tools and screening of
candidate compounds for new drugs for trypanosomiasis are	e improved through collaborative research activities with
Japanese research institutes	
Indicator 1	Indicator 2
Feasibilities of rapid diagnostic test kits for tuberculosis	Candidate compounds for non-clinical trial against
and trypanosomiasis in Zambia are confirmed	trypanosomiasis are produced.

Figure 1: Relationship Diagram of Each Output and its Project Purpose of the Project

As for research activities for Indicator 2 it was confirmed at the time of hearings at UNZA-SVM that this component of the research was planned as a two-step process of screening whereby research at Hokkaido University was supposed to identify candidate compounds that can show anti-trypanosomal activity that was proved to be effective and safe *in vitro*, and then as a basis of the result, UNZA-SVM was to conduct further screening by using an animal model to ascertain activity and cytotoxicity of the candidate compounds *in vivo*. The results of JST-supported research conducted in Japan were on a critical path for determining whether it was possible to do further research in Zambia. Therefore, research activities in Zambia of this matter were inevitably postulated by reference to the result of preceding research in Japan. It was therefore considered inadequate to evaluate this component on a par with the achievement status regarding the development of rapid diagnostic methods.

Therefore, in this evaluation, in judging the achievement of the project purpose, the emphasis was given to the status of the rapid diagnostic methods as noted in Indicator 1, in view of the research activity that has taken place, and the outlook for an early contribution of the utilization of research outcome to countermeasures for infectious disease.

Project Purpose	Indicator	Actual
Research and development capacity of Zambian research institutes for rapid diagnostic tools and screening of candidate compounds for new drugs for trypanosomiasis are improved through collaborative research activities with Japanese research institutes	1. Feasibilities of rapid diagnostic test kits for tuberculosis and trypanosomiasis are confirmed	<ul> <li>Accomplished by project completion         <lamp-tb rdt=""> </lamp-tb></li> <li>The reagent for the RDT proposed by this project was         inexpensive, at 1USD, and it did not require a large         investment in production equipment, so this was         financially better than the existing method.     </li> <li>The detection rate was about 40% higher than in the         case of smear microscopy, due to its higher sensitivity         </li> <li><lamp-tryps rdt=""> <ul> <li>Practicality was confirmed with respect to technical and             cost aspects.</li> <li>Because susceptibility was higher relative to the             conventional parasitological methods, the detection rate             of infection got higher.</li>             The test results got more stable relative to those from             conventional microscopy.</ul></lamp-tryps></li> </ul>
	2. Candidate compounds for non-clinical trial against trypanosomiasis are produced.	<ul> <li>Not accomplished by the project completion Because progress regarding the identification of compounds targeted in the project was not observed, no substantial research activity was done.</li> <li>Issues remained at the project completion There was a necessity to replicate evaluation of the candidate compound for non-clinical testing using infected mice and undertake evaluations of efficacy and safety in infected animals in UNZA-SVM, but by the time the project was completed no compound had been identified as being effective and safe at Hokkaido University.</li> </ul>

Table 1: Achievement of Project Purpose

As shown in Table 1, by the time of project completion, improvement of research and development capabilities was achieved through the work done on rapid diagnostic methods for the two diseases, TB and trypanosomiasis, but with regard to the component of screening candidate compounds for trypanosomiasis treatment, it was not achieved as no related research activity was conducted in Zambia, because in preceding research in Japan, it was impossible to discover any compounds that could considerably show anti-trypanosomial activity.

As indicated above, the project purpose was partially achieved.

## 3.2.2 Impact

As stated above in 1.2, Project Outline, evaluation was attempted making reference to the content regarding lessons learned as given in the terminal evaluation and the understanding shared by related personnel, with the external evaluator using "expected impact" as a substitute for the overall goal and used the manifestation of impact according to information obtained during field research for the evaluation. Since an overall goal was not set in this project, the degree to which the "expected impact" was achieved was not included in the evaluation judgment.

According to the above-mentioned lessons learned SATREPS projects, in addition to obtaining scientific results from the implementation of research and development are also to seek utilization of research outcome as an overall goal or expected impact; that is, it is to aim at yielding some sort of practical result. However, in the planning stage for the project, it was difficult to forecast the duration of time needed for verification and a validation period during the research and development phase, or for producing a tangible result, thus, at the time of the ex-post evaluation scheduled to be carried out three years after project completion, likewise, it made it difficult to make a judgment on whether it is possible to judge the impact to the extent of being validated as an overall goal. Moreover, in the actual process of utilization of research outcome, it may require, in addition to the implementing agency, participation by the government and the private-sector which are outside of the research institute, in such a transition phase.

As stated in 1.2, Project Outline, there was no overall goal assigned to this project. Nevertheless, the project was implemented in a consistent manner with the need for future utilization of research outcome in mind, and with awareness of the intent of realization of rapid diagnostic methods that could be available to TB and trypanosomiasis patients at medical facilities close to their homes, and the intent of developing a new therapeutic preparation for trypanosomiasis. Further, it was presumed that subsequent to project completion, the actual application of the RDTs for TB and trypanosomiasis will take place throughout the nation and that a discovery of candidate compounds will contribute to the development of a new drug for

treating trypanosomiasis. For the utilization of research outcome to take place it was believed that the control of subsequent work must have been assumed by the MOH, that research results be re-examined from a public viewpoint so that official approval can be granted. Depending on the status of progress in actual utilization of research outcome, the impact of the project would be assumed in various ways, ranging from an improvement in the diagnosis rate of patients in rural areas to improvement of the cure rate by early diagnosis, but because this prerequisite is dependent upon MOH's approval as an official method, the impact was not able to be explicitly expressed as an overall goal.

However, noting too that in the ex-post evaluation, as stated in 1.3.2, at the time of terminal evaluation, the three items were described to be the impacts to be accomplished, (1) development of a rapid diagnostic method for TB, (2) development of a rapid diagnostic method for trypanosomiasis, and (3) discovery of a candidate compound for clinical testing for the development of a new drug for treatment of trypanosomiasis, were used for verification of an overall goal of the project on a trial basis.

#### 3.2.2.1 Achievement of Overall Goal (for reference)

As stated above, whereas there had not been an overall goal for this project, the expected impact at the time of the terminal evaluation was taken as being equivalent to an overall goal and used provisionally to gauge the achievement.

Expected impact	Status	Degree of accomplishment
Expected impact Practical use of the LAMP-TB RDT as a diagnosis tool for TB	<ul> <li>Status</li> <li>It was confirmed that the MOH did not take any concrete action for establishing it as an official method.</li> <li>In use as a test kit at the level of the UTH lab.</li> <li>The opinion of UTH technical staff is that processes are fewer than those of the previous method and steps requiring manipulation skill are not complicated, so that a long training period is not needed, and results can be obtained quickly and accurately at rural medical facilities where there is only limited testing equipment.</li> <li>During the project period, there was a transfer of technology to the UTH lab regarding domestic production and distribution, and it is already possible for UTH technical staff to produce the kit. Further, in anticipation of actual use in rural areas a high-volume production system has been almost completed and is expected to be introduced from Hokkaido University in the coming fiscal year.</li> </ul>	Degree of accomplishment In use on a lab base. In absence of approval as an official method, the range of beneficiaries is limited.
	• In expectation of distribution and storage of the reagent which is a consumable material for the test kit used at rural medical facilities, Hokkaido University is now studying and testing for prolongation of the shelf life of the reagent.	

Expected impact	Status	Degree of accomplishment
	• During the project period a study was initiated to target urine as a specimen for childhood TB testing, but because good data were not obtained, at the time of the ex-post evaluation, simplification of processing of sputum is being studied at Hokkaido University instead.	
Practical use of the LAMP-Tryps RDT as a diagnosis tool for trypanosomiasis	<ul> <li>It was confirmed that the MOH did not take any concrete action for establishing it as an official method.</li> <li>Transfer of technology was completed during the project period, and upon request by patients, the diagnosis service has been properly provided. Thus, the test kit has been utilized at the level of the UNZA-SVM lab.</li> </ul>	In use on a lab base. In absence of approval, the range of beneficiaries is limited.
	• Interest has been regionally shown principally by neighboring Malawi and Zimbabwe because trypanosomiasis is an NTD existing in this region of Africa, there is no competing method of a diagnosis like other diseases, and the RDT is highly innovative.	
	• Although it has been thought that the habitat of the tsetse fly which is the carrier of trypanosomiasis was limited to rural river regions in the eastern part of the country, researchers at UNZA-SVM believe that surveillance through the use of the test kit is needed to verify the actual situation of the infection, as there have been unexpected diagnoses of serious cases in the central region and in the southern border region with Zimbabwe.	
	• UNZA, as a higher education and research institution, is not regulated by the MOH, and medical institutions providing therapy such as UTH and hospitals are under the MOH, it is recognized that an inter-ministerial cooperative arrangement is needed for smooth execution of diagnoses and treatment of trypanosomiasis.	
A discovery of a candidate compound for new drug therapy of trypanosomiasis	• Progress has not been confirmed for development of a candidate compound for non-clinical testing of anti-trypanosomal activity in Zambia.	Not achieved

Source: Questionnaires returned from the implementing agencies, and interviews

Although no confirmation with regards to the processes and procedures for granting official approval by the MOH for LAMP-TB RDT and LAMP-Tryps RDT, as for the expected impact, appropriate diagnostic service has been provided at the level of the research lab, and development is continuing, with production and acquisition and other aspects of sustained use in rural medical facilities in mind, and it is thought that the stage prior to actual use for POC testing at local laboratories has been reached. Regarding development of a drug for treatment of trypanosomiasis, however, there has been no change in status since project completion and further development was not confirmed.

As shown above, part of the provisionally set overall goal has not been achieved.

## 3.2.2.2 Other Positive and Negative Impacts

(1) Impact for natural environment

At both the times of terminal evaluation and the ex-post evaluation no impact on the environment was confirmed.

#### (2) Relocation of residents; acquisition of land

The project was implemented on the existing premises of the implementing agencies and hence there was no relocation of residents or acquisition of land. Therefore, at both time of termination and the ex-post evaluation, no impact was confirmed.

#### (3) Research capacity development and sophistication of university education

In 2016, UNZA-SVM was designated as a center for higher education and research on the zoonotic disease, in ACE-II<sup>15</sup>: The Eastern and Southern Africa Higher Education Centers of Excellence Project supported by the World Bank<sup>16</sup>. The background of selection included the evaluation of accomplishments ranging from a high number of international joint research undertakings including the project, the publication of research papers, to the operation of BSL-3-enabled facilities and precision equipment for gene sequencing, where JICA assistance was used to improve the center's scientific analysis of pathology and disease transmission.

The evolution of UNZA-SVM as an emerging center of higher-education and research institution in southern Africa is noteworthy for the following reasons. It had Zambian researchers who were dedicated to and proud of making international contributions. When grant aid was provided by the Japanese government and Hokkaido University in the 1980s, it enabled establishing its school of veterinary medicine for the first time. Since then, an all-Japan approach, notably backed by JICA and the department of veterinary medicine of Hokkaido University has constantly provided technical assistance and help in education for about three decades. Both of recent domestic training under the aegis of SATREPS as well as the preceding acceptance of Zambian students over years in Japan have helped establish a foundation for the comprehensive development of human resources for research<sup>17</sup>.

In light of the above, with regards to the project purpose, it was confirmed that upgrading of the capability of research and development concerning rapid diagnosis of the two diseases had been achieved, however with regard to the screening of candidate compounds for the

<sup>&</sup>lt;sup>15</sup> This World Bank program adopted higher education centers at 24 universities in eight countries in the region. Its scope covers priority areas such as industry, agriculture, public health, education, and applied statistics. It is involved in promotion of higher education and practical applied research that matches the needs of domestic labor markets and in cooperation with domestic and foreign research institutions, domestic institutions, and private industries. It is expected to generate role models as top-class institutions of higher education. Institutions in the program are entitled to maximum of 600 million USD of low-interest financing over a period of five years.

Source: http://documents.worldbank.org/curated/en/105551478248187571/pdf/109745-BRI-ACEII-finalOct-PUBLIC.pdf.

<sup>&</sup>lt;sup>16</sup> The World Bank project that UNZA-SVM is active in is called ACEEZD, or Center of Excellence for Emerging and Zoonotic Diseases.

<sup>&</sup>lt;sup>17</sup> See Hiroshi Kanekawa, "Creation of the Veterinary Medicine Faculty of the University of Zambia – An Education Project for Building Africa's Future (in Japanese)." *Journal of International Cooperation for Agricultural Development*, 12 (March 2012), p. 65-71.

treatment of trypanosomiasis this was not achieved as a candidate compound for non-clinical testing was not identified by the preceding research in Japan. Due to these results, the effectiveness of the project is judged to be fair.

As an impact, exclusive of the evaluation judgment on the accomplishment of an overall goal, research accomplishments have been recognized internationally, and the institution that produces the research has been designated as a center for higher education and research in zoonotic diseases, in the World Bank's ACE-II program. Therefore, research capacity development and its upgrading was confirmed as a positive impact.

In the event that achievement of an overall goal is considered as an impact, while the rapid diagnosis method has been used in the lab of the implementing agencies, and the MOH should begin procedures to put them through an examination process for official approval, it was not confirmed that any such action has been taken by the MOH. Further, as per the related activity on a discovery of a candidate compound for the treatment of trypanosomiasis, it was not implemented in Zambia, inevitably, an impact was not achieved. Therefore, with consideration made for the achievement, although it would be comparatively higher in evaluation based on confirmed impact, there are many items related to achievement of an overall goal that has not been concretely confirmed. Thus, it hardly can be judged as being high, effectiveness and impact are judged to be fair.

In as much as effectiveness and impact had not been set as the overall goal of the project, they are not considered in evaluating the degree of accomplishment. As a result, it is judged that implementation of the project has shown a certain degree of effects, thus effectiveness and impact are fair.

3.3 Efficiency (Rating: ③)

3.3.1 Inputs

Inputs of the project were as shown in the table below.

Inputs	Plan	Actual
(1) Experts	3 long-term experts 1-2 short-term experts (Chief advisor/ Development of diagnostic method for Tuberculosis/ Development of diagnostic method for Trypanosomiasis/ Screening of a candidate compound for trypanosomiasis)	2 long-term experts (74.0MM <sup>*</sup> ) (Development of genetic diagnostic methods for Tuberculosis and Trypanosomiasis / Project Coordinator) 52 short-term experts (31.0 MM)
(2) Trainees received	2 persons	7 persons (Genetic diagnosis for TB, Genetic diagnosis for Trypanosomiasis, Chemosynthesis of anti-trypanosomal candidate compound(s))
(3) Equipment	*Although there was no specific description of equipment to be provided, in special remarks, noted a need to consider the improvement of facilities as a BSL-3 laboratory because it was planned to handle pathogens that may affect the human body.	143 million yen (Genetic analyzer, Ultracentrifuge, Ultra- deep freezer, thermal cycler, BSL-3 compliant container testing laboratory Electric generator for BSL-3 Lab)
(4) Local Activity Cost	n.a.	43 million yen
(5) Third country training	n.a.	1 person (UTH), 1 person (UNZA-SVM)/ Total 2 persons (Trained in the USA regarding maintenance technique of safety cabinet, change of filters, and safety evaluation method)
Japanese Side Total Project Cost	Total 350 million yen	Total 332 million yen
Zambian side Total Project Cost	<ol> <li>Allocation of Counterpart Personnel         <ul> <li>8 persons (researchers)</li> </ul> </li> <li>Equipment and Facilities         <ul> <li>UTH: Office space in TB lab</li> <li>UTH: Research space in TB lab</li> <li>UNZA-SVM: Research Space in UNZA-SVM</li> <li>Existing equipment for research activities</li> </ul> </li> <li>Local cost         <ul> <li>Running costs for research activities</li> </ul> </li> </ol>	<ol> <li>Allocation of Counterpart Personnel         <ul> <li>MOH: 3 persons</li> <li>TB Research Team: 13 persons</li> <li>Trypanosomiasis Research Team: 12 persons</li> </ul> </li> <li>Equipment and Facilities         <ul> <li>UTH: Office space in TB lab</li> <li>UTH: Research space in TB lab</li> <li>UNZA-SVM: Research Space in UNZA-SVM</li> <li>Existing equipment for research activities</li> </ul> </li> <li>Local cost         <ul> <li>Running costs for research activities (e.g. costs for water, electricity and landline phone)</li> </ul> </li> </ol>

Table 3: Inputs of the Project (Plan and Actual)

\* MM stands for man-months.

Source: Ex-ante evaluation sheet (Oct. 2009), Terminal Evaluation Report (Aug. 2014) and hearing survey result from the implementing agency

## 3.3.1.1 Elements of Inputs

There was a substantial increase relative to plans for the number of short-term-dispatch researchers. This was necessary due to the number of new issues that emerged in connection with the improvement of the rapid diagnosis method during the project and action taken to deal with them. As for the introduction of equipment, UTH began use of the newly installed BSL-3 facility at the end of 2012 and made use of it during the latter half of the project. After

beginning its efficient use of the equipment, it succeeded in achieving the project purpose related to drug susceptibility testing by the project completion. Moreover, it was confirmed at the time of the ex-post evaluation that it was being used on a daily basis in two lines of testing for TB drug susceptibility and cultivation at the containerized lab. In addition, the researchers who received training in Japan, who had the opportunity to acquire advanced techniques of molecular biology analysis<sup>18</sup> and through that became more skilled in pathological research or acquired higher university degrees.



## 3.3.1.2 Project Cost

Project cost had been planned at 350 million Japanese yen, while it was actually totaled 332 million Japanese yen, it was within the plan (95% of the plan).

#### 3.3.1.3 Project Period

As the project period was from November 2009 to November 2013 it was implemented as planned (100% of the plan). As stated above, the start of operations of the BSL-3 facility at UTH was in the latter part of this period but this did not cause any delay in the project activities.

Both the project cost and project period were realized as planned and therefore efficiency of the project is high.

## 3.4 Sustainability (Rating: 2)

As stated in the section of effectiveness and impact above, as a matter of the utilization of research outcome after the project completion, proactive efforts of the MOH, as the authority governing pharmaceutical affairs in Zambia, are indispensable. As such, it was necessary to confirm the status of institutional improvement with regards to the current approval process of pharmaceutical affairs together with the organizational continuation status of research implementation.

<sup>&</sup>lt;sup>18</sup> Specifically, polymerase chain reaction (PCR) and spoligotyping. PCR involves selectively amplifying a target segment of DNA sequencing by an enzyme reaction. Spoligotyping is used to genotype clinically isolated mycobacterium tuberculosis because of the necessity to clarify the infection pathway as to how it infects people. It is a method to investigate the presence or absence of 43 spacer sequences (DNA sequences linking structural genes) on the genome, and it is said to solve the drawbacks of the conventional method.

3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

In terms of policy arrangements, it is significant to have maintained its policy towards serious diseases, notably TB as well as a representative NTD, trypanosomiasis in Zambia.

The Revised Sixth National Development Plan (R-SNDP; 2013-2016)<sup>19</sup> adopted in 2014, was in effect at the time of the ex-post evaluation, and among high priority items of health policy was targeted treatment rate of 80% for TB in 2016. Also, the grave importance of improving the accuracy of diagnosis and treatment rates is indicated by the overall trend for the sufferers being superinfected with HIV (70% of TB patients as of the end of 2010) to increase annually, as a bit less than 50,000 persons were reported TB infected for 2008 to 2010. An update of the National Health Strategy Plan had not been released as of the time of the expost evaluation but because the implementation of the plan was being continued to be effective, it is thought that no major change would be made after the project completion. The National Strategic Plan for Tuberculosis Prevention, Care, and Control (2017-2021) was in the final stage of preparation and not yet announced. However, through hearings at the MOH, it is deemed that high importance in policy will be assigned to the rapid diagnosis method.

At the time of the ex-post evaluation, there had not been a great change in the importance in the policy of TB and NTDs, and it is assumed that the policy necessary for sustaining the effects of the project is mostly continuing in force.

3.4.2 Organizational Aspects for the Sustainability of Project Effects

As for organizational aspects, it is significant that the project resulted in a research organization for authorization and improvement of rapid diagnostic methods, and improvement of the MOH as a regulatory body that can process drug approval that is necessary for the utilization of research outcome.

At the time of the ex-post evaluation, the organization for research at UTH and UNZA-SVM was as follows.

UTH is not a research organization but a hospital that also provides clinical education/training, where the TB laboratory section, where work on behalf of the project was conducted, was at the time the major place for TB exams. As a consequence of the project, UTH acquired BSL-3 and thereby improved its holdings of equipment. It has secured laboratory technicians with a high level of knowledge and techniques regarding drug susceptibility and cultivation. It is believed that the strengthening of this group of permanent staff was part of the improvement of the TB laboratory system and the establishment of the basic arrangement for research improvement of LAMP-TB-RDT.

<sup>&</sup>lt;sup>19</sup> The draft Seventh National Development Plan (2017-2021) was still being drafted and not available at the time of the ex-post evaluation.

	Actual									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Permanent researcher/ Laboratory technician	-	-	-	-	14	14	14	14	14	14
Contract researcher/ Contract staff	-	-	-	-	0	0	0	0	0	0
Total	-	-	-	-	14	14	14	14	14	14

Table 4: Trend of the number of researchers at UTH TB laboratory

Source: UTH TB laboratory's response to the questionnaire

Note: no answer was given regarding data from 2007 to 2010.

In a subsequent new project at UNZA-SVM<sup>20</sup>, based on the experience of streamlining research system through the project, they are extending further lab research in order to secure government approval of the LAMP-Tryps RDT for reliable surveillance of trypanosomiasis that had diagnosed only to the extent of a few cases in the past. Note however that it is recognized that as UNZA-SVM is under the administrative control of the Ministry of Higher Education, further cooperation with the MOH should be enhanced concerning diagnosis and therapy for trypanosomiasis infections in humans.

Table 5: Trend of the number of researchers at UNZA-SVM

		Actual									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Permanent researcher (Ph.D.)	3	3	7	7	7	7	7	5	5	5	
Part-time researcher	0	0	0	0	0	0	0	0	0	0	
Total	3	3	7	7	7	7	7	5	5	5	

Source: UNZA-SVM's response to the questionnaire

As for regulatory arrangements of the MOH for approval of pharmaceutical affairs, according to hearings at the ministry, despite the value of an RDT is strongly recognized, neither the RDTs by the project nor any other new RDT are in process for approval, and no specific plans or budget allocation have been engaged. For it to be approved, actually applied and disseminated it inevitably requires add-on tests and its validation in the approval process. Furthermore, assuming the expansion of diagnostic examinations in rural areas, careful planning is needed for related activities at various levels including initiation of domestic production of the RDT kits along with the creation of a distribution scheme. Therefore, additional support from foreign donors is much needed.

On the basis of the above review, at the time of the ex-post evaluation, there was no existing

<sup>&</sup>lt;sup>20</sup> This is a research program that is one of Hokkaido University's international joint research projects, is titled Creation of a Neglected Tropical Disease Countermeasures Model Based on Development of a Rapid Diagnostic Method and Risk Analysis. It has the major objectives of (1) determining the status of Hansen's disease and trypanosomiasis in Zambia, (2) development and actual utilization of an RDT for Hansen's disease and trypanosomiasis, and (3) proposing a package plan for fighting Hansen's disease and trypanosomiasis.

system at the MOH that would permit the utilization of research outcome, but the implementing agency now possesses a systematic research structure for further improvement of the RDT, through the implementation of subsequent research projects by fully utilizing facilities and equipment procured by the project.

#### 3.4.3 Technical Aspects for the Sustainability of Project Effects

Regarding technical aspects of the project, it is important that the implementing agencies can continue research and improvement of capabilities in order to achieve the objective of utilization of the research outcome of the project.

Reports indicate that as a consequence of the project development of human resources at UTH, one of the implementing agencies under the MOH, some staff members of higher ability are seeking to pursue doctor's degree Further, through the substantial improvement of facilities and equipment and of skilled lab techniques by the project, it has enabled the TB laboratory at UTH to become better at functioning as a lab performing high-accuracy culture inspections, ranked after WHO certified top referral labs in Zambia, such as Chest Disease laboratory (CDL) and a Tropical Disease Research Center (TDRC).

As for UNZA-SVM, Zambian researchers there are proceeding with studies at their own initiative and have used a random sample of 100 residents of Mwenya Village in Mambwe, an area where the tsetse fly breeds, for diagnoses of trypanosomiasis and malaria using LAMP-Tryps RDT, and when test results were negative by conventional microscopy, retesting with LAMP-Tryps RDT was performed. Further, the



quality of their research papers has improved as a result of the improvement of facilities and equipment procured by the project.

	Befor pro	re the ject	Project Period			Aft	er the pro	oject		
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
International academic journals	0	0	0	0	0	2	2	1	5	2
Domestic academic journals	0	0	0	0	0	1	0	0	0	0
Total	0	0	0	0	0	3	2	1	5	2

Table 6: Number of academic articles concerning Trypanosomiasis by UNZA-SVM

Source: UNZA-SVM's response to the questionnaire

An official mechanism at the MOH for issuing accuracy certification of any domestically developed medical product, as well as validating and authorizing as an official method does not exist. There is thus no other alternative but to conform to accepting WHO-certified products. Therefore, there is a gap in the technology and knowledge needed to construct such a mechanism for official approval of the RDTs developed by this project.

As indicated above, at the time of the ex-post evaluation, although there is not sufficient technology and knowledge at the MOH for constructing an official mechanism for certifying the accuracy of the RDTs, UTH and UNZA-SVM have achieved the level of technology for validating the diagnostic performance of RDTs for TB and trypanosomiasis.

### 3.4.4 Financial Aspects for the Sustainability of Project Effects

Turning to financial matters, as disease-related policy, activities are continuing with the ultimate objective of the perfection and dissemination of RDTs suitable for practical use, and hence it is important that funds be budgeted for further research and activities regarding utilization of the research outcome.

Among the facilities and equipment provided under the project, BSL-3 facilities that were newly installed at UTH TB laboratory were indispensable to maintain the system of the research implementation. It has also required the operation and maintenance conducted by the implementing agency itself. At the time of the ex-post evaluation, the BSL-3 facilities were functioning for daily examination tasks without any serious problem in operation and being used effectively. Further, maintenance service for the incidental safety cabinet is being obtained through an outsourcing contract with a specialty company in South Africa and since 2014 the annual cost of 20,000 USD has been continually provided for this. Separate budget funds are allocated to purchase needed spare parts. Note, however, that as stated above UTH is considered by the MOH as the proper authority, to be the entity for TB exams, thus UTH is not supposed to undertake research activities and hence research funding per se is not provided.

Table 7: Maintenance expense for BSL-3 facilities at UTH TB laboratory

				Unit: ZMK <sup>21</sup>
	2013	2014	2015	2016
Purchase of spare parts and consumables		459,620	600,000	873,330
Outsourcing for maintenance of safety cabinet		200,000	200,000	200,000

Source: UTH TB laboratory's response to the questionnaire

Continued research relying on the advances made through this project in research capability at UNZA-SVM has been subsequently included in another SATREPS project, Project for

<sup>&</sup>lt;sup>21</sup> The exchange rate at the time of the ex-post evaluation: one ZMK was equal to about 0.1USD.

Surveillance of viral zoonoses in Africa (2013-2018) and International Collaborative Research Program for Tackling the NTDs Challenges in African countries (2015) by AMED. As shown in Table 7, funding for continuing the research has been secured. Further, as indicated in 3.2.2.2, Other Positive and Negative Impacts, it was adopted as a COE by World Bank's ACE-II program and the outlook is for research funds to be obtained from 2017 onward.

		-	-		
					Unit: ZMK
		2013	2014	2015	2016
Research funding	Government	-	-	-	-
	Donors	2,595,540	2,993,150	5,955,057	4,928,893
	Other (private)	-	-	-	-
Research expenditure		2,486,772	2,713,863	5,008,213	4,819,761
Balance		108,768	279,287	946,844	109,132

Table 8: Research funding and expenditure of UNZA-SVM

Source: UNZA-SVM's response to the questionnaire

Add-on tests by a third-party institution being deemed as necessary for the MOH to certify the accuracy of diagnosis performance, need exists to objectively collect the requisite data and design the test to be conducted by that party, but there is no budget for such items.

It is concluded from the above that issues remain, such as lack of a budget allocation for the work needed for utilization of research outcome in the MOH, but the precision equipment provided to UTH and UNZA-SVM are being maintained and a budget allocation has been made for certifying the performance of the RDTs.

In light of the above, regarding institutional, technical and financial aspects, some issues exist. Thus, sustainability of the project effects is judged to be fair.

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

The objective of this project is to perform the research and development needed for a rapid diagnostic method for sustained use in identification of TB and trypanosomiasis, and screening of candidate compounds for improvement of the treatment of trypanosomiasis, in Zambia. The diseases of concern, TB, and Trypanosomiasis, one of the NTDs, are assigned high importance in Zambia's national development plans, and in the field of public health, they have had consistently high priority in health-related policies. Further, both infectious diseases are hence of great concern in connection with the issue of public health, and there has been a consistent need for rapid and accurate diagnosis in order that it can be controlled and treated is amply evident. In addition, concerning Japanese development assistance policy, this project is consistent with the public health concerns addressed in the Japanese Assistance Program for Zambia, Japan Action Plan in

Combating Infectious Diseases in Africa, and the TICAD. Thus, relevance is high. Regarding effectiveness, it is believed that the project achieved advances in the capability for research and development needed for rapid diagnosis, but because no actual activities were implemented on the screening of candidate compounds for the treatment of trypanosomiasis, this latter objective was not achieved. Concerning impact, while work on improvement of a rapid diagnostic method is being continued in the laboratory of implementing agencies, progress has not been made in obtaining official approval of the method by the MOH. However, because there has not been an overall goal assigned to this project, this has not been used in the evaluation of impact. As collateral impacts, research achievements have been made by the UNZA-SVM, that the World Bank has designated as a center for advanced education in zoonotic diseases prevalent in Eastern and Southern Africa. It is expected to contribute to the advancement of education and research, and to the expansion of international collaborative research efforts in the center. Thus, the effectiveness and impact of the project are judged to be fair. Because the project was completed within the planned time frame and budget, it is judged to be highly efficient. As for sustainability, while the necessary policy and institutional measures for the continuation of the effect of the project are assured, there are issues remained in terms of organizational technical, and financial matters to specifically engage the utilization of research outcome in this project so that its sustainability is evaluated as fair.

In light of the above, this project is evaluated to be satisfactory.

#### 4.2 Recommendations

#### 4.2.1 Recommendations to the MOH

In view of the purpose of implementing the project, it was intended to prevent the emergence of latent disease by application of a rapid diagnostic method developed for use on a sustained basis and in conformity with conditions prevalent in Zambia. In particular, it would facilitate diagnosis of people exposed to disease risk in rural areas, and early treatment of those patients. It is thus recommended that the MOH examine its capability for expediting the review of diagnosis performance and clarify issues related to the approval process for authorizing its qualification as an official method. As the rapid diagnostic method developed by the project is already in the stage of lab use, prior to actual use, the ministry should designate the responsible department and officials as soon as possible who would apply themselves to the scientific framework in terms of the necessary number of the specimen for testing and its performance to validate as an official method, confirm human resources and financial requirements for the regulatory arrangement, facilitate add-on tests by the CDL or TDRC under the ministry, and thereby begin the approval process. Moreover, diagnoses for trypanosomiasis using the rapid diagnosis method developed by this project are currently being made only by UNZA-SVM which is under the Ministry of Higher Education, so that it is

necessary to establish a working relationship with the MOH which is responsible for oversight of medical institutions that provide therapy.

#### 4.2.2 Recommendations to JICA

An interruption was found to exist in the stage of transitioning to the process of utilization of the rapid diagnostic methods, the results of the project. In the event that the MOH begins work for approval of the rapid diagnostic methods, it will be important to assure scientific objectivity by use of a third party, and support is deemed to be necessary for the formation of a scheme for official approval of actual use to be granted, that would enable guarantee of diagnosis performance, and because of this it is desirable as a follow-up undertaking to provide the assistance by training of pharmaceutical affairs or dispatch of expert(s) in the area. In the framework of review for official approval by a third-party committee, such as an ethical review committee, it should be on the premise of the dissemination and promotion in medical facilities in the rural area in Zambia. Thus, it is desirable to promote and support the effort from the viewpoint of the comprehensive infection control program, including financial and economic perspectives, with consideration given to incorporate the crucial prerequisites of production and procurement, its distribution cost, training etc. in the scope of the application plan.

#### 4.3 Lessons Learned

Good practice according to a versatile and consistent commitment to developing human resources

Zambia is an excellent example of how versatile Japanese grant aid, technical assistance, student exchange programs etc. over an extended period of time have developed a pool of researchers to the extent which they have become able to make internationally-recognized accomplishments in medical research concerned with disease prevalent in their own country. Further, the outlook is for contributions derived from the research capability that has been acquired in Zambia, contributions to be made to all of Africa. In particular, the outlook, as stated in the section on other impacts, at UNZA-SVM there have been the versatile underpinnings created through the exchange of personnel that represents a strong organizational commitment by Japan. In addition to general analytic ability including skill in using analytical equipment, it is vital to develop the ability to identify hitherto unknown scientific challenges. As the project was undertaken from such perspectives, it is deemed to result in sustainability of the research activities. Specifically, if we consider the case of the TB Laboratory at UTH and the balance of personal benefits accruing individuals desirous of receiving a higher degree, versus public benefit, the establishment of BSL-3 and day-to-day promotion of collaborative research work by technicians aspired for a higher degree have not only provided individual incentives to deepen proficiency of using the equipment but also has raised the overall level of the implementing agency itself. This is seen as a result of comprehensive support for research.

#### Necessity for long-term support in the field of medical and health-related research

Among SATREPS projects concerning the mode of utilization of research outcome in the field of infectious disease control, it is envisaged to aim at not only working on product development of new drugs and/or testing equipment but also making surveillance system to ensure higher accuracy in an inspection by incorporating newly developed research method. However, it is most commonly thought that in the field of medical and health research, it involves the product development of new drugs and/or vaccines accessible to ordinary people in developing countries. It requires a comprehensive, long-term strategy that includes, besides basic research and nonclinical research, the process of conducting a human trial in the developing countries. Note, however, differing from the research and development of drugs in and for the industrialized nations, for research and development of drugs for diseases rampant mostly in developing countries, there is a low commercial incentive for pharmaceutical makers to pursue such research and development. As per market mechanism, therefore it is not usually practiced as symbolically expressed as "neglected tropical diseases". Because of this, based on awareness of and response to the difficulty of both the private pharmaceutical companies and an isolated effort of a SATREPS project in dealing with a smooth transition to the productization from the basic medical research result, it is thus desirable that there be continued progress in basic research and nonclinical research, from a comprehensive viewpoint and teaming with personnel responsible for health policy in the nations concerned, and that there be a strategical study of measures for utilization of research outcome or use of such study findings over the medium and long-term after completion of a SATREPS project.

# Necessity for parallel support for regulatory/legislative aspects of product development in the field of medical and health-related research

In countries where SATREPS projects were implemented, need exists for technical assistance in connection with the governments' regulatory approval process of study and approval of medical products for domestic use and dissemination in those countries. Further, more generally, in developing countries aspiring to reach the semi-developed country status and where SATREPS projects have functioned to develop human resources in the field of research, in close collaboration with the counterpart personnel of the regulatory body, it is necessary to give attention to and examine the status of drug regulation, policy and law concerning intellectual property, ethical concerns for clinical tests in research and development, as well as the administrative organization and functioning of the matter.

### Method of evaluation of a SATREPS project lacking a specified overall goal

When the project does not assign an overall goal, that is, there has not been an agreement with the counterpart regarding an overall goal of the project, information and data corresponding to a super goal of research and development, and results based on the degree of accomplishment of project purpose at the time of terminal evaluation can be adopted as the "expected impact." However, while the related information should be described in the verification of impact on a trial basis, as long as consideration is given to the outlook for actual utilization of results after project completion, it is not to be directly judged in the evaluation. On the other hand, it is necessary to examine whether there are any collateral impacts and the contents, including those that were not anticipated before the start of the project, those thereby should be appraised as overall effectiveness and impact. Furthermore, the continuation of research activities related to the "expected impact" should be judged in the evaluation for sustainability.

End

Thailand

FY2016 Ex-Post Evaluation of Technical Cooperation Project (SATREPS<sup>1</sup>) "Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand (IMPAC-T)"

External Evaluator: Hisami Nakamura, OPMAC Corporation

#### 0. Summary

This project aimed at establishing a system to provide broadly useful information based on the development of simulation models and technology for river flow predictions together with the proof of their usability as scientific evidence. Also, it aimed at use for plans of water control and utilization as well as the consideration of countermeasures against floods and droughts in the agriculture sector and disaster control against floods and landslides in the disaster management sector. The project was consistent with the development policies of Thailand for improvement of weather forecast capacity and the development of databases and models for the assessment of the impact of climate change on water resources. It was also consistent with Japan's ODA policy prioritizing support for environmental management. The project was consistent with the development needs of Thailand in policy planning for adaptation to climate change and for decision making based on appropriate information about water source management. Thus, its relevance is high. By the time of project completion, the project had developed hydrological and meteorological data observation systems and produced research outputs such as hydrological cycle models and water-related risk assessment methodologies. A "Climate Change Data Center", an integrated system for hydrological cycle information was also established in order to support preparation of adaptation measures to mitigate water-related risks. In addition, as a part of actions for "utilization of research outcomes", the implementing agencies of the project have continued research work using the research outputs and models developed by the project and analytical techniques were transferred by Japanese researchers for work including hydrological and meteorological data analysis. These research and analytical outputs have been utilized and reflected in the policy and program planning of the relevant government agencies responsible for considering and implementing water resource management, flood and drought control, and adaptation to climate change. In addition, the research outputs produced by the project and the research equipment provided by the project have been utilized by young researchers for writing their Ph.D. dissertations. Furthermore, there have been some spillover effects on the improvement of research capacity and the scientific literacy of government officers as well as on the promotion of actions for utilization of research outcomes towards policy planning by government agencies based on scientific evidence. For example, even after project completion, government officers on the Thai side who had participated in the project activities were writing Ph.D. dissertations on improvement of the models developed by the project in order to consider more appropriate water

<sup>&</sup>lt;sup>1</sup> SATREPS stands for "Science and Technology Research Partnership for Sustainable Development".

use for more effective farming. All these indicate a high level of effectiveness and impact of the project. Efficiency of the project is high as the project cost was within the plan and the project period was as planned. The implementing agencies of this project, the Kasetsart University (KU), the Royal Irrigation Department (RID) and the Thai Meteorological Department (TMD) have sustained and strengthened their research system and their organizational arrangements for the utilization of the models and data analytical techniques. Researchers and officers engaged in these activities have also sustained their research capacity and skills in data analysis. Each of the implementing agencies has ensured a budget to cover the maintenance costs for the systems and the equipment installed by the project and for the personnel necessary for research work and related data analysis. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

#### 1. Project Description



Project Location



Data servers and displays showing results in the Climate Change Data Center (CCDC)

#### 1.1 Background

In Thailand, there is concern that the impacts of climate change, such as unstable weather, droughts in the dry season and floods in the rainy season, will increase. In particular, these conditions will mean an increased necessity for appropriate water resource management as there are predicted increases in the frequency and size of water-related disasters. However, there has been insufficient long-term monitoring of climate change and systems for the hydrological and meteorological observation of hydrological cycles affected by climate change. The country has also lacked hydrological cycle and water resource models. Research to contribute to the planning of appropriate adaptation to climate change has therefore been necessary. With this background

the project supported the development of necessary technology for the prediction of river flow, the height of water in the Chao Phraya River basin and so on, together with verification of their usability in order to establish a system to provide useful information for broad purposes that copes with climate change including the planning of water control and flood and landslide warnings.

The project was approved as a project in the Science and Technology Research Partnership for Sustainable Development (SATREPS) program and was implemented in collaboration with the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). The program aims at coping with global development issues (such as the environment, energy, disaster control, and the control of infectious diseases), through joint research with developing countries, and thus to improve the capacity of the recipient countries<sup>2</sup>. In the SATREPS program, JST established a committee of academics for the evaluation of academic importance and it was this committee that decided to implement the projects. Even after the adoption of the projects, JST and academics have continued to provide guidance for the projects under the SATREPS program.

#### 1.2 Project Outline

At the time of the ex-ante evaluation, although there was no obligation for the SATREPS project to prepare a Project Design Matrix (PDM), a PDM was prepared for this project, was shared between both Thailand and Japan and was used for project management. This ex-post evaluation is based on the PDM which was revised after the mid-term review in May, 2012. The Overall Goal was set forth even though setting it had been optional. However, verifiable indicators for the Overall Goal were not specified. Also, it was confirmed that there had not been clear agreement on the Overall Goal among the stakeholders of the project during the project implementation. Therefore, in this ex-post evaluation, the achievement level the Overall Goal was verified on a trial base as a part of the impacts of the project in accordance with target values specified by the external evaluator.

<sup>&</sup>lt;sup>2</sup> JST website(<u>https://www.jst.go.jp/global/about.html</u>)

Overall Goal		The developed system by the Project contributed for Thai authorities concerned to make decisions and develop adaptation measures against risks under climate change impact.			
Project Purpose		A prototype of the Integrated System to help decision-making on the adaptation for water-related risks under climate change impact is established.			
Output(s)	Output 1	Monitoring capacity in the field of hydro-meteorology of climate change impact is enhanced.			
	Output 2	An integrated model is developed in consistence with natural hydrological cycle and anthropogenic activities are enhanced.			
	Output 3	Methodology of water-related risk assessment incorporating climate change impact with anthropogenic activities are developed.			
	Output 4	The methodologies and outputs are promoted in order to be applied or incorporated into coping strategy to the climate change impact in Thailand.			
Total cost (Japanese Side)		439 million yen			
Period of Cooperation		April 2009 – March 2014			
Implementing Agency		Kasetsart University (KU), Thai Meteorological Department (TMD), Royal Irrigation Department (RID)			
Other Relevant Agencies / Organizations		King Mongkut's University of Technology Thonburi (KMUTT), Naresuan Unviversity (NU), University of Phayao (UP), Chulalongkorn University (CU)			
Supporting Agency/Organization(s) in Japan		University of Tokyo, Kyoto University, Tohoku University, Hokkaido University, Tokyo Institute of Technology, Fukushima University, Nagasaki University, National Institute for Environmental Studies			
Related Projects		<ul> <li>JICA "The Project on Comprehensive Flood Management Plan for the Chao Phraya River Basin" (Technical Cooperation for Development Study and Master Planning (February 2011-June 2013))</li> <li>JICA "Advancing Co-Design of Integrated Strategies with Adaptation to Climate Change in Thailand (ADAP-T)" (SATREPS) (June 2016- June 2021)</li> </ul>			

## 1.3 Outline of the Terminal Evaluation

## 1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

At the time of the terminal evaluation, the Project Purpose had been achieved. Software development for the hydrological cycle integrated information system, an online system for the compilation of the comprehensive research outputs of the project had been completed by the time of the terminal evaluation. In January, 2014, the hydrological cycle integrated information system was completed as CCDC in KU and the data and research outputs were uploaded and made available to the public on the CCDC website.

## 1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation

In the terminal evaluation, there was no clear mention of the prospects of achievement of the Overall Goal. However, the terminal evaluation assessed efforts for utilization of research outcomes based on the following: i) the current and future utilization of the integrated information system by the major government authorities participating in the project; and ii) the current cooperation and collaboration for the utilization of the research outputs. Regarding i), at the time of the terminal evaluation, it was mentioned that RID and TMD were going to use the system. As a noteworthy example, at the time of a flood occurring in 2011, it was also pointed out that the outputs of the project had provided knowledge for a revision of the Master Plan for the Chao Phraya River Basin Management and the establishment of the flood warning system by RID.

#### 1.3.3 Recommendations from the Terminal Evaluation

In the terminal evaluation, recommendations for the project implementation period and the post project period were proposed.

(Recommendations to be implemented within the project implementation period)

- 1. Preparation of a framework to manage the integrated information system
- 2. Dissemination of project outputs/outcomes
- 3. Preparation of equipment lists by each of the implementation agencies
- 4. Identification of future research topics
- 5. Summary of feedback on the integrated information system
- 6. Management of the flux towers

(Recommendations on actions to be taken for the post project period)

- 1. For KU, RID and TMD: Finalizing the drafted policy in the framework to manage the integrated information system and sharing this with the members participating in the project by March 2015
- 2. For researchers on the Thai side: Making efforts to realize research identified in the project as "future research topics"
- 3. For KU: Compiling feedback from the users and improving the integrated information system based on this feedback

## 2. Outline of the Evaluation Study

2.1 External Evaluator

Hisami Nakamura, OPMAC Corporation

#### 2.2 Duration of Evaluation Study

The ex-post evaluation study was conducted with the following schedule:

Duration of the Study: September 2016 – January 2018

Duration of the Field Study: December 11, 2016 – December 23, 2016, June 18, 2017 – June 24, 2017

## **3.** Results of the Evaluation (Overall Rating: A<sup>3</sup>)

### 3.1 Relevance (Rating: $3^4$ )

#### 3.1.1 Consistency with the Development Plan of Thailand

At the time of ex-ante evaluation, the "*National Water Vision*" of the Office of the National Water Resources Committee, aimed at ensuring sufficient quality and volume of water for all users through efficient management and the organization and legal systems to enable equitable and sustainable water resource utilization for the improvement of life quality and participation of all stakeholders by 2025. Also, in the "*National Strategy on Climate Change Management*" (2008-2012), which was prepared based on the 4<sup>th</sup> Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), proposals were made for improvements in weather forecast capacity, development of databases and models for assessment of the impact of climate change on water resources, and for risk assessment of floods and droughts and identification of hazard areas.

At the time of the terminal evaluation of the project, in the "*Climate Change Master Plan*" (2013-2050)<sup>5</sup>, which was under preparation by the Office of Natural Resources and Environmental Policy and Planning (ONEP) of the Ministry of Natural Resources and Environment (MONRE), water resource management was prioritized as the most important measure for adaptation to climate change. In addition, the "*National Economic and Social Development Plan*" (2014-2016), which was under implementation at the time of project completion, focused on actions to cope with climate change.

As mentioned above, in Thailand, the importance of water resource management was highlighted in the national development plan and the national strategy for climate change management from the time of the ex-ante evaluation to the time of project completion. Therefore, this project, which aimed at the establishment of a hydrological cycle integrated information system equipped with necessary data and models for assessment of the impact of climate change, was consistent with the development policies of the government of Thailand.

<sup>&</sup>lt;sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>&</sup>lt;sup>4</sup> ③: High, ②: Fair, ①: Low

 $<sup>^{5}</sup>$  It has been under process of the cabinet approval as of June, 2017 at the time of ex-post evaluation.

#### 3.1.2 Consistency with the Development Needs of Thailand

In Thailand, there is a great need for adequate water resource management information due to issues including increasing flood damage, ground subsidence caused by overuse of groundwater, long term downward trends in annual discharges and droughts in the Chao Phraya River, necessity for the adequate operation of large scale reservoirs (including dams) in the years when floods occur, and issues of dam developments in the affluent of the Mekong River.

On the other hand, at the time of ex-ante evaluation, although the relevant government authorities, including MONRE, TMD and RID, had been making efforts towards hydrometeorological observation and weather forecasts, including flood warnings, they did not have a sufficient level of capacity in water-related disaster management and water resource management to cope with climate change. In *"the National Strategy on Climate Change Management"* (2008-2012), the government of Thailand recognized that there was insufficient information and knowledge about climate change for policy decisions.

In December, 2010, at the 16<sup>th</sup> Conference of Parties (COP 16) of the United Nations Framework Convention on Climate Change (UNFCCC) ("*the Cancun Agreements*") held in Cancun, Mexico, the implementation of research aiming at data collection, storage, analysis and modeling of climate data and more systematized observations, together with the provision of more precise climate-related data for policy decision makers at national and regional level were recommended. While the international framework on climate change requires to provide more precise climate-related data, the government of Thailand had a great need for information and knowledge necessary for policy decisions. Therefore, the project, which aimed at establishment of a hydrological cycle integrated information system that would enable to provide this necessary data, was consistent with the development needs of Thailand.

## 3.1.3 Consistency with Japan's ODA Policy

"Support for environment management systems" was highlighted as one of the components of "countermeasures to issues associated with the maturation of society" which was one of the four priority areas in the *Economic Cooperation Plan for Thailand*, revised by the Ministry of Foreign Affairs (MOFA) of Japan in May, 2006. The plan focused on cooperation for improvement of the urban environment and environment and disaster management as, because it was a newly industrializing economy, Thailand needed efforts for more proactive environment management. In addition, in the MOFA "*Country Operation Plan for Thailand*", enhancement of disaster management and disaster response capacity was a priority area, as proactive efforts by Thailand on regional and global issues through the enhancement of its capacity for response to global issues would benefit and be important for the sustainable growth and stabilization of Southeast Asia. Under those policies, JICA implemented a broad range of support for capacity development in the areas of water resource and disaster management, including adaptation and mitigation measures against climate change. In light of above, the project objective to establish the hydrological cycle integrated information system for adaptation to climate change was consistent with the Japan's ODA policy for Thailand.

The project was sufficiently consistent with the development policies and the development needs of Thailand as well as with Japan's ODA policy. Therefore, the relevance of this project is high.

## 3.2 Effectiveness and Impact<sup>6</sup> (Rating:③)

- 3.2.1 Effectiveness
- 3.2.1.1 Project Output

At the time of project completion, the level of achievement of the outputs of the project was as follows.

## Output 1: Monitoring capacity in the field of hydro-meteorology for climate change impact is enhanced.

## (Indicators)

- 1-1. The role of Thai research group (TRG) in the promotion of the continuous monitoring for climate change impact are defined.
- 1-2. Tutorials/academic papers for the continuous monitoring system are prepared/submitted.
- 1-3. More than 20 TRG members are trained and obtain necessary knowledge and skills in developing, implementing, and managing the continuous monitoring of climate change impact.
- 1-4. The quasi-real-time hydro-meteorological data transfer systems are installed at observation stations by Thai Meteorological Department and Royal Irrigation Department in Chao Phraya River Basin.

Output 1 was achieved since all the indicators were achieved.

Nineteen research groups to promote research under the project were formulated and the definition of each group was completed by May 2011. Manuals for flux observation and telemetry observation were developed by the observation team in February 2011. By the time of the terminal evaluation, 25 academic papers had been published in academic journals.

Technology for the estimation of rain volume was transferred to 56 participants in total

<sup>&</sup>lt;sup>6</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

through training in Thailand, training in Japan, workshops and site visits. As for flux observation, methodologies for the collection of observation data and analytical skills required for the assessment of the impacts of climate change and changes in land use on the hydrological cycle were transferred to members of the group 8 (5 members) by using the flux observation system constructed by the project.

The quasi-real-time hydro-meteorological data transmission system (telemetry system) was installed in 32 sites in total, including 24 sites at RID observation stations, 4 sites at TMD observation stations and 4 sites for the flux observation towers managed by the three project participant organizations.

# Output 2: An integrated model in consisting with natural hydrological cycle and anthropogenic activities is developed.

## (Indicators)

- 2-1. The hydrological models for Chao Phraya River Basin are established.
- 2-2. The models of anthropogenic activities are established and incorporated in hydrological models.
- 2-3. Tutorial/academic papers for the integrated modeling system are prepared/submitted.
- 2-4. Precision of discharge estimation (annual discharge, peak discharge on monthly basis) by the integrated model is no more than  $\pm 20\%$  difference than measured volume.

Output 2 was achieved since all the indicators were achieved.

The 5 resolution hydrological cycle model targeting the Chao Phraya River Basin (H08)<sup>7</sup> was developed by group 11 and the revised model for the Chao Phraya River Basin based on the land surface process model developed by the Kyoto University (Simple Biosphere including Urban Canopy: SiBUC)<sup>8</sup> was developed by group 13.

Furthermore, the model adding anthropogenic activities (operation of the two dams on the Chao Phraya River, the Bhumibol Dam and Sirikit Dam) to the H08 hydrological cycle model was developed and the "H08 Manual User's Edition" was compiled as a practical guide to the integrated hydrological cycle and water resource model and this was made available to the public via the website. Six academic papers were submitted to academic journals by the model groups.

<sup>&</sup>lt;sup>7</sup> The model was modified based on the open source global water resource model "H08" which was developed by the National Institute of Environmental Studies, Japan.

<sup>&</sup>lt;sup>8</sup> SiBUC is a model developed for improving the accuracy of the land surface process model by adding the effects of urban and water bodies to the biosphere model (Sib). In meteorology, the urban canopy means the sphere covered by buildings.

As a result of simulation to reproduce past discharges in the Chao Phraya River Basin for the period from 1981 to 2004 using the H08 model, the difference between the actual value and the simulated value was around  $\pm 20\%$ . In average simulation results using the SiBUC model, the differences in annual discharges and monthly peak discharge were 17.5% and 20.8%, respectively. Therefore, the differences between the actual values and the simulated values found by using the models were almost within the target value of  $\pm 20\%$ .

## Output 3: Methodology of water-related risk assessment incorporating climate change impact with anthropogenic activities are developed.

#### (Indicators)

- **3-1.** Hydro-meteorological data and simulation outputs are integrated to incorporate in impact assessment.
- **3-2.** Disaster potential in present and future are estimated and risk indices are identified.
- **3-3.** Tutorials/academic papers for risk and impact assessment are prepared/submitted.
- **3-4.** The quasi-real-time risk indices are developed as for an adaptation measures to water-related disasters under climate change, and utilized for early warning system.

Output 3 was achieved since all the indicators were achieved.

Various types of impact assessments were conducted using the hydro-meteorological data and simulation results prepared through the activities of Outputs 1 and 2.

In terms of landslide risk assessment, group 16 checked the disaster risks in the northern mountainous area, the central western mountainous area and the western and central Malay Peninsula area and developed landslide disaster hazard maps. The hazard maps were distributed in areas that could be seriously damaged (the provinces of Chiang Mai, Uttaradit and Phetchabun). As for the risk assessment of coastal erosion, areas with potential coastal erosion and areas with serious damages by coastal erosion were confirmed throughout the whole of Thailand by group 20. The results were presented in a project workshop held in Sendai in November, 2013. In terms of the risk assessment of floods through tropical heavy rain and droughts, group 3 selected risk indices for use in impact assessment and identified flood and drought risks in all 22 provinces of Thailand.

Fourteen academic papers on the risk assessments mentioned above were submitted to academic journals.

The project developed quasi-real-time risk indices and these indices were utilized for disaster warning. In particular, the results of running water analysis by the project were

utilized for the flood early warning system developed by the Foundation of River and Water Basin Integrated Communications of Japan (FRICS) at RID as a part of *the Project on Comprehensive Flood Management Plan for the Chao Phraya River Basin.* In addition, the hydro-meteorological status of the Chao Phraya River Basin was published on the website in quasi-real time. Furthermore, landslide disaster emergency transmission systems were established in areas with a high frequency of landslides in Krabi Province by group 16.

# Output 4: The methodologies and outputs are promoted in order to be applied or incorporated into coping strategy to the climate change impact in Thailand.

#### (Indicators)

- 4-1. Recognition of IMPAC-T among water related policy makers is enhanced.
- 4-2. Cooperation arrangement will be signed.

Output 4 was mostly achieved since indicator 1 was achieved and indicator 2 was partially achieved. It was confirmed that recognition of IMPAC-T among policy makers in the water sector of Thailand had been enhanced. Contributions to improvement of recognition were made by: an interim report of the flood survey under implementation by the project, presented by a Japanese expert of the project who had participated in an emergency damage site survey dispatched by the government of Japan through JICA in November, 2011; IMPAC-T workshops held by the project; presentation on the subtopic of "issues of water-related disasters" to the technical sessions of the 2<sup>nd</sup> Asia Pacific Water Summit (APWS). In particular, discussions about the possible contribution of scientific technology to flood control, made in the presence of the Prime Minister of Thailand, enhanced the understanding of the contribution of IMPAC-T on the part of government authorities. Participation of the top management of RID and TMD in the IMPAC-T activities also brought about an improvement in the recognition of IMPAC-T. Furthermore, other contributions of the project to the consideration of flood control after the flood of 2011, such as recommendations made by the Japanese expert of this project concerning the operation of dams and reservoirs for flood prevention for flood control plan under preparation by the government of Thailand lead to further enhancement of recognition.

Meanwhile, according to the terminal evaluation report, it was envisaged that agreements and signing on the arrangements for cooperation on the dissemination or application of the research outputs of the project would provide frameworks enabling the individuals participating in the project activities to continue to participate in the research activities in the future. Thus, it can be considered that indicator 2 was aiming at cooperation arrangements composed of a larger number of the project participating agencies. There are some cases of cooperation arrangements between the research institutions participating in the project for some specific objectives. However, these have been limited to memoranda or partial agreements, such as a memorandum between KU and PU for joint research on flux observation and cooperation for the construction of flux towers and an agreement on data sharing between KU and RID.

## 3.2.1.2 Achievement of Project Purpose

The Project Purpose of "the development of а prototype Integrated System to help decisionmaking on the adaptation to waterrelated risks under the impact of climate change" refers to the online "Integrated Information System" which comprehensively compiles the research outputs of the project. This enables the storage and processing of hydro-meteorological data transmitted from the observation stations of RID and TMD as well as from the flux observation towers installed by the project, also downloading of the models



Figure 1: Flow Rate of Chao Phraya River updated on the CCDC website

developed by the project, the running of simulations using data collected by the project and the models, and the uploading of the outputs by the research groups. The planned outputs of: i) improvement of hydro-meteorological observation capacity by the establishment of systems for assessment and the observation of climate change impact, ii) the development of the hydrological cycle and water resource model, iii) the development of water-related risk assessment, iv) recognition of the methodologies and models developed by the project on the part of the stakeholders and agreements on cooperation

arrangements made, were mostly achieved as planned. The software for the online hydrological cycle integrated information system, the aim of the project, was developed to compile the project outputs comprehensively. The Integrated Information System was completed as CCDC in KU and information and research outputs useful in mitigating water-related risks were made available on the website

Project Purpose	Indicator	Actual
A prototype of the	(Indicator)	Achieved.
integrated system to help	Recommendations and	Development of the software for the online
decision-making on the	integrated information from the	hydrological cycle integrated information system
adaptation for water-related	system are published on the web	comprehensively compiling the research outputs
risks under climate change	pages.	by the project had been completed by the time of
impact is established.		the terminal evaluation. The hydrological cycle
		integrated information system was completely
		established as CDCC in KU in January 2014. The
		data and research outputs were publicly opened
		on the CDCC website.

Table 1: Achievement of Project Purpose

In the light of above, the Project Purpose was achieved.

## 3.2.2 Impact

## 3.2.2.1 Achievement of Overall Goal

As mentioned above, although PDM was prepared for the project and the Overall Goal was set, the verifiable indicator for the Overall Goal was not set. Therefore, in this ex-post evaluation, the Overall Goal of this project was considered as "actions for the utilization of research outcomes by using the research outputs of the project are expected to be taken". This ex-post evaluation attempted to verify the achievement of the Overall Goal as "an expected positive impact". For reference, the achievement level of the Overall Goal was experimentally assessed by the status of "efforts for utilization of research outcomes", which are considered to be the utilization and application of the system and the research outputs developed by the project and the incorporation of those outputs as scientific evidence into policies and programs by the relevant agencies, including the implementing agencies of the project.

The flood of the Chao Phraya River in 2011 became a trigger, making the stakeholders understand the importance of efforts for utilization of research outcomes and to start concrete actions for utilization of research outcomes. Since the activities to analyze hydro-meteorological data and to develop a hydrological cycle model for the forecastability/ predictability of floods in the Chao Phraya River have been under implementation by the project, suggesting that timely prediction of floods through the project activities was difficult in 2011 In addition, the counterparts from TMD and RID were kept extremely busy with emergency flood countermeasures which caused a stagnation of project activities. However, this was taken as an opportunity and, because the importance to improve the analytical capacity of hydro-meteorological data was recognized by government authorities of Thailand, the research outputs of the project, including the H08 model, the analysis results of hydro-meteorological data and various kinds of simulation results, were utilized for policy and program planning by the government authorities.

The specific actions for utilization of research outcomes by the implementing agency after project completion, as confirmed at the time of ex-post evaluation, are as follows:

(1) KU

KU has published and updated Geographic Information System (GIS) maps on their website, using the skills and methodologies for analyzing and using satellite image data obtained through the project. These maps are utilized by government authorities. In addition, KU has participated in the on-going SATREPS project of ADAP-T as one of the implementing agencies and researchers who had participated in the project activities of IMPAC-T as counterparts also have been engaged in the activities of ADAP-T. In the project activities of ADAP-T, activities for "Co-Design" have been implemented to reflect the simulation results of models such as H08 and the research outputs have been incorporated into policy planning for soil management, disaster management and groundwater development through co-work with the Land Development Department (LDD), the Department of Disaster Prevention and Mitigation (DDPM) and the Department of Groundwater Resources (DGR). Since the concept of "Co-design" by ADAP-T is an action for utilization of research outcomes, the utilization of the research outputs and utilization of research outcomes have been promoted through co-works between research institutions including KU and government authorities.

### (2) RID

At the time of the ex-post evaluation, RID was continuing analysis of data collected by the telemetry system<sup>9</sup> installed by the project and was conducting flood risk management using the H08 model (the hydrological cycle model for the Chao Phraya River Basin). Also, an RID officer, who had participated in IMPAC-T as counterpart, continued research into a model to forecast water use for farmers based on the H08 model (utilization for cropping).

#### (3) TMD

TMD published weather forecasts utilizing the results of the H08 model and data analysis technology transferred by the project on the TMD website and provided the information to the relevant government authorities. In addition, TMD is providing ONEP with information for the Climate Change Adaption Plan (CCAP) which is under preparation.

<sup>&</sup>lt;sup>9</sup> A system to observe subjects at remote points and to collect data. Instruments measuring data such as sensors and measures as well as transmitters which convert data to electric pulses and transmit them are installed at observation points. Receivers to receive the data and systems to store and analyze it are installed at the receiving point.
It has been confirmed that government authorities other than the implementing agencies of IMPAC-T have utilized the research outputs of the project. The Department of Water Resources has been implementing drought control using the drought forecast and the support model based on the simulation results of the H08 model as well as satellite images. Also, through the activities of ADAP-T mentioned above, the results of analysis, forecast and simulation of scientific data such as rainfall by the models, including H08 developed by IMPAC-T, have been integrated in the socio-economic data of each area and this integrated data is used in adaption measures in each area. For example, flood/drought vulnerability maps using the integrated data are used for the consideration of measures to improve farming.

As mentioned above, where the verifiable indicator for the Overall Goal is assumed to be "the hydrological cycle integrated information system and the models for analysis and simulation of hydro-meteorological data are utilized as a tool for the consideration of longterm policy based on scientific evidence", the Overall Goal can be considered to have been "achieved" as the research outputs and analytical results using the models developed by the project have been referred to in the policy and programs of several government authorities.

Overall GoalIndicatorActualThe developed system byNo indicator was set in the PDM. This ex- because of the properties of the pr			
The developed system by No indicator was set in the PDM. This ex- • KU: Collection and analysis of	<b>Overall Goal</b>	Indicator	Actual
the Project contributes for Thai authorities concerned to make decisions and develop adaptation measures against risks under climate change impact.post evaluation assessed the achievement level of the Overall Goal with the following expected impact:hydro-meteorological data has continued in CCDC installed by the project in KU and data has been provided on the website developed by IMPAC-T.measures against risks under climate change impact.• The hydrological cycle integrated information system and the models for analysis and simulation of hydro- meteorological data are utilized as a tool for the consideration of long-term policy based on scientific evidence• RID: The H08 model has been utilized for hydro-meteorological data analysis.	The developed system by the Project contributes for Thai authorities concerned to make decisions and develop adaptation measures against risks under climate change impact.	<ul> <li>No indicator was set in the PDM. This expost evaluation assessed the achievement level of the Overall Goal with the following expected impact:</li> <li>The hydrological cycle integrated information system and the models for analysis and simulation of hydrometeorological data are utilized as a tool for the consideration of long-term policy based on scientific evidence</li> </ul>	<ul> <li>KU: Collection and analysis of hydro-meteorological data has continued in CCDC installed by the project in KU and data has been provided on the website developed by IMPAC-T.</li> <li>RID: The H08 model has been utilized for flood control.</li> <li>TMD: The H08 model has been utilized for hydro-meteorological data analysis.</li> </ul>

Table 2: Achievement of the Overall Goal

### 3.2.2.2 Utilization of the Research Outputs related to the Project

This ex-post evaluation verified the utilization of the research outputs related to IMPAC-T as expected positive impacts besides actions for utilization of research outcomes. The utilization of the research outputs related to the project which were observed by the ex-post evaluation is as follows:

- (1) Continuation of research on the hydrological cycle and water-related risk, newly started research based on the research outputs of the project, and improvement of research capacity
  - In KU, many of the researchers who had participated in IMPAC-T have been participating

in ADAP-T, a successor project of IMPAC-T, continuing their research based on the outputs of IMPAC-T (the data and the models) and conducting analysis and simulation for utilization of research outcomes. For example, in the activities of ADAP-T, analysis combining data such as economic and social activities, demographic distribution and so on has been conducted for the development of hazard maps using the H08 model to cope with waterrelated risks such as floods and droughts in the Upper Chao Phraya River Basin as a part of measures for adaptation to climate change impact. Also, in RID, which is an administrative institution responsible for the management of irrigation water, the counterpart of IMPAC-T, in his Ph.D. dissertation, has modified the H08 model for combining socioeconomic data in areas with irrigation and implemented simulation to improve farming through the recommendation of optimum cropping based on the forecast of water availability. In addition, two lecturers of CU who had participated in the activities of IMPAC-T have continued their research on the application of results from analyzing data of groundwater, discharges of surface water and water resources to irrigation water management by using SiBUC.

(2) Spillover effects from the system and the research outputs established by the project

From the point of view of the development of younger researchers, environment-related research using data collected using the flux observation towers installed by the project has continued in Ratchaburi (KU), Tak (NU) and Payao (PU). In Ratchaburi, a graduate student of KMUTT has been preparing his Ph.D. dissertation using the observation data and a researcher who participated in IMPAC-T has been supervising him. In Nakhon Sawan (KMUTT), the flux observation tower installed by the project was destroyed by fire. It was located in a sugarcane field which was burned off for farming. However, KMUTT reinstalled the flux observation tower using their own budget and thus monitoring activities have continued.

In addition, ex-counterparts who participated in the activities of IMPAC-T have been preparing their Ph.D. dissertations under the supervision of the Japanese researchers engaged in IMPAC-T. As mentioned above, the excounterpart from RID has attended Ph.D. courses at the University of Tokyo. The topics of his dissertation is the improvement of farming using the modified H08 model.



Photo 1: Flux observation tower installed in Ratchaburi

- 3.2.2.3 Other Positive and Negative Impacts
- (1) Impact on the Natural Environment

No positive or negative impact on natural environment by the project was confirmed.

(2) Resettlement and Land Acquisition

No resettlement and land acquisition occurred through the project.

(3) Establishment of an Early Warning System in Krabi Province

As a part of activities of the Output 3 aiming at the development of methodologies for water-related risk assessment considering anthropogenic activities and climate change impact, an early warning system to notify local people of the risk of landslides was established in Krabi Province where there is a higher frequency of landslides. This activity was implemented as a pilot activity to establish a system which was responsive to the needs of local people. The system was composed of a rain gauge installed in a slope in the mountain where there was a higher risk of landslides together with equipment to transmit the data of rain water volume using short radio signals as a warning to a village located at the base of the mountain. Although the system had been maintained by the villagers, it was not functioning due to the battery of the sensor being out at the time of the ex-post evaluation.

The effectiveness and impact of this project are high since the expected effects were realized through the implementation of the project as planned. All the planned outputs, including development of the hydrological cycle model and analysis of hydro-meteorological data, were produced as planned and the hydrological cycle integrated information system to publish and provide the results of analysis and the research outputs was completed as planned. As a result, the Project Purpose had been achieved by the time of project completion. In addition, as a way to utilization of research outcomes, the research and analysis activities using the research outputs of the project, the models developed by the project and the analytical technologies and skills transferred through the project have been utilized as scientific evidence and are reflected in the policy and program planning of the government authorities which are responsible for the consideration and implementation of water resource management, flood and drought control, and adaptation to the impact of climate change. In addition, there were spillover effects contributing to the development of younger researchers through the project.

# 3.3 Efficiency (Rating:③)

# 3.3.1 Inputs

# Table 3: Inputs for the Project

Inputs	Plan	Actual
(1) Experts	1 Long-Term (Project Coordinator) 11 Short-Term (Chief Advisor, Research Planning, Hydro-Meteorological Observation, Hydrological and Anthropogenic Activities Modeling, Impact and Risk Assessment)	1 Long-Term (Project Coordinator), 16 Short-Term (Chief Advisor, Training Planning, Global Observation considering Climate Change Impact, Establishment of Hydrological Cycle and Water Use Model considering Anthropogenic Activities, and Impact and Risk Assessment including Climate Change Impact and Anthropogenic Activities)
(2) Trainees received	50 persons (Counterpart trainings in Japan)	64 persons (Training in Japan at the University of Tokyo, Kyoto University, Tohoku University and so on)
(3) Equipment	Hydro-meteorological data integrated system: servers, mass storage devises, etc.), quasi hydro-meteorological observation system (communication system and meteorological and hydrological observation instruments), concentration observation (supersonic velocity thermometer, radio balance measure, water quality sensor and wind profiler)	Weather observation sensors (rain gauges, automatic weather stations, soil moisture meters, etc.) Flux observation systems for 4 sites, Flux observation tower constructed in PU, GPRS modems for telemetry, Spectro radiometers, construction cost for the installation of sensors, equipment for the hydrological cycle integrated information system (servers, projection systems for the KU server, data servers, etc.)
(4) Local Cost Expenditure	No information	35 million yen (Cost for procuring consumables for research equipment provided, including the flux observation systems, payrolls for research assistants, travel expenses in Thailand, etc.)
Japanese Side Total Project Cost	Total 450 million yen	Total 439 million yen
Thai Side Total Project Cost	No information	KU: Cost for purchasing servers and GPS, operation and maintenance cost for the servers (1 million Bahts per annum), construction cost for the server room (1 million Bahts) communication and electricity cost (0.45 million Bahts per annum), cost for the storage and transport of equipment provided by the project, cost for posting academic papers, cost for purchasing materials and equipment used by group 16 (0.02 million Bahts) RID: Communication cost and maintenance cost for servers, Cost for transport, installation and works of the telemetry equipment TMD: Communication cost and maintenance cost for servers

Source: Ex-ante evaluation sheet, Terminal evaluation report

# 3.3.1.1 Elements of Inputs

### (1) Japanese Side

For the dispatch of experts, while one long-term expert was dispatched as planned, the number of short-term experts dispatched increased to 16 from the original plan of 11 but there was no change in the areas of expertise. As for the trainees received, the number of trainees increased to 64 from the original plan of 50 but no details, including the specific numbers of trainees for which training courses were held, was mentioned in the plan. The training by JICA and the training and workshops held by the University of Tokyo, the Kyoto University, the Tohoku University, the Hokkaido University and the National Institute of Environmental Studies aimed at necessary technical transfer for activities to produce the outputs of the project. These resulted in the definite achievement of the outputs. As for the provision of equipment, observation equipment including rain gauges, flux observation systems, and telemetry systems which were necessary for the project purpose of the establishment of the Integrated Information System, including data servers, was installed.

#### (2) Thai Side

On the Thai side, 51 persons in total, including the officers and researchers of the implementing agencies of KU, RID and TMD as well as researchers of KMUTT, NU, UP and CU, participated in the project activities as counterparts of this project. The project office was set in KU and KU provided the necessary office appliances. Besides this, each implementing agency provided the necessary data for the activities and the production of the planned outputs. In addition, each implementing agency bore the cost of purchasing necessary equipment, the costs for installation and utilization of the equipment installed by the project (including maintenance cost).

# 3.3.1.2 Project Cost

The actual project cost was 439 million JPY against the planned project cost of 450 million JPY which was within the plan (ratio against the plan: 98%). Although the actual numbers of experts dispatched and trainees received exceeded the plan, comparison between the actual and the plan was not possible due to a lack of data for the time of planning. However, the increases in both numbers were due to necessary additional inputs to cover the research areas for the production of the planned outputs and the project cost was within the plan. Therefore, it can be judged that these additional inputs contributed to the efficient production of the research outputs.

### 3.3.1.3 Project Period

The project was implemented for the period from May, 2009 to March, 2014. The project period was 4 years and 11 months as planned (ratio against the plan: 100%).

The project cost was within the plan and the project period was as planned. Therefore, the efficiency of the project is high.

# 3.4 Sustainability (Rating: ③)

#### 3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

In *the National Climate Change Master Plan* (2015-2050), "development of useful knowledge, databases and technology for adaptation to climate change impact and low carbon development" is included as one of the 4 missions. Also, "water resources" is included in the 6 adaption strategies in the Master Plan. Based on the Master Plan, research activities such as the provision of hydrological cycle data and hydro-meteorological data by the Integrated Information System and analysis by the models have been promoted. Since this, CCAP has been prepared by ONEP through consideration of the results of analysis of the hydrometeorological data. Thus, the implementing agencies of the project have been required to provide results of analysis and simulation using the models developed by the project.

By the above mentioned polices of the government of Thailand for adaptation to climate change impact, the sustainability of the project effects has been ensured from the policy and institutional aspect.

### 3.4.2 Organizational Aspects for the Sustainability of Project Effects

Considering the effects of the project, this ex-post evaluation assessed the organizational arrangements necessary to sustain the project effects from the following three aspects: i) operation and maintenance of the Integrated Information System established by the project, ii) research activities related to the research outputs of the project, and iii) cooperation and collaboration between the government authorities and researchers for the utilization of the research outputs of the project.

# (1) Organizational arrangements for Operation and Maintenance of the Integrated

Information System established by the project

The Integrated Information System (the servers) for storage and analysis of the data transmitted from each observation station was installed and sustained at CDCC in KU. In addition, data has been updated on the CDCC website since project completion. Thus, the organizational arrangements for the collection and analysis of hydro-meteorological data has been maintained.

(2) Organizational arrangements for research activities related to the research outputs of the project

Since the many of the ex-counterparts of IMPAC-T, including the researchers of KU and the officers of RID and TMD, have been engaged in the activities of ADAP-T as counterparts, the activities for research and the analysis of hydrometeorological data and the hydrological cycle have been continued. Furthermore, the organizational arrangements to promote actions for utilization of research outcomes have been under preparation. While KU and RID concluded an



Photo 2: RID officers engaged in the activities of ADAP-T

agreement for cooperation on hydro-meteorological research, TMD concluded a memorandum of understanding (MOU) on research cooperation with NU.

#### (3) Cooperation and collaboration between government authorities and researchers

As mentioned above, the research outputs of the project not only contributed to collaboration among KU, TMD and RID, who had participated in IMPAC-T, but they also promoted the reflection of scientific evidence based on the research outputs and analytical results using the models developed by the project in policies and programs of other related government authorities, such as ONEP, including water resource use, disaster management and flood and drought control. Also, through ADAP-T, the organizational arrangements for utilization of research outcomes have been established and enhanced at the local level.

## 3.4.3 Technical Aspects for the Sustainability of Project Effects

In this ex-post evaluation, the technical capacity necessary to sustain the project effects was assessed from the following aspects: i) the necessary skills and knowledge to utilize the research outputs of the project, ii) research capacity related to the research outputs of the project, and iii) scientific literacy necessary to reflect the research outputs of the project in policies.

(1) Necessary skills and knowledge to utilize the research outputs of the project

The ex-counterparts of KU, TMD and RID who had participated in IMPAC-T have sustained the skills and knowledge necessary to use the Integrated Information System and the models developed by the project such as H08 and SiBUC. KU has maintained CCDC and provided the results of analysis and simulation of the data stored in the Integrated Information System for the government authorities. RID has continued monitoring based on the telemetry

system installed by the project and has taken measures for flood and drought control in irrigation water management. TMD has applied H08 and the technology for the utilization of satellite images transferred by the project to weather forecasting, thus improving the accuracy of their routine works.

#### (2) Research capacity related to the research outputs of the project

The research capacity of the implementing agencies and other agencies related to the research outputs of the project has been sustained and improved. As mentioned above, the researchers of KU, KMUTT, NU and PU who had participated in IMPAC-T have been continuing their research activities using the equipment provided by the project. Also, they have been engaged in the development of younger researchers through the supervision of graduate students who have been conducting their research and preparing their Ph.D. dissertations using the equipment provided by the project. In addition, after the project completion, the counterparts of RID who had participated in IMPAC-T have also been improving their individual research capacity through the preparation of Ph.D. dissertations based on the research outputs of the project.

# (3) Scientific literacy necessary to reflect the research outputs of the project in policies

As mentioned above, the scientific literacy of government authorities in Thailand has improved. Not only TMD and RID, but also other government authorities concerned with adaptation to climate change impact, including ONEP, have been promoting the utilization of the results of data analysis and simulation by using the research outputs and the models developed by the project as scientific evidence for the consideration of policies and programs on water resource development, disaster management, and flood and drought control for the agriculture sector. Furthermore, the scientific literacy of local governments has been enhanced through ADAP-T.

## 3.4.4 Financial Aspects for the Sustainability of Project Effects

The financial sources for the sustainment of the project effects were assessed from the aspects of: i) maintenance of the equipment and facilities installed by the project and ii) activities related to the research outputs of the project.

## (1) Maintenance of the equipment and facilities installed by the project

For the maintenance of CCDC (in particular, data servers) equipped by the project, the necessary payroll and maintenance costs (around 0.1 million Bahts per month to cover the electricity cost for cooling the data server room) have been covered by KU where the systems were installed. The telemetry system, servers and PCs provided for RID were registered as

assets of RID and their maintenance costs were budgeted and ensured by RID. The annual budget for one observation station with a telemetry system is 0.012 million Bahts and the total annual budget for the 20 observation stations with telemetry systems installed by the project amounts 0.24 million Bahts. As for the telemetry systems provided for TMD (4 sites), TMD has been utilizing them since project completion, but has not registered them as assets and has not ensured a budget for their maintenance. Although TMD recognized the necessity of registering the equipment provided by the project in the asset list of TMD in order to ensure the maintenance budget, the sufficient instruction for the registration of the equipment was not handed over to the newly assigned manager at the time of personnel rotation and the procedures for registration was not taken. However, it was confirmed that the procedures for registration of the equipment had been started at the time of the ex-post evaluation. On the other hand, the equipment, including PCs, has not already been used due it having exceeded its expected lifetime and no maintenance cost was necessary. Among the four flux observation towers, all except one have been maintained and utilized and KU, KMUTT and UP to which the flux towers were transferred have ensured the maintenance budgets. KMUTT reinstalled the flux tower which was destroyed by fire using their own budget and has been continuing observation activities.

### (2) Activities related to the research outputs of the project

All the implementing agencies of KU, RID and TMD which participated in IMPAC-T have been utilizing and applying the research outputs of the project to their works and most of the ex-counterparts who participated in IMPAC-T have also been continuing activities related to the project. Each of the implementing agencies has ensured a budget to cover the necessary costs for the activities related to the project, including payroll. Further research activities have been supported by the project budget of ADAP-T, which has been under implementation with the cooperation of JICA, for utilization of research outcomes, including the utilization of the research outputs of IMPAC-T.

For the improvement of research capacity at an individual level, a part of the budget for researches on the Ph.D. courses by the counterparts of RID participating in the project has been supported by the Agricultural Research Development Agency (ARDA), a Thai research institute.

In the light of above, no problem was observed in any aspects of policy or in the institutional, organizational, technical and financial aspects. Therefore, the sustainability of the project effects is high.

## 4. Conclusion, Lessons Learned and Recommendations

#### 4.1 Conclusion

This project aimed at establishing a system to provide broadly useful information based on the development of simulation models and technology for river flow predictions together with the proof of their usability as scientific evidence. It aimed at use for plans of water control and utilization as well as the consideration of countermeasures against floods and droughts in the agriculture sector and disaster control against floods and landslides in the disaster management sector. The project was consistent with the development policies of Thailand for improvement of weather forecast capacity and the development of databases and models for the assessment of the impact of climate change on water resources. It was also consistent with Japan's ODA policy prioritizing support for environmental management. Also, the project was consistent with the development needs of Thailand in policy planning for adaptation to climate change and for decision making based on appropriate information about water source management. Thus, its relevance is high. By the time of project completion, the project had developed hydrological and meteorological data observation systems and produced research outputs such as hydrological cycle models and water-related risk assessment methodologies. A "Climate Change Data Center", an integrated system for hydrological cycle information was also established in order to support preparation of adaptation measures to mitigate water-related risks. In addition, as a part of actions for "utilization of research outcomes", the implementing agencies of the project have continued research work using the research outputs and models developed by the project and analytical techniques were transferred by Japanese researchers for work including hydrological and meteorological data analysis. These research and analytical outputs have been utilized and reflected in the policy and program planning of the relevant government agencies responsible for considering and implementing water resource management, flood and drought control, and adaptation to climate change. In addition, the research outputs produced by the project and the research equipment provided by the project have been utilized by young researchers for writing their Ph.D. dissertations Furthermore, there have been some spillover effects on the improvement of research capacity and the scientific and technological literacy of government officers as well as on the promotion of actions for utilization of research outcomes policy planning by government agencies based on scientific evidence. For example, even after project completion, government officers on the Thai side who had participated in the project activities were writing Ph.D. dissertations on improvement of the models developed by the project in order to consider more appropriate water use for more effective farming. All this indicates a high level of effectiveness and impact of the project. Efficiency of the project is high as the project cost was within the plan and the project period was as planned. The implementing agencies of this project, KU, RID and TMD have sustained and strengthened their research system and their organizational arrangements for the utilization of the models and data analytical techniques. Researchers and

officers engaged in these activities have also sustained their research capacity and skills in data analysis. Each of the implementing agencies has ensured a budget to cover the maintenance costs for the systems and the equipment installed by the project and for the personnel necessary for research work and related data analysis. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

#### 4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency None.

4.2.2 Recommendations to JICA None.

# 4.3 Lessons Learned

Involvement of the related institutions for actions to be taken for utilization of research outcomes

The project involved not only a university as a research institution (KU) but also government authorities using the research outputs including the analysis and results of simulation of hydrometeorological data and the hydrological cycle models developed by the project in their routine work (TMD and RID) as implementing agencies. As a result, this implementation arrangement enabled consideration of how to utilize the research outputs during the project implementation period. Furthermore, it contributed to the institutional arrangements for reflecting the data as scientific evidence in policies and programs through the provision of the data to the government authorities responsible for adaptation to climate change impact (ONEP) as well as to other relevant government authorities in areas related to the hydrological cycle including water resource development, disaster management, and flood and drought control (in the agriculture sector). In addition, ADAP-T, which has been successively implemented after IMPAC-T, incorporates project activities aiming at utilization of research outcomes (consideration and planning of policies and programs using the research outputs in cooperation with local governments) in its project design, which reflects the project effects of IMPAC-T. For the project design of SATREPS, it is desirable that the implementation arrangement should be clarified based on the research contents to be implemented by the project for the project period, as well as institutional arrangements for the utilization of the expected research outputs of the SATREPS project for the post project period, in order that consideration may be made of the actions to be taken for utilization of research outcomes. At the same time, from the project planning stage, JICA needs to facilitate the stakeholders of the project including Japanese researchers, research institutions and the relevant organizations of the target country, to help in their understanding of the

importance of the actions for utilization of research outcomes and to coordinate them as a donor agency.

End

Tuvalu

# FY2016 Ex-Post Evaluation of Technical Cooperation Project (SATREPS<sup>1</sup>) "The Project for Eco-Technological Management of Tuvalu against Sea Level Rise" External Evaluator: Nobuyuki Kobayashi, OPMAC Corporation

### 0. Summary

This project aimed at policy-making for coastal protection based on joint research by Japan and Tuvalu and the development of human resources and schemes for the continuous monitoring of coastal topography and the coral reef ecosystem. It was expected that the eco-technological methods based on the research would be adopted in Tuvalu as coastal protection measures. Since the project intention was to pick up research results for coastal protection reflecting the natural process of island formation, the research content of the project was consistent with the development policy of Tuvalu. However, the coastal protection measures developed by the project required a longer period for the incidence of effects and the time scale did not match the urgency of the development needs in Tuvalu. For these reasons, the relevance of the project is fair. The project produced sufficient research results up to project completion and coastal protection measures were prepared. On the other hand, however, sustainable monitoring schemes at the executing agencies were not established through the project. At the time of the ex-post evaluation, out of the proposed measures for coastal protection, open-cut of the Causeway had been adopted in the regional development strategy of Funafuti but not as a coastal protection measure. There, the executing agencies did not conduct research and monitoring activities and subsequent studies were not found in neighboring countries. Thus, the effectiveness and impact of the project are fair. The project period was within the plan but the project cost exceeded the plan. Therefore, the efficiency of the project is fair. The cost overrun was mainly due to an increase in the amount of equipment provided, an increase in the expense of experts dispatched, and the cost associated with the employment of an expert for design and construction supervision. At the time of the ex-post evaluation, the jurisdiction of the executing agencies did not include research and monitoring with the project and an organizational setting for the implementation of subsequent research had not been established. At the time of the ex-post evaluation, no budget had been allocated to relevant research and monitoring. Given these problems in the organizational and financial aspects, the sustainability of the project effects is low.

In light of the above, this project is evaluated to be unsatisfactory.

<sup>&</sup>lt;sup>1</sup> SATREPS stands for "Science and Technology Research Partnership for Sustainable Development".

#### 1. Project Description



#### 1.1 Background

Tuvalu consists of lowland atolls and is one of the countries likely to be affected most severely by future rises in sea level and cyclones caused by abnormal weather. Since the atolls are formed from coral and foraminifera, there is concern that recent population growth will bear an environmental burden on the ecosystem. Due to the unique feature of the islands, coastal protection measures that ignore ecological mechanisms risk jeopardizing the long-term island preservation mechanism in the country. Therefore, at the time of the ex-ante evaluation in 2009, the country needed to implement coastal proception measures based on an understanding of the island formation and preservation mechanism, to prepare for rises in sea level in the future, and to enhance adaptation to climate change. With this background, the project conducted joint research with the Tuvalu government, analyzed the causes of coastal erosion, and aimed at policy formation based on coastal conservation measures from a long-term perspective. While the project conducted research with a long-term perspective, technical cooperation projects aiming at immediate results (the Study for Assessment of the Ecosystem, Costal Erosion and Protection/Rehabilitation of Damaged Areas in Tuvalu and the Project on Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island, Tuvalu) were implemented in parallel. Tuvalu's adaptation to climate change was supported from both long and short-term perspectives.

The project was approved as a project in the Science and Technology Research Partnership for Sustainable Development (SATREPS) program and implemented in collaboration with the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). The program aims were to cope with global development issues (such as environment, energy, disaster prevention, and the control of infectious diseases), to conduct joint research with developing countries, and to improve the capacity of developing countries<sup>2</sup>. In the SATREPS program, JST established a committee of academics for the evaluation of academic importance and the committee decided to implement projects. Even after the adoption of the projects, JST and academics have continuously provided guidance to the projects.

# 1.2 Project Outline

At the time of the ex-ante evaluation, the SATREPS scheme was not obliged to prepare a Project Design Matrix (PDM). At the time of the detailed planning survey, only the Narrative Summary part of the PDM was agreed by the executing agency. Furthermore, the mid-term review partially revised the Narrative Summary and set up indicators. The executing agencies adopted the indicators. This ex-post evaluation is based on the Narrative Summary and the indicators in the mid-term review.

Overall Goal		Countermeasure plan against sea level rise by promoting sand production-transportation-sedimentation process considering the effect of human activities and anthropogenic construction is adopted as coastal management policy of Tuvalu Government.		
Project	Purpose	<ol> <li>A sand production-transportation-sedimentation model which takes into consideration effects of human activities and global warming is developed and eco-engineering technology adapted to the Tuvaluan situations to create and/or restore sandy beach is proposed.</li> <li>Monitoring arrangements which sustain coastal topography and coral reef ecosystems are made by developing staff capacity.</li> </ol>		
Output 1-1		A habitat-sedimentation balance map is made and the coastal characteristics and formation process of the sandy beach are clarified.		
	Output 1-2	The effects of human activities and sea level rise on coastal sand production-transportation-sedimentation are evaluated.		
Output(s)	Output 1-3	Eco-engineering technology to enhance sand production-transportation-sedimentation is proposed.		
	Output 2-1	Technical and administrative capacity of the research staff and government officials engaged in the joint research is developed.		
	Output 2-2	Understanding on land formation and awareness of local communities toward coastal environment and ecosystem conservation is raised.		
Tota (Japane	al cost ese Side)	266 million yen		
Period of	Cooperation	April 2009 – March 2014		

 $<sup>^2\,</sup>$  JICA (2014) "Terminal Evaluation Report on the Project for Eco-Technological Management of Tuvalu against Sea Level Rise"

Implementing Agency	Ministry of Natural Resources and Environment <sup>3</sup>
Other Relevant Agencies	Pacific Islands Applied Geoscience Commission (SOPAC),
/ Organizations	University of South Pacific (USP)
Supporting	University of Tokyo, Oceanic Planning Corporation, National
Agency/Organization(s)	Institute for Land and Infrastructure Management, Ibaraki
in Japan	University, Tokyo Denki University, University of the Ryukyus
Related Projects	<ul> <li>JICA "The Study for Assessment of Ecosystem, Costal Erosion and Protection/Rehabilitation of Damaged Area in Tuvalu" (2009-2011)</li> <li>JICA "Project on Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island, Tuvalu" (2012-2017)</li> </ul>

# 1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

At the time of the terminal evaluation, Project Purpose 1 had been achieved and it was expected that Project Purpose 2 would be achieved by the end of the project. For Project Purpose 2, the preparation of monitoring plans (including internal procedures) had not been achieved but it was expected that it would be achieved within the project period.

# 1.3.2 Achievement Status of the Overall Goal at the Terminal Evaluation

The terminal evaluation did not explicitly mention the prospect of achievement of the Overall Goal. At the time of the terminal evaluation, it was pointed out that eco-technological methods had not been adopted as coastal protection policy and that progress toward the achievement of the Overall Goal was not visible.

# 1.3.3 Recommendations from the Terminal Evaluation

Ten recommendations were made in the terminal evaluation. These recommendations are related to either the dissemination of research results or the continuation of research activities. The recommendations are as follows:

- 1. Preparation of monitoring plans (including internal procedures) for the continuation of research activities
- 2. Approval of the monitoring plans by the Tuvalu government
- 3. Utilization of the Final Report that summarizes research results and makes policy recommendations
- 4. Utilization of aquaculture tanks for foraminifera and auxiliary facilities

<sup>&</sup>lt;sup>3</sup> At the time of the ex-post evaluation, the executing agencies were, the Environmental Department of the Ministry of Foreign Affairs, Trade, Tourism, Environment and Labour; the Fisheries Department; and the Department of Lands and Survey of the Ministry of Natural Resources.

- 5. Awareness campaigns at communities and schools for environmental conservation using materials prepared by the project
- 6. Promotion of the project results inside and outside Tuvalu for a better understanding of island formation and preservation
- 7. Continuation of collaboration on monitoring activities between Japanese researchers and their counterparts in Tuvalu
- 8. Collaboration with research institutions, donor agencies and regional organizations concerning the implementation and continuation of research activities
- 9. Pilot implementation of eco-technological methods for coastal protection
- 10. Formal appointment of a government official to carry out an awareness campaign based on the results of the project

# 2. Outline of the Evaluation Study

- 2.1 External Evaluator Nobuyuki Kobayashi, OPMAC Corporation
- 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September 2016 – January 2018

Duration of the Field Study: February 6, 2017 – February 22, 2017,

April 24, 2017 – May 5, 2017

# **3.** Results of the Evaluation (Overall Rating: D<sup>4</sup>)

- 3.1 Relevance (Rating:  $2^5$ )
  - 3.1.1 Consistency with the Development Plan of Tuvalu

The national development strategy at the time of the ex-ante evaluation was *the National Strategy for Sustainable Development 2005-2015 (Te Kakeega II).* In this strategy, the goal of the environment sector was to "Establish national climate change adaptation and mitigation policies". "Impacts associated with climate change and rises in sea level, specifically the salt-water inundation of pulaka pits, coastal erosion and flooding" were recognized as development issues. The Tuvalu government formulated the National Adaptation Program of Action (NAPA) in 2007 as a policy for adaptation to climate change and the program was in its implementation phase at the time of the ex-ante evaluation. NAPA picked up the development needs of major fields including coastal protection. In NAPA, coastal protection focused on the enhancement of resilience against climate change in coastal

<sup>&</sup>lt;sup>4</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>&</sup>lt;sup>5</sup> ③: High, ②: Fair, ①: Low

and residential areas and projects to cope with coastal erosion were proposed.

At the time of the terminal evaluation, both *Te Kakeega II* and *NAPA* were ongoing. Adaptation to climate change remained important at both national policy and sector policy level throughout the project period. During the project period, the Tuvalu government formulated *the National Strategic Action Plan for Climate Change and Disaster Risk Management 2012-2016 (NSAP)*. The plan embedded projects for coastal protection and foraminiferal sand in its program for climate change and referred to coastal protection activities reflecting the natural process of island formation.

At both the times of the ex-ante evaluation and project completion, the development strategy supported the formulation and implementation of policies for adaptation to climate change and focused on coastal protection as a part of the policies for adoption. The development strategy also referred to coastal protection which reflected the natural process of island formation. This project aimed to pick up research results that could be utilized for coastal protection without hampering the natural process of island formation. Thus, the research content of the project was consistent with the development plan.

#### 3.1.2 Consistency with the Development Needs of Tuvalu

Since the most areas of Tuvalu are lowland atolls with a height of 1-3 m above sea level, overtopping waves and spring water<sup>6</sup> during high tides have caused damage to inhabitants. There are several factors behind the disasters. First, rises in sea level due to global warming can be pointed out. As of the time of the ex-ante evaluation, sea level had been rising in Tuvalu over the past 20 years and the trend was expected to continue. *The IPCC<sup>7</sup> Fourth Assessment Report* compared actual data of



Photo 1:Ta Microscopic Image of Foraminifera

the global average sea level from 1980 to 1999 with a forecast of the global average sea level from 2090 to 2099. The rise in sea level was estimated to be 0.18m to 0.38m at minimum and 0.26m - 0.59m at maximum. In addition, there were artificial factors in Fongafale Island where this project was implemented. As aforementioned, atolls in Tuvalu are formed by coral and foraminifera. A population increase in Fongafale Island caused water pollution and there was the concern that the natural process of sand production might be hampered due to the degradation of the ecosystem.

In the background of the development needs in Tuvalu is the fact that the lowland

<sup>&</sup>lt;sup>6</sup> Hide tides are one of the factors that cause spring water as sea water enters underneath coral reefs.

<sup>&</sup>lt;sup>7</sup> Intergovernmental Panel on Climate Change (IPCC)

geographical conditions make the country prone to damage caused by high tides. This geographical condition remained the same from the ex-ante evaluation to project completion. The depression caused a high tide in March 2014 and damaged a part of the revetment. Moreover, rises in sea level were expected to continue in the long run even at project completion. In *the IPCC Fifth Assessment Report*, which was published in 2014, the expectation of rises in sea level up to the year 2100 had increased by 20cm from the similar scenario laid out in the 4th report<sup>8</sup>. The population of Fongafale Island continuously grew and the population of Funafuti<sup>9</sup> increased by nearly 40% between 2002 and 2012 (see Table 1).

The reason for the population growth was more employment opportunities and better life convenience in Funafuti. A degradation of water quality has occurred due to population growth and in 2010 a water quality inspection found that the sea water on the lagoon side of Fongafale Island contained Escherichia coli at 27 times the environmental standard of Japan<sup>10</sup>. The substantial amount of Escherichia coli suggested that the water quality near the island needed to be improved through the treatment of domestic wastewater.

	1991	2002	2012
Funafuti	3,839	4,492	6,194
Other areas	5,204	5,069	4,643
Total	9,043	9,561	10,837

Table 1: Population Trends in Tuvalu

Source: Tuvalu Central Statistics Division 2012 Population and Housing Census

The project aimed at coastal protection with a long-term perspective and its outcome was the development of technology utilizing the natural process of island formation together with policy-making for coastal protection based on this technology. The research content of the project was highly advanced and there was no institution to conduct research as its mandate. For these reasons, relevant persons on the Tuvaluan side lacked hands-on experience of research. It was suggested at the time of the ex-ante evaluation that the relevant persons on the Tuvaluan side could not clearly understand the timing of the realization of research outcomes. It was pointed out in the terminal evaluation that the Tuvalu side misunderstood the project results and that their expectations did not match the planned outcomes. As the research results were picked up at the project implementation stage, the Tuvaluan side realized that the eco-technological coastal protection proposed by the project would require a

<sup>&</sup>lt;sup>8</sup> Center for Regional Environmental Research, National Institute for Environmental Research (2015) *Reading Points in the IPCC Fifth Report* 

<sup>&</sup>lt;sup>9</sup> Funafuti consists of several islets and Fogafale Island has the largest population.

<sup>&</sup>lt;sup>10</sup> Hajime Kayane (2014), the Final Report for the Project for Eco-Technological Management of Tuvalu against Sea Level Rise

long period of time. Since coastal protection is an urgent issue in the country, the Tuvaluan side pointed out in the terminal evaluation that the research activities were of lower priority than the coastal protection projects that generate immediate results.

At both the times of the ex-ante evaluation and project completion, there was the development need for coastal protection to reduce damage from high tides. The purpose of the project is generally in line with this development need. However, the coastal protection measures developed by the project required more time for the incidence of effects than that required by conventional coastal protection projects. The project was commenced while stakeholders in Tuvalu still did not fully recognize the timing of the realization of the research results. While this project produced coastal protection measures with a long-term perspective, the Tuvaluan side had urgent needs. This mismatch became evident during project implementation.

## 3.1.3 Consistency with Japan's ODA Policy

At the Japan-Tuvalu summit meeting in December 2007, the then Tuvalu Prime Minister, Mr. Ielemia, requested assistance for climate change. Under the initiative of the then Prime Minister of Japan, Mr. Fukuda, the formation of this project began. Japan proposed the Cool Earth Partnership in 2008 and the project was implemented as part of the partnership. For five years from 2008, the partnership would help developing countries reduce emissions and support the adaptation<sup>11</sup> of developing countries severely affected by climate change. In the ODA policy at the time of the ex-ante evaluation, Tuvalu was recognized as an island country vulnerable to climate change, and assistance for the country focused on climate change. Priority fields included "sustainable development" and countermeasures for climate change were considered part of this<sup>12</sup>.

At the time of the ex-ante evaluation, the Japanese government planned to support developing countries in their adaptation to climate change and the project was a part of this effort. As the project conducted research for coastal protection in Tuvalu, the project goal was consistent with Japan's ODA policy.

# 3.1.4 Appropriateness of the Project Plan and Approach

At the time of the ex-ante evaluation, the Japanese side recognized the importance of securing staff to conduct research activities after project completion. It was understood that a budget for research and monitoring was an external condition from the Project Goal to the Overall Goal. To ensure the achievement of this external condition, it was planned that the project would involve research institutes from other countries in joint research, so that

<sup>&</sup>lt;sup>11</sup> Ministry of Foreign Affairs of Japan (2009), Japan's Official Development Assistance White Paper 2008

<sup>&</sup>lt;sup>12</sup> Ministry of Foreign Affairs of Japan (2009), Japan's ODA Data by Country 2008

research resources would be acquired from the outside after project completion. Furthermore, it was recognized that the arrangement of a monitoring scheme was a prerequisite for securing the budget. Tuvalu did not have a research institution and, thus, it was necessary to establish a scheme for future research in parallel with the joint research. However, no formal agreement had been made with research institutes of other countries at the time of the ex-ante evaluation. When the project was commenced, the achievement of the external condition was uncertain. The sustainability of project effects was unclear since there was no research institution on the Tuvalu side at the time of the ex-ante evaluation, Nevertheless, the project was adopted due to its academic importance and consistency with Japan's aid policy. This suggests a problem in the project plan.

Although a researcher from a research institute in another country joined the project, cooperation was based on an individual relationship with the researcher and no formal agreement had been made with the research institution by project completion. The project was not able to establish a scheme to continuously support the research capacity of Tuvalu through the uninterrupted activities of a foreign research institution.

As mentioned above, the project conducted research in the eco-technological field. However, the long-term perspective of the research activities and the urgent needs of the Tuvaluan side did not match at the time of the project completion. The Tuvaluan side did not have a strong incentive for monitoring activities leading to subsequent studies and was reluctant to acquire research resources from outside. While the project produced research results that could be used for policy planning for coastal protection, a sustainable monitoring scheme at the executing agencies had still not be arranged at project completion. As a result, the executing agencies were not conducting activities to follow-up research at the time of the ex-post evaluation.

At the time of the ex-ante evaluation, it was recognized that the resources for research would become an external condition and that a monitoring scheme would need to be arranged before project completion. However, the approach of the project did not match the development needs of Tuvalu. For this reason, there were difficulties in the establishment of a sustainable monitoring scheme and it was not possible to establish a cooperative relationship with a research institute in another country. As a result, it was difficult to implement the project in accordance with the original plan.

This project was partly irrelevant to the country's development needs and had minor problems in the project plan and approach. Therefore, its relevance is fair.

# 3.2 Effectiveness and Impact<sup>13</sup> (Rating: 2)

### 3.2.1 Effectiveness

# 3.2.1.1 Project Output

At the time of project completion, the achievement of the Outputs of the project was as follows. Outputs 1-1, 1-2, and 1-3 are related to the Project Purpose 1 and the Outputs 2-1 and 2-2 are related to the Project Purpose 2.

# Output 1-1: A habitat-sedimentation balance map is made and the coastal characteristics and formation process of the sandy beach are clarified.

Output 1-1 was achieved. A habitat map of foraminifera around Fongafale Island and Tengako Island was prepared. Furthermore, an estimation was made of the sand production by foraminifera and a model to predict the volume of sand drift was made.

# Output 1-2: The effects of human activities and sea level rise on coastal sand production-transportation- sedimentation are evaluated.

Output 1-2 was achieved. Based on an assessment of the influence of water pollution on the foraminiferal habitat, an assessment of the influence of jetties and the Causeway on sand drift, together with an assessment of the influence of landfills and revetment on sedimentation, the influence of human activities on the production, transportation and sedimentation of sand was understood.

# **Output 1-3: Eco-engineering technology to enhance sand productiontransportation-sedimentation is proposed.**

Output 1-3 was achieved. The project produced research results such as aquaculture technology for foraminifera, technology for the treatment of water pollution, countermeasures for man-made structures and open-cut of the Causeway. These results were used in the proposal of an eco-technological method which contributes to coastal protection.

# Output 2-1: Technical and administrative capacity of the research staff and government officials engaged in the joint research is developed.

Output 2-1 was partially achieved. Counterparts in the Fisheries Department acquired the capacity to monitor coral ecosystems while those in the Department of Lands and Survey obtained the capability to monitor coastal topography. However, periodic monitoring reports on coastal ecosystems (mainly coral reefs) and topographical changes (mainly the Alapi Beach) were not made as originally planned in the project. No counterpart was

<sup>&</sup>lt;sup>13</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

assigned for public relations.

# Output 2-2: Understanding on land formation and awareness of local communities toward coastal environment and ecosystem conservation is raised.

Output 2-2 was partially achieved. Counterparts and government officials organized briefing sessions for residents and awareness campaigns for residents were carried out during the project period using results of the research. Nevertheless, the terminal evaluation pointed out that residents did not initiate environmental conservation activities voluntarily thanks to these enlightenment activities. In the ex-post evaluation, it could not be confirmed through interviews with relevant parties that there had been a relationship between public awareness campaigns by the project and environmental conservation activities among residents<sup>14</sup>.

#### 3.2.1.2 Achievement of Project Purpose

#### (1) Achievement of Project Purpose 1

The project had two Project Purposes. Project Purpose 1 was policy-planning of coastal protection measures using eco-technological methods. It is concluded that the Project Purpose 1 was achieved.

The experts of the project had completed *the Final Report on the Eco-Technological Management of Tuvalu against Rises in Sea Level* (hereinafter "Final Report") by project completion and submitted it to the Tuvaluan side. In the Final Report, analysis was made on the influence of human activities on sand production, transportation and sedimentation and eco-technological methods developed by the project as well as beach nourishment and replanting of coastal vegetation were proposed. The Final Report is not only a list of coastal protection measures but also shows the positioning of individual measures based on a time scale for the incidence of effects and scientific/technological difficulties. The Final Report assessed the coastal protection measures from the viewpoint of public policy. For JICA's Study on the Assessment of the Ecosystem, Costal Erosion and Protection/Rehabilitation of Damaged Areas in Tuvalu, the project recommended a gravel beach instead of a vertical seawall, which may hamper sand sedimentation. JICA's Project on Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island adopted the recommendation.

In the project, research produced new eco-technological methods (e.g. aquaculture technology for foraminifera and technology for the control of water pollution) and made

<sup>&</sup>lt;sup>14</sup> In the ex-post evaluation, officials of the Kauple (organization for resident autonomy) and stakeholders at a church which supported an awareness campaign, a women's group engaged in environmental conservation activities, and the Solid Waste Agency (6 people in total) were interviewed. For the arrangement of the interviews, project stakeholders suggested organizations involved in the awareness campaigns and those who recognized the activities of the project were identified at each organization.

policy proposals on coastal protection based on the research results. This suggests that Project Purpose 1 was achieved. The indicators for Project Purpose 1 and their achievement at the time of the project completion are shown in the following table.

Project Purpose	Indicator	Actual
A sand production-transportation -sedimentation model which takes into consideration effects of human activities and global warming is developed and eco-engineering technology adapted to the Tuvaluan situations to create and/or restore sandy beach is proposed.	Indicator (A) Model to enhance sand transportation-sedimentation by reflecting coastal ecosystem conservation and human activities is developed.	Achieved. Coastal conservation measures were recommended using the eco-technological methods developed by the project (e.g. aquaculture technology for foraminifera, open-cut of the Causeway, removal of man-made structures, treatment of domestic wastewater) as well as beach nourishment and coastal vegetation.
	Indicator (B) An eco-technological plan to enhance sand production- transportation-sedimentation.	Achieved. Initial costs and maintenance costs and issues were examined for countermeasures against man-made structures (removal of jetties, reclamation of underwater borrow pits, sand bypass) and open-cut of the Causeway. During the project, a gravel beach which did not hinder recovery of the sandy beach was recommended in JICA "the Study for Assessment of Ecosystem, Costal Erosion and Protection/Rehabilitation of Damaged Area in Tuvalu". JICA "Project on Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island" adopted the recommendation.

Table 2: Achievement of Project Purpose 1

#### (2) Achievement of Project Purpose 2

Project Purpose 2 of the project was institutional building to continuously monitor coastal topography and the coral reef ecosystem and the development of human resources for the monitoring scheme. It is concluded that Project Purpose 2 was partially achieved.

The Fisheries Department and the Department of Lands and Survey assigned staff for the monitoring activities for the research and the project carried out training. As a result, data collection continued during the period that experts were absent from Tuvalu. Nevertheless, the monitoring activities were limited to those related to the research of the project and were not incorporated into the routine work of the executing agencies. The executing agency terminated the monitoring activities at the time of the terminal evaluation because the expected research results could be obtained within the project period. For continuity of the research, the terminal evaluation recommended the preparation of monitoring plans (including internal procedures) for coastal reef ecosystems and coastal topography (mainly the Alapi Beach). However, the plans had not been prepared by the time of project completion and the monitoring activities were not resumed.

The counterparts acquired the skills necessary for monitoring through the training of the project. On the other hand, the scheme to continue the monitoring activities was not established. These suggest that Project Purpose 2 was partially achieved. The indicators for Project Purpose 2 and their achievement at the time of project completion are shown in the

# following table.

Project Purpose	Indicator	Actual
Monitoring arrangements which sustain coastal topography and coral reef ecosystems are made by developing staff capacity.	<b>Indicator (A)</b> Monitoring implementation system (staff assignment) will be internally regulated in related departments.	Unachieved. At the time of the terminal evaluation, the Fisheries Department and the Department of Lands and Survey were expected to prepare monitoring plans (including internal procedures) and to consider budget allocation based on the plan but no plan was prepared.
	<b>Indicator (B)</b> Monitoring staff are assigned at each related department.	Achieved. During project implementation, three persons were assigned at the Fisheries Department and the Department of Lands and Survey for monitoring and data collection for research.
	<b>Indicator (C)</b> Monitoring results are submitted to Japanese experts on a regular basis.	Partially Achieved. Monitoring of coral ecosystems and that of coastal topography were conducted during the research period but the monitoring activities were discontinued at the time of the terminal evaluation and had not been resumed by the project completion.

Table 3:	Achievement	of Projec	t Purpose	2

For Project Purpose 1, the project produced sufficient research results, and coastal protection measures were planned using the research results. For Project Purpose 2, the project contributed to the development of the monitoring capability of the counterpart but it did not establish monitoring schemes at the executing agencies. Thus, the project achieved at a limited level its project purpose.

# 3.2.2 Impact

# 3.2.2.1 Achievement of Overall Goal

In the mid-term review (August 2011), the Overall Goal of the project was revised to coastal conservation measures in Tuvalu adopting eco-technological methods which had been picked up by this project. At the time of the ex-post evaluation, it was concluded that the Overall Goal had not been achieved.

At the time of the ex-ante evaluation, the Overall Goal was to restore and strengthen the resilience of sandy beaches but it was difficult to strengthen the resilience of the ecosystem within 3 to 5 years after project completion. Therefore, as an intermediate step



Figure 1: Location of Causeway

leading to strengthening of the resilience of the ecosystem, the Overall Goal was revised so that research results would be reflected in the coastal protection measures of the Tuvalu government. Since the Overall Goal is defined as a goal to be achieved within 3 - 5 years after project completion, this amendment is appropriate. Although no indicator was chosen for the Overall Goal over the project period, the terminal evaluation used the status of the implementation of eco-technological methods in coastal protection as evidence.

At the time of the ex-post evaluation, the regional development plan, the Funafuti Strategic Plan (2016-2020) referred to open-cut of the Causeway proposed by the project. A small channel between Tengako Island and Fongafale Island was landfilled and the Causeway was built. Open-cut of the Causeway will allow sand to flow from the ocean side to the lagoon side along with the ocean current and sandy beaches on the lagoon side will recover. Although open-cut of the Causeway is expected to contribute to coastal protection, the above regional development plan regarded the improvement of access to fishery resources for small-scale fishermen (more specifically, a shortening traveling time to fishing grounds, savings in fuel costs) as the project purpose of the open-cut. At the time of the ex-post evaluation, activities for future project implementation (such as design, environmental and social impact assessment, and budgeting) had not been conducted for open-cut of the Causeway.

After completion of the project, the Tuvalu government implemented a beach nourishment project, which was completed in 2016. No relevance between the project and the above beach nourishment project could be found through interviews with relevant officers on the Tuvalu side, experts of the project and the JICA "Project on Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island". It was not confirmed that the research results and technical advice from the project were used in the formation of the beach nourishment project. UNDP's Tuvalu Coastal Adaptation Project, a project funded by the Green Climate Fund (GCF), is currently assessing beach nourishment.

The indicator for the Overall Goal and its achievement at the time of the ex-post evaluation are shown in the following table.

Overall Goal	Indicator	Actual
Countermeasure plan against sea level rise by promoting sand production-transportation-sedim entation process considering the effect of human activities and anthropogenic construction is adopted as coastal management policy of Tuvalu Government.	No indicator was selected during the project period.	The incidence of Impact is limited. Based on the extent to which the coastal protection measures of the Tuvalu government adopted the recommendations of the project, open-cut of the Causeway proposed in the Final Report had been incorporated into the development plan at the time of ex-post evaluation. However, open-cut of the Causeway was chosen as a measure to support small-scale fishery, not as a coastal protection measure.

Table 4: Achievement of the Overall Goal

#### 3.2.2.2 Continuation of Research and Monitoring

One of the paths towards achievement of the Overall Goal is the continuation of research and monitoring by the Tuvalu government. The accumulation of research results and data through research and monitoring will contribute to policy planning in coastal protection in the future and will be an essential source of information for aid and research. The continuation of research and monitoring will also stimulate the interest of international cooperation agencies and research institutions.

At the time of the ex-post evaluation, out of the executing agencies, the Fisheries Department alone regarded research as its jurisdiction. However, research on coastal protection and conservation of the natural environment (such as protection of foraminiferal habitats) was not carried out because the department only conducted research and data collection from the viewpoint of fisheries resources management. The Fisheries Department had discontinued the operation of the experimental facility for aquaculture of foraminifera at project completion due to expensive operation costs. At the time of the ex-post evaluation, the executing agencies did not prepare monitoring plans for the continuation of the research and the monitoring schemes were not established.

Another path to the Overall Goal is subsequent research in Tuvalu or neighboring island countries by experts and other researchers who participated in the project. Research results from neighboring island countries which have similar natural and social conditions may be used in coastal protection measures in Tuvalu.

The interviews with experts in the ex-post evaluation found that experts in the project were conducting follow-up studies such as those on aquaculture foraminifera on coral gravel in Japan but follow-up studies were not ongoing in Tuvalu or in neighboring island countries. Interviews with relevant parties of the Tuvalu government and international cooperation agencies<sup>15</sup> did not confirm research activities relevant to the research results of the project.

The overall goal has not been achieved. Out of the eco-technological measures proposed by the project, open-cut of the Causeway was adopted in the regional development plan but it was not regarded as a measure for coastal protection. The executing agencies did not resume research and monitoring activities and follow-up studies in Tuvalu or in neighboring countries.

#### 3.2.2.3 Other Positive and Negative Impacts

(1) Impact on the Natural Environment

The terminal evaluation did not point out a negative impact on the natural environment.

<sup>&</sup>lt;sup>15</sup> Interviews with four officers in the Secretariat of the Pacific Community (SPC), the Secretariat of the Pacific Regional Environmental Programme (SPREP), and the United Nations Development Programme (UNDP)

The project built aquaculture tanks for foraminifera. A building was removed and equipment such as tanks had been stored in an existing government facility at the time of the ex-post evaluation because a cyclone destroyed the facility in 2015. At the time of the ex-post evaluation, other equipment was installed in existing government buildings. Therefore, the negative impact on the natural environment caused by the project is considered very minor.

#### (2) Resettlement and Land Acquisition

The project built a facility for the aquaculture of foraminifera. As the facility was set up on land owned by the Tuvalu government, resettlement of residents and land acquisition were not required.

#### (3) Obtaining Patents

Based on the research results of this project, two patents had been obtained by the time of the ex-post evaluation. The University of Tokyo and Oceanic Planning Corporation applied for and obtained a patent on technology for aquaculture of foraminifera in Japan. Experts and a counterpart on the Tuvaluan side were co-inventors of the patent, and the counterpart became the first patent holder in Tuvalu. In addition, Ibaraki University applied for and obtained a patent on wastewater treatment with sea water in Japan.

#### (4) Contribution to Activities for Environmental Awareness

Based on the research results of this project, picture books were made for environmental education and these were distributed in Tuvalu after project completion. The picture books were written in Tuvaluan and explained that the island consisted of coral and foraminifera and that the protection of their habitat was crucial. In the ex-post evaluation, it was found through an interview with a school official that the picture book was in a classroom at a school in Funafuti and children with an interest could read it.

JICA's *Project for Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island*, Tuvalu conducted awareness campaigns using the research results of the project (the island consists of foraminifera and protection of the foraminifera habitat contributes to coastal protection). At the time of the ex-post evaluation, residents regularly clean up the beach made by the gravel beach project.

According to counterparts, the habitat map of foraminifera was used as reference material for public explanation when the Fisheries Department established fish habitat protection areas.

## (5) Utilization of New Skills in Daily Operation

The counterparts of the project utilize capabilities acquired in this project in daily operation. The counterparts of the Fisheries Department strengthened their abilities as research divers and were collecting samples for research on ciguatera poisoning at the time of the ex-post evaluation. Moreover, the counterparts in the Department of Lands and Survey had gained skills in using the latest survey instruments through the project and were surveying outer islets at the time of the ex-post evaluation.

Since this project has to some extent achieved the project purpose and overall goal, effectiveness and impact of the project are fair. For the Project Purpose, coastal protection measures were proposed by using the research activities of this project but the monitoring schemes were not established at the executing agencies. For the Overall Goal, the regional development plan adopted open-cut of the Causeway but the open-cut was not regarded as a coastal protection measure. The executing agencies did not conduct research and monitoring activities and a follow-up study was not found in neighboring countries.

# 3.3 Efficiency (Rating: 2)

3.3.1 Inputs

Inputs	Plan	Actual
(1) Experts	1 Long-Term (Project Coordination, no information on MM <sup>*</sup> )	3 Long-Term (Project Coordination, 60MM)
	5 Short-Term (Project Leader/Marine Ecology, Remote Sensing, Costal Engineering, Costal Erosion Assessment, and Marine Geology, no information on MM)	17 Short-Term (7 Marine Geology/Ecology, 2 Remote Sensing, 4 Coastal Engineering,1 Foraminifera, 38 MM)
(2) Trainees received	No information on the number of trainees	3 persons
(3) Equipment	Ultrasonic current meter, Water quality testing equipment, Survey equipment, Ecological research equipment, etc.	Aquaculture tanks for foraminifera, Ultrasonic current meter, Water quality testing equipment, Survey equipment, etc.
(4) Local Cost Expenditure	10 million yen	15 million yen
Japanese Side Total Project Cost	Total 160 million yen	Total 266 million yen
Tuvaluan Side Total Project Cost	No information	Total 1 million yen (estimation, project operational cost)

# Table 5: Inputs for the Project

Source: Internal documents, Terminal evaluation report Note: \* MM stands for man/months.

## 3.3.1.1 Elements of Inputs

For the input of the Japanese side, although three long-term experts were assigned, only one expert was stationed in Tuvalu except for transition periods. Thus, the actual assignment was largely in accordance with the original plan. The number of short-term experts was increased mainly due to the facts that (1) aquaculture tanks for foraminifera were operated in Tuvalu as well as in Japan and one short-term expert in Marine Ecology who designed the facilities was added and (2) the number of short-term experts in Marine Engineering was increased because research on water quality improvement was added. In addition, one of the dispatched experts was a foreign researcher who was responsible for teaching counterparts about the aquaculture of foraminifera. In the opinion of the executing agencies, the expertise of the dispatched experts matched research content. As experiments on the aquaculture of foraminifera was added to the project scope, aquaculture tanks for foraminifera were added to the equipment provided. At the time of the ex-ante evaluation, it was assumed that experiments on the aquaculture of foraminifera would take place in a small tank. However, actual use of the aquaculture technology to be developed would require introduction on a larger scale. The Aquaculture tanks were therefore constructed for larger scale aquaculture experiments.

For the inputs from the Tuvaluan side, 10 officers were assigned for counterparts during the project period. In addition, the Tuvaluan side provided some equipment (sinks, air conditioners), a project office, utility costs, a part of the project operational costs (transportation costs of equipment, cost of survey boats, etc.). However, the Japanese side bore the cost of electricity cost for the aquaculture tanks for foraminifera as this was too expensive for the Tuvaluan side.

# 3.3.1.2 Project Cost

The project cost was planned to be JPY 160 million. The actual project cost was JPY 266 million, which was significantly higher than planned (166% of the planned project cost). Major reasons for the increase in project cost were (1) the cost of the equipment provided substantially exceeded the plan (planned: JPY 30 million, actual: JPY 80 million), (2) the cost associated with the dispatch of experts became significant (approximately JPY63 million on a contract basis), and (3) personnel costs for experts were required (approximately JPY 39 million on a contract basis). For the increase in the cost of the equipment, as aforementioned, the construction of larger aquaculture tanks for foraminifera was included in the project scope and the amount of other equipment increased as well. The cost associated with the dispatch of experts increased because more short-term experts were assigned and this increased the number of trips to Tuvalu. The short-term experts made 90 trips in total. The personnel costs for experts were for the employment of an expert who

designed and supervised the construction of the aquaculture tanks for foraminifera.

#### 3.3.1.3 Project Period

This project was implemented from April 2009 to March 2014, and the project period was as planned (100% of the planned period). At the beginning of the project period, the equipment provided required transformers due to a difference in voltage. However, this minor problem did not cause a significant delay in the project activities.

Although the project period was within the plan, the project cost exceeded the plan. Therefore, efficiency of the project is fair.

# 3.4 Sustainability (Rating: ①)

3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

For the policy and institutional aspects, it is important that policies remained intact for the continuation of relevant research and the introduction of coastal protection measures based on the eco-technological methods proposed by the project.

The national development strategy at the time of the ex-post evaluation was *Te Kakeega III* (2016-2020). *Te Kakeega III* set targets for 12 development issues and, given its serious impact on Tuvalu, climate change was regarded as the primary development issue. To protect Tuvalu from the impact of climate change, the national strategy recognized the necessity of various measures to enhance resilience to climate change. In the field of the natural environmental, the strategy assumed that human activities were adversely affecting naturally formed coastlines and proposed coastal protection measures that did not disturb the process. These measures were restrictions on construction activities, a ban on the collection of sand and stone, and the plantation and preservation of coastal vegetation.

At the time of the ex-post evaluation, *NAPA* was ongoing. The implementation of the program was divided into three phases and *Phase 2 (NAPA 2)* was underway at the time of the ex-post evaluation. As mentioned above, coastal protection was one of the priority areas of *NAPA* but the main focus of *NAPA 2* was disaster prevention and coastal fishery. For this reason, a project to implement coastal protection measures proposed by this project had not been carried out at the time of the ex-post evaluation. The succeeding plan of *NSAP* was under preparation at the time of ex-post evaluation.

Tuvalu ratified the Paris Agreement (December 2015) in COP 21 and, as a contracting party of the agreement, was responsible for the preparation of an adaptation plan and its implementation (Clause 9, Article 7). The agreement also referred to the effective action for climate change that developing countries among the contracting parties, especially island countries, needed to adopt to improve their capacity (Clause 1, Article 11).

Given the contents of the national development strategy, there is the condition that the policy contributes to the sustainability of the project effects.

#### 3.4.2 Organizational Aspects for the Sustainability of Project Effects

For the organizational aspects, it is crucial that organization for research and monitoring is well-established for the implementation of a project's subsequent research.

At the time of the ex-ante evaluation, there was no research institute conducting scientific research in Tuvalu. Therefore, the implementation scheme centered on the Environment Department under the Ministry of Natural Resources and Environment. Moreover, researchers from SOPAC and USP were expected to participate in the project as sufficient research resources could not be obtained in Tuvalu. This cooperative relationship was intended to secure future research resources. In consideration of the research content, the Department of Environment, the Fisheries Department and the Department of Lands and Survey became the executing agencies of the project. During project implementation, the Department of Environment, and Labor. On the hand, the Fisheries Department and the Department of Lands and Survey belonged to the Ministry of Natural Resources.

At the time of the ex-post evaluation, the Department of Environment remained under the Ministry of Foreign Affairs, Trade, Tourism, Environment and Labor while the Fisheries Department and the Department Lands and Survey stayed under the Ministry of Natural Resources. Due to the duties and the level of human resources of the executing agencies, no scheme to implement subsequent research of the project was established. The organization for the research and monitoring of each executing agency is shown in the following table.

<b>Executing Agencies</b>	Current Situation
Department of Environment	Since research was not in the mandate of the department, there was no scheme to continuously conduct research as a daily operation. The Department of Environment did not collect environmental data regularly, and no monitoring that was relevant to the research of the project was conducted. At the time of the ex-post evaluation, there was one official in the department and no one was assigned for research and monitoring.
Fisheries Department	The department conducted research from the viewpoint of fishery resource management (current amount of fishery resources, ciguatera poisoning, etc.) but it did not conduct research for coastal protection and preservation of the natural environment. The Fisheries Department was responsible for monitoring but its purpose was to manage fisheries resources. Therefore, the Fisheries Department did not conduct research and monitoring to enable subsequent research of the project. Four staff was engaged in research and monitoring in the field of coastal fisheries.
Department of Lands and Survey	Since research was not in the jurisdiction of the department, there was no scheme to continuously conduct research as a daily operation. Surveying was the main task of the Department of Lands and Survey and topography data of Tuvalu was continually collected. At the time of the ex-post evaluation, two staff were assigned for surveying but data collection had nothing to do with the continuation of the research conducted by the project.

Table 6: Organization for Research and Monitoring of the Executing Agencies

Source: Answers for the questionnaires to the executing agencies, Interviews with relevant officials

			Unit: person
	2014	2015	2016
Department of Environment	3	1	1
Research	0	0	0
Monitoring	0	0	0
Fisheries Department	No Data	43	43
Research*	4	4	4
Monitoring*	4	4	4
Department of Lands and Survey	6	8	8
Research	0	0	0
Monitoring**	2	2	2

Table 7: Number of Employees of the Executing Agencies after Project Completion

Source: Answers to the questionnaires with the executing agencies

Note 1: \* The same staff are assigned for both research and monitoring.

Note 2: \*\*The number of staff who are in charge for land survey and mapping

Researchers at SOPAC and USP, those who were supposed to join the project at the time of the ex-ante evaluation, did not participate in the research of the project but a foreign researcher (belonging to SOPAC at the beginning and, then, transferred to USP) became an expert of the project. However, this cooperative relationship was based on an individual connection with the researcher. The project did not establish a scheme to have foreign research institutes continue their research in the country and to support the improvement of the research capacity in Tuvalu after project completion.

In Tuvalu, organization for research and monitoring was not established. Thus, there was a problem in the organizational aspects.

#### 3.4.3 Technical Aspects for the Sustainability of Project Effects

For the technical aspects, it is important that counterparts can maintain their research and monitoring capabilities through training and daily operation and to use the equipment provided for subsequent research.

Counterparts collected research data during project implementation and obtained the capability required for monitoring during the project period. At the time of the ex-post evaluation, research and monitoring relevant to the project was not being conducted but the counterparts were using the capabilities necessary for monitoring in daily operation. In the site visit survey, various equipment provided by the project was examined. Based on the list of the equipment provided made at the terminal evaluation, out of 111 items provided to the Tuvaluan side, there were 98 items for the Fisheries Department and 13 items for the Department of Lands and Survey. Although research and monitoring relevant to the project was not being conducted, the equipment relevant to the daily operation of the executing agencies was being used at the time of the ex-post evaluation. The use of the equipment suggested that the counterparts to some extent maintained their capability operation is project implementation.

The Fisheries Department did not conduct monitoring relevant to the research of the project but scuba equipment and a microscope were used for sample collections in other research. According to officials from the Fisheries Department, water quality testing equipment is hardly used because in training they used a different type of equipment. For the equipment installed at the laboratory of the Fishery Department, a large



Photo 2: Microscope in Fisheries Department Laboratory

amount of equipment had been provided and the laboratory was not organized well. For these reasons, the items on the list of equipment provided were not fully inspected. However, most items of expensive equipment (over JPY500,000) were found.

The Department of Lands and Survey used GPS, total station<sup>16</sup>, and survey equipment (survey poles, tripods, etc.) for survey operation. After project completion, the GPS could not be used for a certain period because a battery for the equipment could not be obtained. Some of the inexpensive equipment (such as web cameras) was discarded due to depletion but other equipment was found.

Among the training activities of the executing agencies at the time of the ex-post evaluation, the activities which were likely to contribute to the continuation of project effects are shown in the following table.

Executing Agency	Current Status	
Department of Environment	International cooperation agencies provided training on marine spatial management (setting of nature reserves etc.).	
Fisheries Department	On coastal fisheries, training on underwater visual censuses <sup>17</sup> was provided. In add knowledge on the collection and analysis of sample methods was shared through OJT Fisheries Department.	
Department of Lands and Survey	Training is mainly on the use of equipment through OJT. International cooperation agencies provided training (use of GIS software, etc.).	

Table 8: Training Activities of the Executing Agency

Source: Answers from the questionnaires with the executing agencies, Interviews with relevant officials

Neither research nor monitoring relevant to the project was carried out at the time of the ex-post evaluation, although the counterpart was collecting data for the research of the Fisheries Department and the survey operations of the Department of Lands and Survey. The capabilities necessary for monitoring were maintained even at the time of the ex-post evaluation. It is concluded that the sustainability of the technical aspect had been secured to some extent.

<sup>&</sup>lt;sup>16</sup> Survey equipment to measure several parameters such as distance and angle

<sup>&</sup>lt;sup>17</sup> A research method on biota based on the number of species by visual observation

3.4.4 Financial Aspects for the Sustainability of Project Effects

For the financial aspects, it is important that budget for research and monitoring is allocated for the activities of subsequent research.

The recurrent budget of the executing agencies after project completion is shown in the following table. Although the recurrent budget of the Department of Environment showed a downward trend, the decrease was due to the organizational change when the function of the Department of Environment was partially transferred to the Climate Change Disaster Management Unit. For the Fisheries Department, the recurrent budget of the Coastal Fisheries Section, a section which was directly involved in the project, remained constant. The recurrent budget of the Department of Lands and Survey showed an upward trend and that for survey and mapping increased substantially in FY 2016.

	Unit: Australian Dollar		
	2014	2015	2016
Department of Environment	154,696	146,927	81,163
Fisheries Department	711,028	711,916	749,704
To Coastal Fisheries Section	136,480	130,638	135,414
Department of Lands and Survey	202,868	210,532	291,797
To Survey and Mapping	60,329	50,300	78,278

Table 9: Recurrent Budget for the Executing Agencies after Project Completion

Source: Government of Tuvalu (Minister for Finance and Economic Development)

The allocation of the recurrent budget implied that the financial situation of the executing agencies is stable. Nevertheless, research and monitoring relevant to the project were not conducted and there was no allocation of a budget for subsequent research. At the time of the terminal evaluation, the Fisheries Department and the Department of Lands and Survey were supposed to submit monitoring plans to the Department for Planning and Budget. Budget allocation was to be assessed. However, these plans had not been submitted by the time of the ex-post evaluation and, thus, no budget was allocated to monitoring relevant to the research of the project.

At the time of the terminal evaluation, the operation of the aquaculture tanks after project completion was under consideration for more effective use of the facility. However, operation was suspended after project completion because the executing agency could not bear the operating cost (mainly electricity costs) of the tanks. As a cyclone damaged the facility, the aquaculture tanks for foraminifera were removed and, at the time of the ex-post evaluation, the tanks and auxiliary items were stored in warehouses and containers. A new building was being built on the site of the demolished facility with the support of New Zealand.

Research and monitoring relevant to the project were not conducted and no budget was

allocated. Therefore, there is an issue with the financial aspects.

Major problems have been observed in terms of the organizational and financial aspects. Therefore, sustainability of the project effects is low.

# 4. Conclusion, Lessons Learned and Recommendations

#### 4.1 Conclusion

This project aimed at policy-making for coastal protection based on joint research by Japan and Tuvalu and the development of human resources and schemes for the continuous monitoring of coastal topography and the coral reef ecosystem. It was expected that the eco-technological methods based on the research would be adopted in Tuvalu as coastal protection measures. Since the project intention was to pick up research results for coastal protection reflecting the natural process of island formation, the research content of the project was consistent with the development policy of Tuvalu. However, the coastal protection measures developed by the project required a longer period for the incidence of effects and the time scale did not match the urgency of the development needs in Tuvalu. For these reasons, the relevance of the project is fair. The project produced sufficient research results up to project completion and coastal protection measures were prepared. On the other hand, however, sustainable monitoring schemes at the executing agencies were not established through the project. At the time of the ex-post evaluation, out of the proposed measures for coastal protection, open-cut of the Causeway had been adopted in the regional development strategy of Funafuti but not as a coastal protection measure. There, the executing agencies did not conduct research and monitoring activities and subsequent studies were not found in neighboring countries. Thus, the effectiveness and impact of the project are fair. The project period was within the plan but the project cost exceeded the plan. Therefore, the efficiency of the project is fair. The cost overrun was mainly due to an increase in the amount of equipment provided, an increase in the expense of experts dispatched, and the cost associated with the employment of an expert for design and construction supervision. At the time of the ex-post evaluation, the jurisdiction of the executing agencies did not include research and monitoring with the project and an organizational setting for the implementation of subsequent research had not been established. At the time of the ex-post evaluation, no budget had been allocated to relevant research and monitoring. Given these problems in the organizational and financial aspects, the sustainability of the project effects is low.

In light of the above, this project is evaluated to be unsatisfactory.
### 4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

Equipment provided was effectively utilized during the project period and research results were obtained within the project period. At the time of ex-post evaluation, however, most of the equipment provided to the laboratory of the Fishery Department had not been used as it was difficult to conduct activities relevant to the research of the project. It is difficult for the Tuvalu side to resume relevant research and from it to derive coastal protection measures. Nevertheless, the equipment provided is in good condition and remains usable. Regarding the completion of the new laboratory of the Fishery Department in 2017 as an opportunity, it is desirable that effective use of the equipment provided by the project is examined and that the results of assessment reported to JICA, to be reflected in research and monitoring activities after FY 2018.

### 4.2.2 Recommendations to JICA

As mentioned above, at the time of ex-post evaluation most of the equipment provided to the laboratory of the Fisheries Department was not in use. It is desirable that monitoring on the assessment for the use of the provided equipment by the Fisheries Department continues and, if possible, give advice on the use of the equipment provided to the department.

# 4.3 Lessons Learned

## Selection of Research Institute as a Counterpart of the SATREPS Scheme

Although the project was joint research, the counterparts of the joint research were government agencies which do not have research in their mandate. While the project included in the Project Purpose the establishment of a sustainable monitoring scheme necessary for the continuation of research, this could not be established at the agencies despite the improvement of the monitoring capacity among the counterparts. In the project, it was difficult to simultaneously implement both the institutional building of a monitoring scheme and the joint research. Moreover, the selection committee of JST should assess the level of research capability of counterpart organizations as well as their mandate from the viewpoint of continuing research. For a project to use the SATREPS scheme, it is desirable that a counterpart organization with an appropriate level of research capability is selected and that confirmation is made that the organizational mandate will not hamper continuation of the research at the time of the detailed planning survey, and also that monitoring capacity will be strengthened through joint research.

#### Securing Research Resource in an Island Country

At the beginning of the project the Japanese side had considered securing research resources

to be problematic after project completion but no way to solve this issue had been found until the project completion. At the time of the ax-ante evaluation, it was planned that the project would involve research institutes from other countries in joint research to secure research resources in the future from outside of Tuvalu. However, the formal involvement of research institutes was not achieved. In an island country where research resources are scarce, it is desirable that the possibility of regional projects are assessed with a detailed planning survey including the involvement of research institutions in another country. It is also advisable that for enhancement of research resources, the results of such assessment are reflected in a specific and feasible project implementation plan after discussion with the executing agency, and follow up its progress during project implementation.

End