Internal Ex-Post Evaluation for Technical Cooperation Project (SATREPS[1])

conducted by Malaysia Office: January, 2021

Country Name	**Research and Development for Reducing Geo-Hazard Damage in Malaysia caused by Landslide and Flood**
Malaysia	

I. Project Outline

Background	Flood and landslide are two major disasters that cause human losses and economic damage in Malaysia. To cope with the disasters, government agencies prioritized the importance of reducing geo-hazard damage caused by landslides and floods. For example, The Slope Engineering Department (CKC) under the Public Works Department (JKR) developed the National Slope Master Plan (2009-2023) for slope management and the development of the Early Warning System (EWS). The Department of Irrigation and Drainage (DID) under the Ministry of Natural Resources and Environment, adopted the approach of Integrated Flood Management, where EWS was an integral part of the response plan.		
Objectives of the Project	The project aimed to propose a trial system of an advanced disaster risk management system with an integrated data system of landslide and flood to the relevant government agencies in Malaysia, through the construction of 1) an analysis system for temporal change and real-time condition of surface environment, 2) a comprehensive, advanced numerical flood-runoff models, 3) a landslide hazard assessment system, and 4) a comprehensive disaster information database, as well as 5) the trial proposal of a risk management system utilizing risk information in local government and community, thereby contributing to the improvement of the existing early warning system of the government agencies and the improved accuracy of geo-hazard risk assessment. 1. Expected Overall Goal: NA. 2. Project Purpose: A trial system of an advanced disaster risk management system with an integrated data system of landslide and flood is proposed to the relevant government agencies in Malaysia for supporting their consideration of disaster management programs implementation.		
Activities of the Project	1. Project Site: Peninsular Malaysia; Kelantan River basin and Dungun River basin * Dungun River basin was added during the project implementation. 2. Main activities: 1) Group 1 on Remote sensing (RS)/Geographical information system (GIS): Development of high-quality Digital Elevation Model (DEM) using RS technologies such as Unmanned Aerial Vehicle (UAV) and Circularly Polarized Synthetic Aperture Rader (CP/SAR); development of a method to estimate flood/landslide hazardous area from multi-temporal spatial datasets. 2) Group 2 on Flood risk assessment: Development of a flood analysis model for the targeted river basin based on the Integrated Flood Analysis System (IFAS); development of a mid-resolution 3D hydro-geological model and a high-resolution 3D hydro-geological model for the Kelantan River basin based on the General Purpose Terrestrial Fluid-Flow Simulator (GETFLOWS). 3) Group 3 on Landslide risk assessment: Development of a landslide prediction method based on 2D/3D physical models with hydrological analysis; installation of landslide monitoring stations; hazard estimation of the monitoring areas with proposed numerical analysis method. 4) Group 4 on Disaster information database: Development of a landslide/flood hazard information system (hazard maps, sustainability maps, and inventory maps in each scale); development of a disaster reduction online database. 5) Group 5 on Preparation of Risk Management System: Experimental installation and operation of a web-based EWS for landslide/flood hazard for selected monitoring areas; provision of web-based risk communication tools for local government and community. 3. Inputs (to carry out above activities) Japanese Side 1) Experts: 3 persons (long term), 22 persons (short term) 2) Trainees received: 185 persons 3) Equipment: Server facilities, data storage, satellite data, real-time monitoring equipment for flood and landslide 4) Operation cost Malaysian Side 1) Staff allocated: 102 persons 2) Operation cost		
Project Period	June 2011 – May 2016	Project Cost	(ex-ante) 394 million yen, (actual) 260 million yen
Implementing Agency	The Ministry of Education; Universiti Sains Malaysia (USM); Universiti Tenaga Nasional (UNITEN); Multimedia University (MMU)		
Cooperation Agency in Japan	University of Tokyo; Chiba University; National Institute of Earth Science and Disaster Prevention (NIED); Global Center of Excellence for Water Hazard and Risk Management (ICHARM); Kyoto University; Ibaraki University; Vision Tech Inc. (VTI)		

II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

For this SATREPS project, a Project Design Matrix (logical framework) was not prepared, and the Overall Goal was not identified in the Ex-ante Evaluation Sheet/Master Plan attached to the Record of Discussions. Meanwhile, in the Terminal Evaluation Report, "the improvement of the existing early warning system of the government agencies and the improved accuracy of geo-hazard risk assessment that can be utilized for disaster risk management planning from the national to the local level" was mentioned as expected project benefits in terms of social application of the research outputs/outcomes. Therefore, this ex-post evaluation regards the following as the Expected Overall Goal: "The existing early warning system of the government agencies and

[1] SATREPS: Science and Technology Research Partnership for Sustainable Development

the accuracy of geo-hazard risk assessment are improved." The achievement status of the Expected Overall Goal is considered as a part of the expected positive impact.

1 Relevance

<Consistency with the Development Policy of Malaysia at the Time of Ex-Ante Evaluation>

This project was consistent with Malaysia's development policies on slope and flood management, as mentioned in "Background" above. The 10th Malaysia Plan (2011-2015) also aimed to promote the Integrated River Basin Management approach.

<Consistency with the Development Needs of Malaysia at the Time of Ex-Ante Evaluation>

As mentioned in "Background" above, this project was consistent with the need to reduce geo-hazard damage caused by landslides and floods.

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

This project was consistent with "Country Assistance Program for Malaysia" (2009) that held appropriate assistance "in the fields of disaster prevention and management against such disasters as flood, landslide, haze, earthquake and tsunami" as part of "Overcoming Regional Issues," one of the priority issues of assistance.

<Evaluation Result>

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

2 Effectiveness/Impact

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

The project is deemed to have achieved the Project Purpose to a certain extent at the time of project completion. The relevant government organizations, namely, JKR (related to landslide) and DID (related to flood), participated in the research and technology transfer in the project. The landslide and flood analysis models developed by the project were reviewed by JKR and DID, respectively (Indicator 1). Regarding the EWS, a trial version of the EWS for landslide was developed and being fine-tuned in collaboration with JKR. At the same time, the development of the one for flood was delayed and did not reach the review phase by DID (Indicator 2). A WEB-GIS type disaster reduction database named Hazard Watcher was developed and installed at the participating universities. It was reported that all the project outputs were presented to the government organizations, but whether they reviewed the database for their adoption is not clear (Indicator 3).

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

Some project effects from SATREPS are still being continued to the time of ex-post evaluation. It was confirmed that UNITEN, USM, and MMU have continued some of this project's research or started new research projects in such topics as UAV+CP/SAR, RS/GIS image processing, landslide risk mapping, Hazard Watcher, and real-time monitoring based on the project's outputs. Many research activities have been carried out in collaboration between UNITEN and other organizations/companies such as Malaysian Department of Mineral and Geoscience (JMG), Tenaga Nasional Berhad (TNB; Malaysian electricity utility provider), Malaysia Space Agency, Sarawak State Government, and Geomapping Technology (GMT) Sdn Bhd. Moreover, UNITEN collaborates with JMG in training on landslide assessment. While the knowledge and concept learned in SATREPS research has become basis of flood management system at DID Malaysia, the trial EWS developed under this project was not utilized in totality (see below).

A number of the equipment and software provided to the counterpart universities under this project (e.g., flood monitoring stations, Data Centre, server facilities, software such as ArcGIS, ERDAS, UDEX, Agisoft, Matlab) have been utilized for these research projects. After SATREPS completion, there was no further budget allocated on some equipment that are not utilized after SATREPS research was concluded.[2] Also, although IFAS and GETFLOWS were installed at the DID Forecast Centre, they are no longer in the operational mode because DID developed and currently operates the real-time EWS, namely, the National Flood Forecasting Warning System (NaFFWS), using a different model which can produce flood hazard maps automatically in real-time mode. According to DID, some parts of the models introduced under the project had to be modified to suit the Malaysian situation and personnel capability.[3] At UNITEN, IFAS is still used by postgraduate students.

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

The Expected Overall Goal has been partially achieved by the time of ex-post evaluation. Although the trial version of EWS developed under this project was not directly adopted by the government agencies, DID acknowledged that the knowledge learned during development of the system during SATREPS and its concept has become good reference in developing the National Flood Forecasting Warning System (NaFFWS). For landslide, this project's EWS did not directly contribute to the EWS that JKR is in the process of developing since, according to USM and JKR, human resources involved in the research are no longer around, and there is a challenge in budget allocation. For flood, as already explained, DID developed NaFFWS but did not use this project's prototype.

While there are some cases where parts of the model developed through SATREPS are not directly adopted, experience and knowledge from this project have contributed to the establishment of some other systems. After SATREPS project completion, Malaysian government progressed further to independently continued to improve disaster management system and venture into new researches. For example, JMG used the example from Hazard Watcher to establish its landslide risk management named the National Geospatial Terrain And Slope Information System (NATSiS) in the year 2018. DEM developed under this project was integrated with other sources to establish NATSiS. Also, TNB Grid Maintenance established the Virtual Geohazard Management Asset System (ViGMAS). This system enables TNB to forecast any flood event five days ahead and predict landslide events five or six hours ahead. This extra time is valuable for TNB Grid Maintenance

[2] The landslide monitoring system broke down after project completion and no budget for repair and maintenance has been allocated, presumably because the system had been used to collect data for landslide risk assessment in the project and its role has been terminated upon the completion of this research.

[3] According to DID, IFAS installed during this project could only produce hydrograph, but according to DID, there is a new necessity arises now that requires a real-time system that can produce flood hazard map. GETFLOWS is not deemed as user-friendly, as it has no Graphic User Interface (GUI) and DID officers are not well-versed in the programming language.

in terms of future planning for emergency response in assuring public safety.

Regarding the accuracy of geo-hazard assessment, as well, the three counterpart universities and DID confirmed the improvement and the indirect contribution of this project through the enhancement of knowledge of developing and using different models (e.g., DEM, CP/SAR, IFAS, and GETFLOWS).

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

No negative impact was observed by the counterpart organizations interviewed. Positive impacts they pointed out include enhanced skills and knowledge among the participating researchers,[4] contribution to national landslide and flood prevention measures,[5] completion of masters and Ph.D. degrees in related topics, and networking and collaborative skills among various institutions.

<Evaluation Result>

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

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) A trial system of an advanced disaster risk management system with an integrated data system of landslide and flood is proposed to the relevant government agencies in Malaysia for supporting their consideration of disaster management programs implementation.	Indicator 1: The landslide/flood models are reviewed by the government agencies for incorporating in their research or actual hazard risk management.	Status of the Achievement: achieved (partially continued) (Project Completion) - The landslide risk assessment model was completed and demonstrated to JKR. JKR was involved in the development of the model. - The flood analysis model based on IFAS and the 3D hydro-geological models based on GETFLOWS was developed for the target river basin. DID was involved in the development of the models. It also reviewed the two models in comparison with the existing model. (Ex-post Evaluation) Although the models mentioned above have not been incorporated in the system of the government agencies in totality, further research has been conducted using the constituent technologies as follows. - USM and MMU applied the landslide risk assessment model to a selected Cameron Highland site. - UNITEN, in collaboration with JMG, used satellite image for landslide risk assessment and virtualized in the 3D system. - UNITEN integrated the high-resolution 3D hydro-geological model with a groundwater survey using resistivity and seismic for the Groundwater Resources Assessment Project (National Project) with JMG and GMT Sdn. Bhd. - UNITEN conducted the Comprehensive Geomorphology and Geological Study in Malaysia using UDEX Software with JMG and GMT Sdn. Bhd. - UNITEN conducted the terrestrial laser scanning in geological risk assessment using UDEX Software with JMG and GMT Sdn. Bhd. - UNITEN developed the Innovative Slope Indicator Monitoring and Asset Management System (ISIMAMS) using integration concept from the Groups 1-3 outputs of this project and Hazard Watcher under Sarawak State Government, GMT Sdn. Bhd, JKR Sarawak, and JMG. - UNITEN used Hazard Watcher for extracting normalized difference vegetation index (NDVI) data and monitoring in Sarawak State Government. - UNITEN, TNB, and the Malaysia Space Agency collaborated in research and operational tasks for the TNB-Grid using satellite imagery and GIS for vegetation and landslide risk and vulnerability assessment. This is to ensure the sustainable supply of electricity to users via the national grid. - UNITEN used the real-time slope monitoring concept adaptation to TNB, Sarawak State Government, and JMG. - UNITEN collaborated with JMG in training on landslide assessment. - UNITEN and Sarawak State Government, JKR Sarawak, GMT Sdn. Bhd. and JMG Sarawak conducted collaborative research to establish the Visualize Slope Management System using ArcGIS System, satellite data, and the Hazard Watcher concept. - MMU utilized the SAR sub-system for further development of a ground-based SAR (GBSAR) to detect land deformation. GBSAR has higher detection accuracy compared to CP/SAR, and 1 Ph.D. student graduated under this research project. * See “Expected Overall Goal” below for the use of the models in developing EWS.
	Indicator 2: The EWS is reviewed by the government agencies for full or partial adoption to improve their existing warning system.	Status of the Achievement: partially achieved (partially continued) (Project Completion) - A trial version of the EWS for landslide was developed and being fine-tuned in collaboration with JKR. EWS for flood had not yet been completed. (Ex-post Evaluation) - The trial version of EWS developed under this project was not directly adopted by the government agencies, but the knowledge from this project was used for the development of NaFFWS. * See “Expected Overall Goal” below for more information.

[4] For example, UNITEN informed that their researchers joined Collaboration Hubs for International Research Program (CHRP).

[5] Besides collaborating in the development of NaFFWS, UNITEN was involved in development of Guideline for Landslide Vulnerability Assessment and Risk analysis for Critical Infrastructure (CI) in Malaysia with the Construction Industry Development Board (CIDB) Malaysia.

	Indicator 3: The disaster reduction online database is reviewed by the government agencies for update and improvement of their existing database.	Status of the Achievement: partially achieved (partially continued) (Project Completion) - Information on flood/landslide disaster collected as a WEB-GIS type database called Hazard Watcher. The beta version was installed at each university. - The project compiled all outputs and submitted it to the Malaysian Government by the end of the project. (Ex-post Evaluation) Hazard Watcher is accessible by all researchers (including researchers from government agencies such as DID and JKR) who were a part of SATREPS teams and used among the counterpart universities for various research projects (See Indicator 1 above). Some government agencies use the database indirectly through the research projects in which they are involved, but the database continues to function on an inter-researcher basis and is not used directly by government agencies.
(Expected Overall Goal) The existing early warning system of the government agencies and the accuracy of geo-hazard risk assessment are improved.	The extent of the improvement of the existing early warning system of the government agencies and the accuracy of geo-hazard risk assessment.	(Ex-post Evaluation) partially achieved <u>EWS</u> - DID developed NaFFWS, and the knowledge from this project was used for its development. For example, some findings from this project's systems utilized by DID were the acquirement of abilities on IFAS operation for real-time flood forecasting. Also, IFAS was used as one of the models in the development of a flood forecasting model for NaFFWS. - JKR continue to develop EWS that is suitable for Malaysia condition and at the moment is not directly contributable by SATREPS project output - JMG established NATSiS using the example from Hazard Watcher and by integrating DEM with other sources. - TNB Grid Maintenance established ViGMAS for asset maintenance and geo-hazards management. Researchers' experience and knowledge of 3D modeling from this project have contributed to the development of ViGMAS. Hazard Watcher is also referred to for this system. <u>Accuracy of geo-hazard risk assessment</u> - The respective organizations pointed out that the following system, which was developed using part of the concept/outputs of this SATREPS project, enhanced the accuracy of geo-hazard risk assessment: NaFFWS (DID), NaTSIS (UNITEN), GBSAR (MMU).

Source: JICA document; Final Report; Questionnaire with the implementing agencies

3 Efficiency

Both the project cost and the project period were within the plan (ratio against the plan: 66% and 100%, respectively). The Outputs of the project were produced as planned. Therefore, the efficiency of the project is high.

4 Sustainability

<Policy Aspect>

The Malaysian Government remains to have national policy aiming for disaster risk reduction such as the 11th Malaysia Plan (2016-2020) and the Long-Term Improvement Plan on flood forecasting under the NaFFWS Program.

<Institutional/Organizational Aspect>

This study could not collect factual information on the current organizational setting of the counterpart organizations and the government agencies for the utilization of the research outputs/outcomes of this project. However, it can be inferred from the various research activities and social implementation efforts, as described above, that a certain level of organization has been established. Among the equipment provided under this project, the ones that are still working are operated and maintained by a particular school or faculty of each university.

<Technical Aspect>

Many ex-counterpart personnel remains in the same counterpart universities. According to the questionnaire and interview with them, researchers at each university have sufficient research capacity to continue their research and get more research funding. Government organizations such as JKR and DID also have enough ability to develop their own EWS mentioned above.

Although the trial version of EWS developed under this project was not directly adopted by the government agencies, DID acknowledged that the knowledge learned during development of the system through SATREPS and its concept has become good reference in developing the National Flood Forecasting Warning System (NaFFWS).

<Financial Aspect>

There are a number of financial resources available in Malaysia, contributed by the federal government, local government, and also private entity for the reduction of geo-hazard damages caused by landslide and flood. Each counterpart university has secured the budget to continue its research activities, as indicated in the table below, although information on the amount was not available. No concrete information was available on whether government agencies have secured enough budget for relevant policy implementation. However, as mentioned above, they are developing and implementing EWS and other disaster risk management systems. Therefore, it can be assumed that they have a certain amount of budget available.

University	Source of fund
USM	Long Term Research Grant Scheme (LRGS) research grant by Ministry of Higher Education (MOHE), specifically translational research grant (with the condition that the research outcome must have benefits to society) under Malaysia Research University Network (MRUN).
UNITEN	TNB Direct Access Fund, JMG, Fundamental Research Grant Scheme (FRGS) (MOHE), Sarawak State Government, GMT Sdn. Bhd.

MMU	MOHE, Ministry of Science, Technology and Innovation (MOSTI), and Malaysia Digital Economy Corporation (MDEC) for GBSAR

<Evaluation Result>

In light of the above, factual information of the institutional/organizations and financial aspects of the implementing agency is not available. Therefore, the sustainability of the effects through the project is fair (cannot determine as high).

5 Summary of the Evaluation

The project is deemed to have achieved the Project Purpose to a certain extent of proposing a trial system of an advanced disaster risk management system with an integrated data system of landslide and flood: the trial system was mostly completed and reviewed by the relevant government agency. Although the trial EWS model developed during SATREPS is not directly adopted, counterpart acknowledged the beneficial experience and knowledge learned during SATREPS. After project completion, the counterpart universities have utilized various technologies developed under this project in research activities in collaboration with relevant government agencies. However, the trial EWS developed under this project was not used in totality. Regarding sustainability, as factual information of the institutional/organizations and financial aspects of the implementing agency is not available. On the other hand, no problem was found in the policy and technical aspects. Considering all of the above points, this project is evaluated to be satisfactory.

III. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

With regards to equipment, it is recommended to relevant organizations (universities, government departments, etc.) to continue with utilization of equipment procured through this project and allocation of budget for O&M, after hand over from JICA.

In view of social utilization of the project output, it is recommended that more researchers from implementing agency that are deemed as potential end-users (and not only from academic institutions/universities)[6] are included in research team. This is to ensure that project output has higher potential to be adopted through input by researchers from implementing agency.

Lessons Learned for JICA:

This project was the first SATREPS project in Malaysia. During the planning of the project, it wasn't clearly explained that it would be evaluated for content that is "beyond project implementation" as the Overall Goal to the Malaysian side. That is why the Malaysian side feels this is rather "unfair," and that evaluation should reflect the implementation of this research during research duration (i.e., until the trial system to be proposed to relevant agencies in Malaysia for review towards adoption, which was almost done). On the other hand, JICA wants to emphasize the social utilization of project output after project completion. When this project was planned, the decision to conduct ex-post evaluation for SATREPS projects had not been made, and there is no mention of ex-post evaluation in the agreement between the Malaysian side and JICA for this project. Therefore, such a feeling is reasonable. However, even after FY2016, when the conduct of ex-post evaluation for SATREPS projects was defined and commenced, it is still important to fully explain it to the counterpart agencies. Also, at the time of planning, it is necessary to have an agreement with the counterpart agencies on the Overall Goal and its indicators as well as the necessary monitoring framework (implementing entity, system, etc.) with social utilization of the expected research outputs in mind.

Photo 1 (provided by UNITEN): One of the equipment procured for flood monitoring (Water Level and Rainfall Station) is still being used by UNITEN and DID.

Photo 2 (provided by MMU): MMU utilized the SAR sub-system for further development of a ground-based SAR (GBSAR) to detect land deformation. According to MMU, GBSAR has higher detection accuracy compared to CP/SAR and can detect sub-mm movement on natural or synthetic objects.

[6] Although the SATREPS research team only include researchers from DID and JKR as those from government agencies, there are a number of other potential users such as Malaysian National Disaster Management Agency (NADMA), local/state governments, Malaysian Meteorological Dept (MMD), Malaysian Mineral & Geoscience Dept (JMG), Malaysian Civil Defense Force (AMP), Government-Link Company (GLC) Tenaga Nasional Berhad (TNB).