APPENDIX 1

FINAL EVALUATION REPORT
ON
THE INTEGRATED STUDY PROJECT ON HYDRO-METEOROLOGICAL PREDICTION AND ADAPTATION TO CLIMATE CHANGE IN THAILAND

November 29, 2013

Japan International Evaluation Agency

TABLE OF CONTENTS

Acronyms and Abbreviations

APWS	Asia-Pacific Water Summit
DRRAA	Department of Royal Rainmaking and Agricultural Aviation
FRICS	Foundation of River and Water Basin Integrated Communications of Japan
IMPAC-T	Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand
IPCC	Inter-governmental Panel on Climate Change
JCC	Joint Coordinating Committee
JER	Joint Evaluation Report
JICA	Japan International Cooperation Agency
JST	Japan Science and Technology Agency
KMUTT	King Mongkut's University of Technology Thonburi
KU	Kasetsart University
MNRE	Ministry of Natural Resources and Environment
NU	Naresuan University
OECD-DAC	Development Assistance Committee of the Organization for Economic Cooperation and Development
ONEP	The Office of Natural Resources and Environmental Policy and Planning of the Ministry of Natural Resources and Environment
PDM	Project Design Matrix
PU	University of Phayao
RID	Royal Irrigation Department
SATREPS	Science and Technology Research Partnership for Sustainable Development
SiBUC	Simple Biosphere including Urban Canopy
TICA	Thailand International Development Cooperation Agency
TMD	Thai Meteorological Department
UT	University of Tokyo

1. INTRODUCTION

1.1 Background to the Project

"Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand (IMPAC-T (hereafter "the Project")) "is a technical cooperation and joint research project for Thailand, supported by Government of Japan. The Project was formulated with a view to proposing a prototype of a comprehensive hydrological information system to support the decision-making by Government of Thailand on water-related climate change (see 1.2 Project Outline for detailed activities).

As an emerging nation whose economy consists primarily of agriculture and rapidly growing industries, Thailand is dependent on water resources and vulnerable to the impacts of climate change. The fluctuation of climate conditions has affected its water availability and agricultural production, and has threatened human security and economy in the form of natural disasters.

Thailand's National Strategy for Climate Change Management (2008-12) recognises the risks that climate change causes to its water resources, and suggests measures for water sector as a key component of its adaptation strategy. These include, among others, the development of climatological database and forecast system; the creation and development of numerical model for evaluation of climate change impacts to hydrological condition and water resources; the development of models for natural disaster risk evaluation; and studying climate change impacts on the risks of flood and drought in Thailand[1]. Against this backdrop, the Project was requested by Government of Thailand in 2008, to fill the knowledge gap of Thai government officers and researchers in implementing adaptation measures, with the assistance from an international institution of academic excellence in water-related climate change research.

IMPAC-T is one of the first projects implemented under the framework of Science and Technology Research Partnership for Sustainable Development (SATREPS), a program supported jointly by Japan International Cooperation Agency (JICA) and Japan Science and Technology Agency (JST) to promote international joint scientific research to address global issues. Established in 2008, total 78 projects have been implemented so far under the SATREPS scheme.

1.2 Project Outline

The activities of the Project consist of three parts. The first part focuses on strengthening the capacity of Project members and organizations to collect and analyse hydro-meteorological observation data. This is realised through enhancing hydro-meteorological observation network to capture climate change, and through training the Project members on the observation methodologies and technologies. The second part is the development of the high-resolution regional hydrological models that can take into account the human activities such as reservoir operations, agriculture, and the land use change in the Chao Phraya

[1] Extract from a tentative translation of the original document in Thai language. The web link for the document available at: http://www.onep.go.th/images/stories/file/file2011feb21.pdf

river basin. The third is the impact assessment on water sector, including the prediction of future yield, slope failures, and coastal erosion. The results of the assessment will be then translated into hazard maps. The key outcomes of the three activities – the data collected, models developed, simulations conducted and risk assessment results – will all be compiled into one Integrated Information System, as a tool for decision-making on the adaptation for water-related risks under climate change impact.

PROJECT SUMMARY

(1)	Title:	:	Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand
(2)	Period	:	May 11th, 2009 to March 31st, 2014
(3)	Thai Counterpart organizations	:	Kasetsart University(KU), Royal Irrigation Department(RID), Thai Meteorological Department(TMD)
(4)	Participating organisations	:	Shown in Annex 2
(5)	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".

(6) Outputs

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

Indicator 1.1 The roles of Thai research group in the promotion of the continuous monitoring for climate change impact are defined.

Indicator 1.2 Tutorials/academic papers for the continuous monitoring system are prepared/submitted.

Indicator 1.3 More than 20 That research group members are trained and obtain necessary knowledge and skills in developing, implementing, and managing the continuous monitoring of climate change impact.

Indicator 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 the Chao Phraya river basin.

Output 2: "An integrated model is developed in consistence with natural hydrological cycle and anthropogenic activities are enhanced".

Indicator 2.1 The hydrological models for the Chao Phraya river basin are established.

Indicator 2.2 The models of anthropogenic activities are established and incorporated in hydrological models.

Indicator 2.3 Tutorials /academic papers for the integrated modelling system are prepared/submitted.

Indicator 2.4 Precision of discharge estimation (annual discharge, peak discharge on monthly basis) by the integrated model is no more than ±20% difference than measured volume.

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

Indicator 3.1 Hydro-meteorological data and simulation outputs are integrated to incorporate in impact assessment.

Indicator 3.2 Disaster potential in present and future are estimated and risk indices are identified.

Indicator 3.3 Tutorials/academic papers for risk and impact assessment are prepared/submitted

Indicator 3.4 The quasi-real-time risk indices are developed as for an adaptation measure to water-related disasters under climate change, and utilized for early warning system.

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".

Indicator 4.1 Recognition of IMPAC-T among water related policy makers is enhanced

Indicator 4.2 Cooperation arrangement will be signed.

2. FINAL EVALUATION - OVERVIEW

2.1 Purpose of the Final Evaluation

The purpose of this final evaluation is to implement Article V of the "Record of Discussion" signed by JICA, KU, RID and TMD in March 2009. The article stipulates that an evaluation be conducted jointly by the Thai authorities concerned and JICA, during the last six months of the term of the Project[2]. Accordingly, this evaluation was conducted with the following objectives:

(1) Review and assess the project performance against target indicators shown in the agreed Project Design Matrix (PDM)(May 2012 version)(Appendix 1) ;
(2) Evaluate the confirmed performance against 5 criteria proposed by Development Assistance Committee of Organization for Economic Cooperation and Development (OECD-DAC)(see 2.2(2) for details);
(3) Draw lessons learned and recommendations for the Project stakeholders;
(4) Summarize the above findings in a Joint Evaluation Report (JER);
(5) Agree and sign on the Minutes of Meeting, with the JER and relevant documents attached; and
(6) Discuss and resolve concerns that stakeholders have on the project implementation.

2.2 Team Members and Schedule

(1) Evaluation Members from Thailand

Ms. Attaya Memanvit
Development Cooperation Officer of the Planning and Monitoring Branch,
Thailand International Cooperation Agency (TICA)

(2) Evaluation Members from Japan (hereafter "the Team")

Names	Visit Schedule
Mr. Eiji IWASAKI Team Leader/ Deputy Director General and Group Director for Water Resources and Disaster Management Global Environment Department -JICA	November 24(Sun) –30 (Sat), 2013
Mr. Hidetake AOKI Evaluation Planning Deputy Director for Water Resources Management Division 1, Water Resources and Disaster Management Group Global Environment Department –JICA	November 25(Mon) –29 (Fri), 2013
Dr. Kotaro INOUE SATREPS Evaluator/Senior Fellow Japan Science and Technology Agency(JST)	November 25(Mon) –29 (Fri), 2013

[2] While this Project is supported jointly by JICA and JST (see "1.1 Background"), this evaluation study was undertaken by JICA within the framework of its Guidelines for technical cooperation (see "2.3 Evaluation Framework"). The evaluation by JST, based on JST's criteria and viewpoints, will be carried out separately from this evaluation, and a report will be prepared by JST in Japanese language.

Ms. Misato UNOSE SATREPS Evaluator/ Assistant Programme Officer Research Partnership for Sustainable Development Division-JST	November 24(Sun)–29 (Fri), 2013
Ms. Emi YOSHINAGA Evaluation Analysis Japan Development Service Co. Ltd	November 17th(Sun) – 29th(Fri), 2013

The itinerary of the mission visit is provided in Annex 3.

2.3 Evaluation Framework

This study was conducted within the framework of "JICA Project Evaluation Guidelines (June 2010)"[3]. According to the Guidelines, JICA's project-level evaluation consists of three components: (1) the assessment of the performance of a project, (2) the value judgment on (= the evaluation of) the project, using Five Evaluation Criteria proposed by OECD-DAC, and (3) making recommendations and drawing the lessons learned from the evaluation, to feed them into future projects.

(1) Assessment of Project Performance

This component involves three types of actions, described below.

- ***Measurement of results and outputs***, to confirm to what extent the target indicators shown in the PDM(Appendix 1) are attained;
- ***Examination of implementation process***, i.e., the analysis on how the events that took place in the implementation process (such as natural disasters) have affected the project performance;
- ***Examination of causal relationships between inputs/activities – outputs – project purpose***, to confirm 1) which (and to what extent) project activities contributed to the achievement of the Project Purpose, and 2) which other factors contributed or hindered the achievement of Project Purpose.

(2) Evaluation by Five OECD-DAC Criteria

The project performance confirmed in 2.(1) above was evaluated from five different points of view – "Relevance", "Effectiveness", "Efficiency", "Impact", and "Sustainability". The five viewpoints are the criteria proposed by OECD-DAC in 1991. The project's performance were then assessed against each criterion, on the four-point rating scale of "high", "relatively high", "moderate", or "low". The details of each criterion are the followings.

Five Evaluation Criteria by OECD-DAC	
1. RELEVANCE	Assesses whether the design (focus, scope, target population) are in line with development policies and needs of recipient country at the time of evaluation. It likewise ensures the project's consistency with international policies and discussions, and with Japan's assistance strategy.
2. EFFECTIVENESS	Examines the extent to which the objective of the Project has been achieved. This criterion will include analysis on performance indicators, and on the

[3] http://www.jica.go.jp/activities/evaluation/guideline/pdf/guideline.pdf
The 2010 Guidelines is available only in Japanese language. The English translation of the 2004 Guidelines, however, will provide a good overview of JICA's basic project evaluation methods and procedures (http://www.jica.go.jp/english/our_work/evaluation/tech_and_grant/guides/guideline.html) .

	factors that contributed to, or impeded, the achievement of the objective.
3. EFFICIENCY	Measures how efficiently the various inputs are converted into outputs of the project (i.e. productivity of implementation process). This criterion will examine the appropriateness of inputs such as project cost and its volume, implementation schedule, timing, and institutional/organizational function.
4. IMPACT	Identifies the extent to which the project outcomes are applied in real practices. Also verify whether any unintended positive or negative impacts occur as a result of the project (cf. impacts on policy, environments,….).
5. SUSTAINABILITY	Examines whether project activities and outcomes are likely to be sustained after completion of the project. This criterion will involve, among others, a review on whether appropriate policies and institutional framework are in place, whether human resources and budget are secured, and whether the level of skills are sufficient to support the further research activities and dissemination of project outcomes.

(3) Recommendations and lessons learned

Based on the evaluation results, the Team made recommendations to the Project on the actions to be taken before and after the Project completion. The Team drew lessons learned from the evaluation results, as a feedback for other JICA projects in the future. All the findings including the evaluation results, recommendations and lessons learned, are summarized in this report.

2.4 Evaluation Questions and data collection

To collect data and information necessary for the assessment, a detailed set of evaluation questions were prepared, and the method of data collection were defined in an "Evaluation Grid" shown in Appendix 4. The primary method to obtain data and information are as follows.

(1) Desk review, including project reports and presentations, the record of training and of the use of budget, Thailand's national strategies, international policy reports and the reports from other similar JICA projects.

(2) Interviews: individual interviews were held in Thailand from 19-27th 2013, and in Sendai-Japan at the time of the Project's annual meeting in 11-13 November 2013. The informants in Thailand include the Administration Committee member organizations and the key recipients of Project's funding (KU, RID, TMD, King Mongkut's University of Technology Thonburi (KMUTT), University of Phayao (PU)), and The Office of Natural Resources and Environmental Policy and Planning(ONEP). Interviewees in Sendai are primarily those who did not respond to the questionnaire survey.

(3) Questionnaire survey: due to the time constraint to interview all Project members, a questionnaire survey was undertaken in October 2013, to identify key issues and receive feedbacks from all 19 research groups. 15 representatives from 19 groups and 4 Japanese experts responded to the questionnaires, and major findings are summarized in Appendix 5.

(4) Direct observation: Site visits were conducted by the Evaluation Team members to directly observe the equipment provided. The sites visited are shown in the evaluation schedule in Appendix 3.

3. ASSESSMENT OF PROJECT PERFORMANCE

3.1 Progress on Attaining Outputs and Project Purpose

The table below shows the progress by the Project toward attaining agreed performance indicators shown in the PDM.

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

1-1 <u>The roles of Thai research group in the promotion of the continuous monitoring for climate change impact are defined (**complete**).</u>

Defining of the roles of 19 research groups is complete by May 2011. This was done by the Project's administration committee (see the role and function of this committee in "3.3 Implementation Process") through calling for research proposals[4] from each group, and reviewing and approving these proposals. This rigorous process helped the Project identify the overall direction of research and the roles that each group should play in the implementation of Project activities. The activities of research groups #1-10, named as "Earth Observation Group", are broadly linked to Output 1; that of groups #11-14, "Modelling Group", to Output 2; and of #15-20 ,"Impact Assessment and Adaptation Group", to Output 3 of this Project. To note, the achievement of this indicator experienced significant delay, due to a management issue at the early stage of this Project (see 3.3 for the progress of activities).

1-2 <u>Tutorials/academic papers for the continuous monitoring system are prepared/submitted (**complete**).</u>

- The preparation of tutorials on flux- and telemetry observation is complete by February 2011. The tutorials are shared with the members of Earth Observation Group and used for the training on the observation methodology.
- According to the information obtained through research groups and Japanese experts during the workshop in Sendai in November 2013, 25 academic papers were submitted for journals by the time of this evaluation[5].

1-3 <u>More than 20 Thai research group members are trained and obtain necessary knowledge and skills in developing, implementing, and managing the continuous monitoring of climate change impact (**complete**).</u>

Total 28 members [6] of "Earth Observation Group (research group #1-10) "received the training through lectures, workshops and joint research, in the areas of expertise shown in bullet points below.

- ***Rainfall estimation***: to obtain observation data necessary for Output 2 activities, rainfall estimation skills were developed through such activities as the training in Japan and in Thailand, workshops, and site observation. The training involves the spatial distribution of rainfall through various observation methodologies – the ones using satellite, radars, and rain gauges; another using meso-scale meteorological model; and the rainfall estimation in mountains areas.
- ***Flux observation***: Techniques were transferred to Group 8, to collect and analyse the data from

[4] Including the details on project activities, members, management structure, and the plan for training, equipment purchase and budget.

[5] The data on academic papers cited here were collected through interviewing the leaders of each research group, and cross-checked against relevant written materials. As far as the Team confirmed, the number of papers will increase to 32 if the definition of "academic papers" is broadened to include proceedings, and to 63 if presentations and documentaries are included. The number may not include the publications written only by the Japanese experts. For the summary of all written academic outputs of this Project, refer to the final report to be prepared by the University of Tokyo by the end of the Project.

[6] According to the list provided by the Project, as shown in Appendix 2.

flux observation system established by the Project (see Indicator 1-4 for details). The flux data obtained will be used for the assessment of the impact that climate change and land use change will bring about on hydrological cycle.

Overall, both Thai and Japanese project members are satisfied with the level of knowledge and skills acquired by the members[7]. From the presentations and the discussions by the Thai members during the workshop in Sendai in November 2013, the Team also concluded the level of knowledge acquisition is sufficient in meeting this target indicator. The progress and outputs of research activities by this group will be uploaded and updated on the Project's website on a regular basis.

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 the Chao Phraya river basin (**complete**).

The quasi-real-time hydro-meteorological data transfer system ("telemetry system") was installed at total 32 observation stations in and around the Chao Phraya river basin. These are at 24 stations managed by RID, 4 stations by TMD, and 4 flux observation towers managed by 3 project member organizations.

- For RID, 20 existing rainfall observation stations (8 in Mae Wang, 4 in Mae Cham) and 12 new stains in Kwai Noi were telemetrised. The observed rainfall data will be transferred to the servers that the Project installed at RID on an hourly basis, and to KU, through the RID server.
- For TMD, telemetrying of 4 automatic weather stations that the TMD established in 4 provinces (Uthai Thani, Lampang, Lamphun, and Nakhon Sawan) are complete. The observation data are then transferred to the servers that the Project provided to TMD and KU (through TMD server), and TMD uploads them on its website after verification, twice daily.
- The flux observation towers provided by the Project were also equipped with telemetry system. Of 4 towers, 3 (the ones in the paddy field in Ratchaburi, in cassava field in Tak, and in sugar cane field in Tak Fa) are managed by KMUTT and Naresuan University(NU), and data are monitored jointly. The fourth tower, established in the forest area within the PU campus, is managed by the PU. The flux observation data are then transferred to the KU server.
- The construction of an observation station in Ayuthaya, being discussed at the time of the Mid-term evaluation of this Project, was cancelled due to the concerns on safety.

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

2-1 The hydrological models for the Chao Phraya river basin are established (**complete**).

Following two hydrological models were developed, by revising the models originally created by Japanese researchers.

- ***"H08"***: a 5-minutes resolution model covering the Chao Phraya river basin was developed by Group #11, by revising "H08"model originally proposed by National Institute for Environment Studies of Japan. The uniqueness of this model is that it can incorporate reservoir operations that significantly affect water cycle.
- ***"SiBUC"***: another model covering the Chao Phraya river basin was developed by Group #13, by revising the Simple Biosphere including Urban Canopy (SiBUC) model originally proposed by a Kyoto University.

2-2 The models of anthropogenic activities are established and incorporated in hydrological models (**complete**).

A model of anthropogenic activities (reservoir operations in Bhumibol and Sirikit, to be precise) was developed by the Model Group, and was incorporated into the hydrological model developed under the Indicator 2-1 in 2011.

[7] According to the result of the questionnaire survey. Refer to Annex 5.

2-3 Tutorials /academic papers for the integrated modelling system are prepared/submitted (**complete**).

- The "H08 Manual User's Edition" was compiled as a tutorial for the integrated hydrological model developed under Indicator 2.1 [18]. The manual contains instructions on all the key procedures from the installation of the model, the method of data collection, and running and analysis of the model.
- According to the information collected during the workshop in Sendai-Japan, there are total 6 journal publications produced by the Modelling Group by November 2013[9].

2-4 Precision of discharge estimation (annual discharge, peak discharge on monthly basis) by the integrated model is no more than ±20% difference than measured volume (**achieved**).

- The average precision (or the error) of discharge estimation of Chao Phraya river basin between 1981-2004, undertaken using the H08 model developed under Indicator 2.2, proved less than ±20%. The estimation result was summarised in an academic paper prepared by the Project members and submitted to Water Resources Research[10].
- The error of the estimation using the SiBUC model proved average 17.5% for annual discharge, and 20.8% for peak discharge on a monthly basis. The accuracy of estimation for "C2" observation station, the most important station for decision-making on the runoff in the Chao Phraya river, recorded 98%, and for Y.6 station, 100 %[11]. For these results, the Team evaluated this target as being successfully met.

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

3-1 Hydro-meteorological data and simulation outputs are integrated to incorporate in impact assessment (**complete**).

The purpose of this indicator is to prepare a set of the data, information, and tools necessary for assessing the impacts of climate change-induced disasters in the mountains, oceans and rivers. Such data/information/tools encompass the observation data, hydrological models, simulation results using these data and models, and the climate change-related data set (i.e., IMPAC-T Forcing Data).

Through the activities under Output 1 and 2, hydro-meteorological data and simulation results were already prepared and have been utilised for various impact assessment. The results of the impact assessment carried out by research groups were presented to the Team during the workshop in Sendai in November 2013, and will be uploaded on the Project's website.

3-2 Disaster potential in present and future are estimated and risk indices are identified (**complete**).

This indicator aims at identifying the areas potentially at risk of slope failures and coastal erosion, as well as the extent of the damage they may cause. It likewise suggests that indices for flood and drought risk assessment be selected and used to specify the extent of the risk.

On the landslides, risk potentials were identified in northern- and central-west mountain areas as well as in the west and central Malay Peninsula. The identified risks were then summarised in a hazard map and has been distributed to landslide-prone areas such as in Chiang Mai, Uttaradit, and Phetchabun. For the coastal erosion, the areas at risk and the extent of potential damage were identified by Group #20 and the results shown in hazard maps were presented also at the Sendai

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8 The manual can be viewed at http://h08.nies.go.jp/h08/files/USERen_20130501.pdf.

9 The number will increase to 17 if proceedings are included, and to 19 if posters and other informal presentations are included.

10 Cherry Mateo, Naota Hanasaki , Daisuke Komori , Dai Yamazaki , Masashi Kiguchi , Kenji Tanaka , Adisorn Champathong , Thada Sukhapunnaphan,Taikan Oki (2013): A physically-based hydrological model for simulatingand assessing the impacts of reservoir operation rules to floodplaininundation and water availability, Thailand, Submitted to Water Resources Research

11 The results of these estimations can be viewed at: www.kotsuki-shunji.com/document/paper/2013.08.aphw.kotsuki.pdf .

workshop. Likewise on the flood and drought risks in tropical rainfall, the risk indices were identified by Group #3 and the impact assessment was conducted in 22 provinces, using the indices.

3-3 Tutorials/academic papers for risk and impact assessment are prepared/submitted (**achieved**)

- Tutorials on risk and impact assessment will not be prepared under this indicator. This decision was agreed at the JCC in May 2011, as the members recognised the number of risk/impact assessment implemented would be more important than the creation of tutorials.
- According to the information collected through interviews and desk reviews, there are 14 academic journal papers submitted by the Impact Assessment Group[12].

3-4 The quasi-real-time risk indices are developed as for an adaptation measure to water-related disasters under climate change, and utilized for early warning system (**achieved**).

- On the development of "quasi-real time risk indices", the Project uploads - near real-time on its webpage- the results of water-related risk assessment worked out with the risk indices identified under Indicator 3.2.
- The use of the quasi-real time risk indices for early warning was realised in the following 3 ways:
  - The Project's cooperation to RID's early warning system: The Project contributed significant knowledge and experiences to the establishment of RID's flood risk and early warning system[13]. The system was developed by the Foundation of River and Water Basin Integrated Communications of Japan (FRICS) within the framework of JICA's Project for Flood Management in the Chao Phraya river basin, a project which started in response to the flood in Thailand in 2011. The knowledge contributed includes the results of discharge and flood analysis, and other experiences beneficial for the creation of a Master Plan for Water Resource Management.
  - Dissemination of information through website: the Project uploads quasi-real time information on hydro-meteorological condition in Chao Phyraya basin, as an early warning for the public. While the FRICS's system focuses on the information on flood area, the Project's webpage on early warning, called "Today's Chao Phraya", focuses on the condition of rainfall, river discharge and dam operations.
  - Early warning on landslide risk in Krabi province: at community level, Group # 16 piloted an early warning system in the landslide-prone province of Krabi. This system sensors the landslide risks upstream, and delivers through wireless network the risk information to the communities downstream.

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

4-1 Recognition of IMPAC-T among water related policy makers is enhanced(**achieved**)

This indicator was added after the Mid-term Review, to gain renewed recognition on the Project by the new TMD management. It can also be interpreted as a criterion to be filled in ensuring continued support from counterpart organizations. The Team concluded this indicator as being achieved, after examining the following examples that indicate the improvement in their awareness:

- ***Contributions to the 2011 flood***: the Project has made considerable efforts in addressing the Chao Phraya river flood in 2011 (see Indicator 3.4), and the dissemination of flood-related information and predictions through a number of seminars. The participation that the Project's 2nd Flood Seminar received from Deputy Prime Minister His Excellency Kittiratt provides an ample example of how the work of the Project has been recognised and credited.
- ***2nd Asia-Pacific Water Summit (APWS)***: the Project was invited to present the outcomes of the Project at a technical session on water-related disaster management, at the APWS hosted in Chiang Mai-Thailand in May 2013. The role assigned to the Project at this technical session, as mentioned by

[12] The number will increase to 21 if conference papers and proceedings are included, and to 27 if poster and other informal papers are counted.
[13] Can be access at http://floodinfo.rid.go.th/index_en.html

numerous Project stakeholders during this study, as a visible example of how the work of the Project has been received in Thailand.

- ***Involvement of Senior Management in the Project***: While there were only the middle-management who took part in the Project at the beginning, the Project has increasingly received attentions and participation from senior management of the counterpart organisations (such as RID and TMD), as in the case of the workshop in Sendai in November 2013[14]. The questionnaire survey also confirmed the rise in the recognition, as felt by the Project members.

4-2 Cooperation arrangement will be signed (**met in part**).

- This indicator was added upon the recommendation from the Mid-term review, to provide a cooperation framework so that members participating as an individual with limited support from their organizations would stay active in the Project activities.
- There are a sizable number of cooperation agreements between certain member organizations made during the Project (such as the Memorandum of Understanding (MoU) between KU and PU on joint research and flux tower construction, the agreement on data sharing between RID and KU…). These cooperation agreements deserve positive evaluation on one hand, while on the other hand they may not fully correspond to the original intension of this indicator.

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".

Indicator: "Recommendations and integrated information from the system are published on web pages"(**achieved**).

The Team interpreted this system as a comprehensive online system where all the Project outputs can be archived and operated. This means, the hydro-meteorological data sent from RID/TMD/flux stations can be stored and viewed, hydrological models can be downloaded, simulations can be carried out with these data and models, and the results of research including various impact assessments can be uploaded.

The software component of this system is complete by March 2013, and most of the information in the system will be made public through the Project website currently being prepared by the Team for official opening by the end of 2013. Under this definition of Integrated System, the establishment of the prototype is complete, and the indicator of "recommendations and integrated information from the system are published on the websites" is expected to be achieved.

During the interview process, the Team also noted that the basic information of the "Integrated Information System"(what functions are installed in whose servers, how they are linked, which data are transferred to whom via whom, etc) is not documented in a manner that clearly explains how it function, and recognised the need for a documentation that concisely summarises such information . This point will be dealt in "4.2 Effectiveness".

3.2 Provision of Inputs

(1) Inputs provided by Japanese Side

1) Experts

Dispatch of Japanese experts (May 2009-Sep 17th 2013)*

Fields of expertise	# of experts	Total Person- month
Chief advisor	1	2.67
Research planning/earth observation	3	29.40
Earth observation considering climate change	5	7.00

14 Attended by several director-general level management of TMD and RID.

Hydrological cycle and water resources model considering human activity	3	2.93
Impact and risk assessment incorporating climate change and human activity	4	3.33
Project Coordinator	1	54
Total	17	99.33

*Based on the data provided by the University of Tokyo in September 2013

2) Training in Japan and in Thailand

The training was conducted according to the proposal submitted by each 19 research group at the beginning of the Project. The list of key training is shown in Appendix 6.

3) Operation cost borne by Japanese side (excluding equipment in 4) below) (As of November 2013)

Due to the stagnation of the Project activities till early 2011(see "3.3 Implementation Process" section), there are increase in the purchase and payment in the latter half of the Project since mid-2011. The purchase of equipment, aside from the cost for data/simulation servers and flux towers, is based on the request from research group according to their original proposals.

No	Items	2009	2010	2011	2012	2013	Total(THB)**
1	Purchase of goods*	243,694	132,208	2,801,672	1,088,658	3,310,756	7,576,988
2	Goods transportation cost	3,907	9,572	122,327	127,133	54,623	317,562
3	Communication	7,477	3,920	78,515	45,670	132,367	267,948
4	Material preparation	6,690	18,165	120,144	4,397	35,203	184,599
5	Rental costs(car rental)	96,316	315,595	1,087,140	721,343	477,398	2,697,792
6	Miscellaneous(checks, service charges)	750	745	5,683	12,356	5,427	24,961
7	local consultant contract	0	0	512,198	1,214,850	911,676	2,638,724
8	Remuneration for research assistants	15,057	45,747	2,625,740	4,105,001	2,226,001	9,017,546
9	Air fares	1,265,760	378,970	1,407,170	1,874,311	1,340,324	6,266,535
10	Travel expense(for C/P)	1,116,299	310,291	1,727,011	1,887,180	1,361,155	6,401,936
11	Conferences and meetings	38,631	85,405	38,880	52,405	49,124	264,445
	Total	2,794,581	1,300,618	10,526,480	11,133,303	9,904,054	**35,659,036**

*Mainly the equipment purchased by individual research groups

* *Official JICA exchange rate as of November 2013 (1 THB =3.168JPY)

4) Equipment and Facilities* (May 2009 to November 2013)

Equipment	Amount(THB)
Meteorological sensors (rain gauge, automatic weather station, soil moisture measurement etc.)	3,264,896
Flux measurement systems (4 units)	12,031,604
Flux tower construction at PU	3,098,000
Data archive servers for KU, TMD, RID/telemetry servers for TMD and RID	3,006,420
GPRS modems for telemetry system (28 units)	1,018,500

Atmosphere Model simulation server and software for TMD (for Group 1)	951,530
Spectro-radiometer (2 units)	1,238,400
Accessories for field spectrometer	266,071
Others (data logger and software)	743,920
Construction work to install sensors	1,164,000
Data server and HDD	574,495
Servers and storage for H08 at RID	1,111,742
Servers and storage for H08 at KMUTT	1,025,884
Servers and storage for H08 at TMD	1,620,896
Integrated servers and storage at KU	18,000,316
Projection system for KU server	2,212,753
Total	51,329,427

* Includes the equipment provided with the financing from JICA headquarters and office in Bangkok. The cost of other goods purchased in Thailand using the Project budget – such as the accessories for servers and the consumables provided to research groups - are included in "1) Purchase of goods" in "3) Operation cost borne by the Japanese side" above.

5) Key meetings, seminars and workshops

A number of the meetings, seminars and workshops were held during the Project implementation, raining from biannual internal workshops at project level to international symposium. Details are shown Appendix 7.

(2) Inputs provided by Thai side

1) **Assignment of counterpart personnel**: Project Director and Manager were assigned from Faculty of Technology of KU. Total 51 members joined the Project as counterparts (according to List of Counterparts shown in Annex 3).

2) Operations cost borne by the Thai side

Organizations	Inputs provided for IMPAC-T
KU	• Facilities: IMPAC-T office room and office furniture, computer server room, meeting room, air conditioners • Equipment: IBM server, GPS • Consumables for Group 16 (≒20,000 Baht) • Server operation and maintenance cost (≒ 1 million Baht per year) • Construction work to install servers (≒ 1 million Baht per year) • Utilities: communication (including use of internet) and electricity (approximately 450,000 Baht per year for office and server room) • Other inputs: daily data from satellite (image), the costs for equipment clearance and transportation of equipment and rewards to the researchers to contribute to journals
RID	• Provision of all data available to the participating organizations • Provision of data from approximately 150 existing stations in the Chao Phraya river basin • Communication cost for telemetry system • Transportation and labor costs for telemetry installation
TMD	• Some computer resources such as TMD supercomputer/servers to run atmospheric model/climatic model/Crop Growth Simulation

	Model to support many sub-group projects in IMPAC-T • Server maintenance cost and operators

3.3 Implementation Process

(1) Project Management Framework

- Participants: the Project is participated by 51 Thai members from 11 academic and government organizations[15], and by 16 Japanese researchers from 8 institutions[16]. By inviting both government officials and academics to undertake a joint research, the Project aims to establish a human network among practitioners and academics who would benefit from the exchange of knowledge and information, but had limited opportunity for cooperation in the past.
- Management Structure: The Project consists of 19 research groups, an "Administrative Committee", and a "Social Application Group" established upon recommendation from Mid-term Review. The prime implementing agencies on the Thai side are Kasetsart University (KU), Royal Irrigation Department (RID), and Thai Meteorological Department (TMD); and the main organizer of research activities on the Japanese side is the University of Tokyo (UT). The four agencies together form the aforementioned Administration Committee, a body in charge of overall project management.
- Research activities:
  - ✧ As introduced in Output Indicator 1-1 in Chapter 3, the research topics of the 19 groups are categorized into 3 major areas of focus that this Project strives to strengthen. Groups #1-10 are categorized as "Earth Observation Group", whose activities are linked to Output 1; Groups #11-14 are the "Modelling Group", and linked to Output 2; and Groups #15-20 are "Impact Assessment and Adaptation Group", whose research relates to Output 3 of this Project.
  - ✧ The activities of the research groups (including the training and request for budget and equipment) are carried out based on the research proposals that each 19 group submitted in 2011 (see Output Indicator 1-1 for details). Each research group is different in size and in the topic of research, but is common in that 1) the Thai researchers are expected to take ownership in moving their research forward, and 2) there are one or two Japanese members as an advisor on the research.
- Decision-making and monitoring:
  - ✧ At the level of research group, the monitoring of the progress and information-sharing are mostly through regular group meetings, e-mails, and the communication at the training and workshops hosted by the Project. At project level, Internal Workshop held twice a year serves as an opportunity for project members to share the progress and research outcomes with other members.
  - ✧ For the coordination of the project activities, the Administrative Committee consisting of UT, KU, RID, and TMD holds a meeting on a monthly basis, and the record of meetings are shared with Project members through mailing lists and website. Joint Coordination Committee (JCC) meetings are held at the beginning of each fiscal year, to approve annual activity plans, as well

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[15] According to the list provided by the Project. See Annex 2 for the list of research groups and participants.

[16] University of Tokyo, Tohoku University, Tokyo Institute of Technology, Kyoto University, Fukushima University, Hokkaido University, Nagasaki University, National Institute for Environmental Studies.

as for a key event such as Mid-term review. There were 6 JCC meetings held in the past[17], and the 7th meeting is planned during this evaluation on 29th of November, 2013.

(2) Overall Progress and Factors that affected the Activities

- Progress before 2011: As reported in the Mid-term Review, the progress made only slow progress for the first one and half years, due primary to the management style of the former project manager. Communication channel was unclear and the participation to the project was limited only to a small group of researchers[18].
- Progress since 2011: The change in the leadership took place in late 2010, and the framework of research was transformed into the current format in early 2011, by accepting and approving research proposals from a larger number of Thai researchers (see Output Indicator 1-1 on the process to accept proposals). After the restructuring of the project management, the overall Project administration saw significant improvement, and the activities since have generally been kept on time.
- Impact of 2011 flood: the severe flood that occurred in Thailand in 2011 had a several consequences on the Project activities. On one hand, the occurrence of such a disaster physically took the time of many Project members – especially those working for government and the members of H08 group – for them to address the incident. This caused a short disruption of some of the Project activities, although overall progress was not affected. On the other hand, the incident also promoted the flood-related research by the Project, and served as an occasion for the Project outcomes to be utilised in real practice. For example, the Project dispatched an emergency team to assess the situation and analyse the cause of the flood, and disseminated the results and related information through seminars and workshops attended by government management and by the Japanese enterprises based in Thailand. The H08 group carried out and contributed a run-off analysis, which was utilised for the revision of the Chao Phraya river basin management master plan supported by JICA(see Indicator 4-1 and "4.4 Impact"). The incident also reminded the Project of the importance of the management of the Chao Phraya river and the measures to mitigate the negative consequences on human lives (such as slope failure), which brought about some shift in the focus of the Project's research toward these topics.

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17 June 2009, November 2010, April 2011, February 2012, May 2012, March 2013.

18 From the IMPAC-T Mid-term review available at: http://libopac.jica.go.jp/images/report/12079448.pdf

4. RESULTS OF EVALUATION

4.1 Relevance

Relevance of this Project is high.

The basis of the Team's conclusion is as follows. The Project is consistent with the international discussions on climate change, national- and sector policies of Thailand, and with Japan's development assistance policy for Thailand[19].The Team also found its design and approach as suitable to address the skills needs of target population who are responsible for implementing or contributing to the above-mentioned strategies.

1) Consistency with international, national and sector policies.

- The Project's objective corresponds to the recommendations from the Forth Assessment Report (AR4) by the Inter-governmental Panel on Climate Change (2007)[20]. The Chapter 3 of the AR4 ("Fresh Water Resources and their Management "), prepared by the Working Group II of the IPCC, recognizes the need for water-related climate change research to improve understanding and estimation of climate change impacts in quantitative terms, and to fulfil the pragmatic information needs of water managers who are responsible for adaptation[21]. The decisions adopted at the 16th Conference of Parties of the United Nations Framework Convention on Climate Change ("the Cancun Agreements") recommends the improvement of climate-related research and systematic observation for climate data collection, archiving, analysis and modelling in order to provide decision makers at the national and regional levels with improved climate-related data and information[22]. The Integrated Information System developed under this Project is the implementation of this recommendation, and satisfies the objective of the SATRES scheme that aims to promote joint and advanced scientific research on global issues.
- Thailand's National Strategy on Climate Change Management (2008-2012), formulated based on the IPCC report, proposes measures that are highly related to the Project activities[23]. In the same Strategy, however, Thailand also recognizes its lack of knowledge base and information for decision-making on climate change. The focus of this Project – the establishment of a comprehensive information

19 Of 3 priority areas of Japan's development assistance to Thailand, this Project falls under the "Sustainable Economic Growth and Responses to Aging Society". The actions under this priority area include flood prevention program, and the strengthening of research capacity and network, to which this Project strongly contributes to. Refer to: http://www.jica.go.jp/thailand/english/activities/activity04.html (although the content needs updating).

20 Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability

21 Ditto," 3.8 Key uncertainties and research priorities"

22 Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010, Addendum, "Part Two: Action taken by the Conference of the Parties at its sixteenth session", II. Enhanced action on adaptation (g),(h),(i).

23 Including the improvement in forecasting capability, development of database and models to evaluate climate change impacts on water resources, and conduct of flooding and drought risk assessment to identify areas of hazard.

system with data and models for impact assessment – was both timely and highly relevant to this Strategy.

- While still a draft, the next Climate Change Master Plan (2013-2050) [24]is expected to place water resource management as a priority adaptation measure (see also "4.5 Sustainability" on this plan). The Project is thus highly relevant to these strategies in terms of its focus, the timing of its intervention, and of the foresights it offers for the implementation of the future Master Plan. The government's commitment to climate change is also warranted by the 11th National Economic and Social Development Plan (2012-2016)[25].

2) Relevance of approach

Being a research project that pursues an excellence in an advanced research, the Project also put emphasis on the capacity development of Thai researchers. This approach is deemed highly appropriate for Thailand to strengthen its research-base, and for Thai counterparts to enhance the ownership in carrying out the research activities.

Having stated that this Project is relevant to climate change strategies, the Team also noted that the Project information is not sufficiently shared with the authorities in charge of climate change management, such as the Office of Natural Resources and Environmental Policy and Planning (ONEP) (see the "4. Recommendations" for a suggested action).

4.2 Effectiveness

Effectiveness of this Project is high.

The evaluation on Effectiveness is based primarily on the attainment of the Project Purpose: "A prototype of the Integrated System is established to help decision-making on the adaptation for water-related risks under climate change impact".

As explained in the "3.1 Progress on Attaining Outputs and Project Purpose", both the Project Purpose and its indicator have been achieved. The software component of this system is complete by March 2013, and most of the information in the system will be publicized through the Project's website currently being prepared by the KU and UT for official opening by the end of 2013.

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[24] Currently under consideration by the technical subcommittee of National Committee on Climate Change (NCCC) and anticipated to be approved by the NCCC by end 2013-early 2014.

[25] Risk assessment section (2.2.5) recognizes the threat posed by climate change, especially the shortage of water. As a response, Strategy 5.6.3 recognizes the need to upgrade the capacity in adaptation to achieve climate-resilient society, by enhancing knowledge and management tools for handling and responding to challenges from climate change. The draft in Thai language available at : http://www.onep.go.th/images/stories/file/file2013july31a.pdf.

From the research perspective, the implication that a prototype system has on the climate change management in Thailand is never insignificant. The stable supply of hydro-meteorological data, and in particular the flux data from the towers established by the Project as one of the few initiatives in the monsoon Asia, and will provide useful climate information for the neighboring countries with limited ability to gain meteorological data. With the development of high-resolution hydrological models for Chao Phraya river basin (see Output Indicators 2-1 and 2-2), long-term simulations of water discharge with consideration to human activities is now available for decision-making. Research on long- and short-term impact assessment, especially on slope failures, was rarely available in Thailand in the past. This Project is one of the few which undertook such assessment and made the results available and accessible to the public, through the development of risk indices, disaster potentials, and a hazard map. While the outcomes of the Project (including the skills of the members and the models) need continuous improvement, the introduction of the advanced research and practices per se should deserve positive evaluation.

From the project management perspective, the strengthened partnership between government officials and researchers is a major success of this Project, and contributed to the effectiveness to a significant extent. Many participants reported that they never experienced a project joined both by government and researchers, and data sharing and cooperation among them would have been difficult without this Project. An example of this cooperation will be mentioned in "5.4 Impact" section.

During the interviews, the Team also noted that the basic information (what functions are installed in whose servers, how they are linked, which data are transferred to whom via whom, etc) was not well-documented in a concise manner. For the future management and utilization of this Integrated Information System, basic information on the system should be clarified and shared with Project stakeholders (see "Recommendations" section for concrete actions and other issues related to the Integrated System).

4.3 Efficiency

The efficiency of this Project is relatively high.

This evaluation result is based mainly on 1) the level of attainment of Output indicators, and 2) whether activities and inputs (personnel, equipment, training and other budget) were efficiently managed and used for the attainment of these indicators.

1) Attainment of Output Indicators: all the indicators related to the research were met, regardless of the interruption of the Project activities during the 2011 flood. The progress was slow in the first year of the Project due to the management style of the then Project Manager (see "3.3 Implementation Process" for details). The activities after the restructuring of the project management, however, have

generally been kept on time, and the recommendations from the Mid-term Review are addressed immediately after the Review.

2) Number of outputs produced: According to the report from the Japanese experts, total 63 academic papers (52 Thai- or international journals, and 11 Japanese) were accepted by the Project by September 2013. This number can be viewed as a significant academic achievement. Another effort is underway to publish the summary and outcomes of this Project to an international publication of "Hydrological Research Letter".

3) Management of activities: For a project of this size (in terms of the.number of participants), IMPAC-T is well-managed. After the restructuring of the project management in late 2010 to early 2011, the overall administration of the Project saw significant improvement (see "3.3 Implementation Process"). The new management fostered a good communication among participants, and respected ownership of reach group in advancing the activities under the supervision of the Japanese experts.

   As mentioned in the previous sections, IMPAC-T is one of the first SATREPS projects which commenced when there were no predecessor examples to refer to. This naturally implies that the Project implementation process involved many learning-by-doings, and some inefficiencies incidental to such a situation. In particular, it took time for the project management to reconcile and gain understanding of its members on the differences between the requirements for a pure research project, and for a capacity development project implemented under JICA's technical cooperation. This point will be mentioned again in the "6. Lessons Learned" section.

4) Provision of inputs: There are two categories of equipment and inputs provided during the Project.

- *Equipment provided to KU, RID, TMD, KMUTT, NU and PU*: including the data and simulation servers and flux towers. The provision of several servers experienced some delay, partly because of the stagnancy that the Project experienced during the previous Project Manager, and of the flood in 2011.
- *Equipment inputs for research groups*: the equipment, training cost, and other budget requested by research groups were provided by the Project on time.

4.4 Impact

The Impact of this Project is high.

The evaluation of Impact was based on 1) how likely the Project's outcomes are utilised for real practices or decision-making ("social application"), particularly by government agencies, and 2) any other positive effect from this Project that needs particular attention. On social application, special attention was paid to (1) the utilisation of the Integrated Information System by key government agencies, and (2) the utilization of research outputs and cooperation agreements signed to utilize the outputs have been.

1) **Social Application of the Integrated System**

From the discussions with the RID and TMD as two key government counterpart agencies, the Team concluded that the likelihood for the system to be used by participating government institutions is high. Followings are the current plans of these organizations to utilise the system, although these plans per se do not automatically guarantee their permanent use of this system.

- RID currently uses the Project's hydrological model to predict the river discharge for next year, as one of several models if not a mainstream. By so doing it wishes to monitor the performance and credibility of the system, and to use it as a future decision-making tool to predict long-term climate change impacts (when constructing a new dam, for example). RID also sends its officer to Tokyo to foster a specialist in the operation of H08 model, which demonstrates a long-term commitment by RID to utilize the system.
- TMD applies the models and skills learned to carry out the simulations in their routine work, and expressed willingness to use and share with more colleagues the hydrological model of this Project as one of main tools for long-term simulation[26].

2) Social application of other research outputs

In addition to the examples shown in 1), the Team collected several other examples where the research outputs were translated into real practices. Among them, the following efforts particularly had high impacts to the society and decision-making, which the Team evaluated positively.

- ***The Project's contributions to the 2011 flood***: as mentioned in Output Indicator 4.1, the outcomes of the Project significantly contributed to JICA's Project on a Comprehensive Flood Management Plan for the Chao Phraya River Basin in establishing a flood warning system for the RID. This contribution, the Team considers, spurred the Project's progress toward the social application of the research outcomes.
- ***Community-based early warning system in Krabi***: Group #16 developed a system in the landslide-prone Krabi province, to notify the villages downstream when a sensor detects a slope failure upstream. This activity also promoted dialogues between the villagers of different religions, and between the villagers and local government, who would otherwise not have approached to each other. The Team considers this as a good example of social application.
- ***Cooperation agreement between KU and DRRAA***: KU exchanged a MoU with the Department of Royal Rainmaking and Agricultural Aviation (DRRAA), to utilize the results of rainfall observation and prediction by satellite for the work of the Department.

For many other outcomes not mentioned above, the demand for their practical application is potentially high, given the recent and frequent fluctuation of the climate conditions, the damages it has caused, and the strategies shown in the future Master Plan on Climate Change (2013-2050). The reason for this potential to remain yet to be realised could be threefold. The first is the difficulty for the Project to plan how to apply the outcomes for the society, before any concrete research result is obtained. Second is the

[26] According to the discussion with TMD participants during the evaluation.

lack of clear plans to connect the outcomes to real practices. That is, a roadmap to turn this potential into reality is missing at this right moment. The third is the difficulty for the Project to gain broad understanding on the advanced scientific research it is undertaking. Due to the technical nature of the Project activities, some members feel that they were not always successful in communicating to the public what the Project's activities are about and what they are useful for. Refer to "5. Recommendations" and "6. Lessons Learned" for suggested actions and additional thoughts.

4.5 Sustainability

The sustainability of this Project is relatively high.

Sustainability was assessed by whether four criteria that support the Project's sustainability are satisfied. These are: 1) whether international and national policies are favourable for the future of the Project, 2) whether the research activities are likely to continue into the future, 3) whether the members' skills are sufficient and outputs of this Project are utilised for their routine work, and 4) whether the inputs provided by the Project and the outcome (the Integrated System) will be well-maintained and used after the Project.

1) ***Policy aspect:***
Sustainability is high from policy aspect. As international level, existing agreements, such as the Cancun Agreement mentioned in "4.1 Relevance", promote the research and capacity development in climate change. At national level, the draft Climate Change Master Plan (2013-2050) is expected to serve a long-term support for the areas of work that this Project focused on. The current draft recognizes integrated water resource management as the first priority of its adaptation strategy, and encourages capacity building of human resources and organizations for climate change risk management. The outcome of this Project strengthens the government's efforts in such capacity development.

2) ***Prospect for the continuation of research activities:***
It is likely that the research activities will continue, if not is the same size and structure as this Project. For the university participants whose main work is the research, the activities are likely to continue in one way or another. The long history of cooperation between KU and the UT indicates that cooperation among key researchers will continue. The government participants also have interests in continuing the research similar to this Project and their cooperation with other Project members established under this Project is likely to be sustained. Nevertheless, their participation may be more subject to the future management than the researchers(i.e if there is a change in the management and the supervisors lack in understanding of the benefit of such a study). Awareness-raising under Output Indicator 4-1, therefore, is an activity that needs to be sustained both during and after the Project alike. On the Thai side, the representatives from 16 groups so far expressed their group's willingness to continue the work of the

groups in one way or the other. Some initiatives are already taking place in the form of cooperation agreements and the discussion on forming an emergency advisory group in the case of natural disasters.

3) *Utilization of skills and outputs*:

- In the questionnaire survey, 10 out of 15 respondents said that the Project activities are "strongly related" to their daily work, and 3 respondents, as "related to some extent". The answers indicate certain prospect for the research outcomes to be utilised in their own work.
- According to the interviews during the evaluation, the participants from government agencies - mostly the TMD and RID participants - have already applied basic skills and outputs (data and models) to their daily work, although the use of advanced models may be limited to specific officers. For this reason, RID sends 2 of its officers to study at the UT, and their contributions of knowledge to RID are likely to enhance the capacity of their Project colleagues long-term.
- Participants from universities reported clear plans to utilize the knowledge and models from the Project in their own lectures and further academic works, and the Team feels assured on the sustainability of their work.

4) ***Maintenance and use of inputs and outcome***:

There are several concerns that need to be addresses during the Project.

- For the management and utilization of the Integrated System, there is a need for clear management policy. The management of the system involves the responsibilities of those who take part in running this system. Currently, however, there is no formal system management policy or a framework of problem resolution, in case some members stop providing data, or use the provided equipment in a manner against the interest of the Project. The cost of maintenance of the servers– electricity cost, mainly – are likely to be met by KU, TMD, RID and KMUTT and the personnel are assigned to take care of the servers.
- The PU reported on the difficulty in securing the maintenance cost for the flux tower, and communication cost to transfer the data.
- The nature of the equipment provided to research groups –the electronic devices such as PC, hard-desk drives and UPS implies that they will be used for the routine work. For the purpose of future monitoring, there is a need for each participating organization to list the equipment they received from the Project.

5. RECOMMENDATIONS

5.1 Recommendations of the actions to be taken by the end of the Project

1) Prepare the framework to manage Integrated Information System.

The representatives of the organizations who received the servers – KU, RID, and TMD – should initiate the following actions, in consultation with Japanese experts:

- To summarise the basic information on the Integrated Information System, in a manner that facilitates the understanding of the outside stakeholders who need explanation on the system. Such information includes the roles and functions of each server, and the route through which observation data is transferred and stored. Share this summary to the Project members and stakeholders.
- To start preparing the policy to ensure regular and continuous data transfer and information update for the Integrated Information System. The issue(s) that each organization should decide should be discussed by each organization respectively; for the cross-cutting issue(s), all the three should consult together. The schedule to finalise the policy should also be determined during this preparation process.

2) Disseminate Project outputs/outcomes.

The Project should share the outputs and outcomes of this Project widely with the stakeholders in water resource management, climate change, disaster management, and with those responsible for formulating and implementing the policies in these sectors, and promote the social application of the Project outcomes in cooperation with those stakeholders. In so doing, the Project should consider the invitation of the organizations concerned – such as Ministry of Natural Resources and Environment (MNRE) (including ONEP and Department of Water Resources) and Ministry of Science and Technology – to the symposium of the Project planned in January 2014.

3) Create equipment list by Project participant organizations.

For the purpose of future monitoring, the Project should prepare a list of equipment provided to each organisation[27], and share it with a designate a person from each organization to manage the list.

4) Identify future research topics.

To utilise the skills and outcomes of this Project for further research activities, the Thai researchers should discuss and compile a list of future research topics in the water-related climate change adaptations.

5) Obtain feedbacks to the Integrated Information System.

[27] Not by each research group, since it is still unclear where the framework of the current research group will be maintained after the Project.

The Project should obtain feedbacks on the Integrated Information System from its users, and compile the results.

6) Secure management cost for the flux tower.

- By the end of the Project in March 2013, PU should confirm the way to finance the maintenance cost of the provided flux tower.
- Both KMUTT and NU should prepare a document that clearly states the source of funding for the maintenance of the flux towers.

5.2 Recommendations of the actions to be taken after the Project

1) KU, RID, and TMD should finalise the draft policy discussed in 5.1 before March 2015, and share the final version to the Project members.
2) Thai researchers should make their utmost efforts to realize the research presented in 5.1. 4).
3) KU should improve the Integrated Information System based on the feedbacks obtained in 5.1. 5).

6. Lessons learned

Below are the lessons learned by JICA through the implementation of IMPAC-T.

1) As mentioned in "4.3 Efficiency", SATREPS is on one hand a research project that requires academic outcomes, and the same time a capacity development project implemented under JICA's technical cooperation. The differences in the requirements from the two schemes should have been sufficiently clarified and shared among the Project stakeholders at an early stage of the Project implementation.
2) The implementation of the IMPAC-T proved the difficulty to plan the activities for social application before any concrete research result is obtained. Such difficulty should be taken into consideration in the early stage of project formulation, so that the activities to realize social application can be discussed and planned once the research outcomes are clarified.
3) The cooperation among project members and their stakeholders is essential to gain better understanding from the public on the advanced scientific research undertaken by SATREPS projects. Such cooperation could involve the holding of regular study meeting among stakeholders, networking with outside stakeholders on a more daily basis, and the compilation of project information in a manner clear to the third party.