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

conducted by Peru Office: January 2020

Country Name	Project for Enhancement of Earthquake and Tsunami Disaster Mitigation Technology
Republic of Peru	

I. Project Outline

Background	Peru, as well as Japan, is a country located in the Circum-Pacific seismic belt, prone to earthquakes and tsunamis. These disasters have been major obstacles to the country's social and economic development. In 2001 and 2007, the earthquakes of magnitude (Mw) 8.4 and 8.0 respectively had occurred and led to many deaths and injuries and wrecked buildings. Both of the earthquake events were of the inter-plate type caused by the subduction boundary of the Nazca plate under the South American plate, which also caused tsunami to led damages and victims. Since inter-plate type earthquakes could occur cyclically with periodicity, occurrence of similar earthquakes and tsunamis for the future had been thought to be highly predictable; therefore, this project sought to assess accurately the risk of future earthquakes and tsunamis and to take concrete measures for mitigation of risks for damages.		
Objectives of the Project	Through strong motion prediction, seismic microzonation, tsunami simulation, development of tsunami countermeasures, experiment and analysis of seismic retrofitting, development of spatial information databases using remote sensing technology and earthquake damage, etc. in the Metropolitan Areas of Lima and Callao, the project aimed at developing programs for assessment and mitigation of earthquake/tsunami disasters caused by large-magnitude inter-plate earthquakes occurring off the coast of Peru.		
	1. Overall Goal: None. 2. Project Purpose: Technologies and measures are developed for assessment and mitigation of earthquake/tsunami disasters caused by large-magnitude inter-plate earthquakes occurring off the coast of Peru.		
Activities of the project	Project site: Metropolitan Areas of Lima and Callao 1. Main activities: Strong motion prediction, seismic microzonation, tsunami simulation, development of tsunami countermeasures, experiment and analysis of anti-seismic retrofitting, development of spatial information databases using remote sensing technology and earthquake damage, etc. 2. Inputs (to carry out above activities) Japanese Side 1) Experts from Japan: 27 persons 2) Training in Japan: 30 persons 3) Equipment: Equipment for structural experiments and ground data collection, etc. 4) Local cost: Peruvian Side 1) Staff allocated: 71 persons 2) Land and facilities: Research facility and equipment, office space, etc. 3) Local cost for operation and maintenance of the office space, etc.		
Project Period	March 2010 to March 2015	Project Cost	(ex-ante) 360 million yen, (actual) 277 million yen
Implementing Agency	Japan-Peru Center for Earthquake Engineering Research and Disaster Mitigation of the National University of Engineering (CISMID- UNI)		
Cooperation Agency in Japan	Chiba University, Tohoku University, Building Research Institute, Tokyo Institute of Technology, National Institute for Land and Infrastructure Management, National Research Institute for Earth Science and Disaster Prevention, University of Tsukuba, Nagoya University, Yokohama National University, Akita Prefectural University, National Institute of Advanced Industrial Science and Technology, Tokyo Electric Power Services Co.,Ltd., Ritsumeikan University, Toyohashi University of Technology, Tohoku Gakuin University, Hiroshima University, Tokyo Soil Research Co., Ltd.		

II. Result of the Evaluation

[Special Perspectives Considered in the Ex-post evaluation]

- Although the Expected Overall Goal was not set in the Master Plan developed during the discussion for the project implementation, it was described that it was "diffusion and expansion of the possibly-applicable research results and regional disaster mitigation plan to other Latin American countries" in the terminal evaluation report of JST. At the ex-post evaluation, diffusion and expansion to other Latin American countries were considered as the Overall Goal (efforts for social implementation) and verified as part of positive impacts.

1 Relevance

<Consistency with the Development Policy of Peru at the time of ex-ante evaluation and project completion>

The "National Disaster Management Plan" (2004) and the "National Plan for Disaster Management and Disaster Response" (2004) aimed at avoiding and mitigating the loss of human lives and property and environmental degradation due to natural and human-made disasters for sustainable development. Under this overall goal, there were five specific objectives, namely, "disaster risk assessment," "enhancement of citizens' disaster prevention and emergency response capabilities," "promotion of development plans and programs considering disaster prevention," "sustainable development considering disaster prevention," "participation of relevant agencies in planning" and "strengthening the national civil defense system". The project objectives were consistent with the Peruvian development policy until the time of project completion as the National Disaster Risk Management System Act" (No. 29554) (2011) had led to establishing the National Disaster Risk Management System (SINAGERD).

<Consistency with the Development Needs of Peru at the time of ex-ante evaluation and project completion>

As the past large-scale and inter-type earthquakes had a significant impact on the Peruvian coastal area, the same was expected in the Metropolitan Areas of Lima and Callao, the center of the political economy with nine million people. In the Metropolitan Areas, there was no urban planning in areas vulnerable to earthquake and tsunami risks, and the project was relevant to these needs.

<Consistency with Japan's ODA Policy at the time of ex-ante evaluation>

In the "Country Assistance Program for Peru" (2000), "prevention and recovery from natural disasters" was placed under the priority area "environmental conservation."

<Evaluation Result>

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

2 Effectiveness/Impact

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

The Project Purpose was achieved by the time of project completion. Technologies and measures were developed in four areas that contribute to the prediction and mitigation of earthquake and tsunami damage caused by a huge subduction-zone earthquake in the coastal areas (Indicator 1). In addition, as a disaster mitigation strategy in Lima City, two policies were formulated: seismic resistance building and land-use regulation, and an earthquake scenario was established (Indicator 2). The micro zoning survey was conducted for preparing the earthquake hazard map in 15 districts in the Metropolitan Areas of Lima and Callao and part of the four Departments of Ica, Cajamarca, Cusco, and Arequipa, and the result was referred to by the Ministry of Housing, Construction and Sanitation (MVCS) for implementation of its land-use programs. The revised Tsunami inundation maps of the Metropolitan Areas of Lima and Callao was shared among the National Institute of Civil Defense (INDECI), the Geophysical Institute of Peru (IGP), and the Directorate of Hydrography and Navigation (DHN) for the purpose of being utilized for development of disaster mitigation measures (Indicator 3).

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

The project effects have continued. Research results related to the simulation of strong motion were used by MVCS to revise the regulations to establish concrete standards (NTE-E060). Results of the structural tests related to seismic retrofitting effects were reflected in the guidelines for risk management of the slope residence in northern Lima. New research has been started based on Research outputs of the project, and it has been utilized by external researchers, engineers, and municipalities. CISMID also signed a memorandum with the National Construction Technology Training Center in 2017 to conduct research on the establishment of fragility curve for seismic performance of non-engineered masonry structures. In addition, CISMID has published seismic microzonation zoning maps, seismic wave databases, spatial infrastructure data, research results, etc. on its website, which have been utilized for disaster risk-related policy formulation and research. Major equipment provided to CISMID (equipment for structural experiments, data collection for collecting ground data, etc.) has been continuously used for research, consultation with external organizations, and lectures. Also, continuity of the results and experience obtained in the project has been utilized up now and would continue in the future.

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

Firstly, the Expected Overall Goal (approach for utilizing research outcomes) was expected as "research results and expansion of the applicability of regional disaster mitigation plans to Latin American countries and expansion of applicability." Research outputs of the project have been shared with researchers in Central and South American countries, including Chile, for the purpose of formulating regional disaster prevention plans. In 2016, at the seminar organized by JICA's technical cooperation project, "Disaster Risk Reduction Training Program for Latin America and the Caribbean" (2015-2020), some results of seismic tests on brick buildings undertaken by CISMID were introduced, and thus academic exchanges were strengthened among Peru, Chile, and Japan.

Another impact is that the preliminary tsunami inundation maps of the Metropolitan Areas of Lima and Callao developed by the project were shared with the Tsunami Warning Center of DHN, and it has been utilized by INDECI for the purpose of helping municipalities and community organizations identify their secured zones for evacuation through conducting training and evacuation drills. In addition, INDECI has helped municipalities, first response organizations and community representatives identify their evacuation routes through their technical support. Also, the models of seismic microzoning and tsunami simulation elaborated by the project, together with risks assessment measures have been applied when the second runway of Lima Airport was designed.

<Evaluation Result>

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

Achievement of the Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) Technologies and measures are developed for assessment and mitigation of earthquake/tsunami disasters caused by large-magnitude inter-plate earthquakes occurring off the coast of Peru	1. The number and contents of developed technologies and measures for assessment and mitigation of earthquake/tsunami disasters caused by large-magnitude inter-plate earthquakes occurring off the coast of Peru	Status of achievement: Achieved (Continued) (Project Completion) - Technologies and measures for prediction and mitigation of disasters of earthquakes and tsunamis applicable to Peruvian situations were developed in the following areas. 1) Strong motion prediction and development of seismic microzonation 2) Development of tsunami countermeasures based on numerical simulation 3) Enhancement of seismic resistance of buildings 4) Development of spatial information databases using remote sensing technology and earthquake damage assessment (Ex-post Evaluation) - The above technologies and measures have been continuously utilized as mentioned <Continuation Status of Project Effects at the time of Ex-post Evaluation>.
	2. The contents of developed land-use proposals for mitigation of earthquake/tsunami disasters	Status of achievement: Achieved (Continued) (Project Completion) - After 2011, MVCS assigned microzoning studies to CISMID for 15 districts in the Lima and Callao metropolitan area, and for a part of 4 Departments, Ica, Cajamarca, Cusco, and Arequipa. The results were referred to for implementing land-use programs. (Ex-post Evaluation) - Tsunami evacuation routes have been formulated every year from 2013 to 2018 in the District 3 and District 4 of Lima City.
	3. The contents of developed	Status of achievement: Achieved (Continued)

	local disaster mitigation plans for the study area	(Project Completion) - The Tsunami inundation maps of the Lima and Callao metropolitan area were revised in January 2015 and shared among INDECI, IGP, and DHN. It was planned to be used later by municipalities for disaster mitigation measures such as tsunami evacuation drills. (Ex-post Evaluation) - INDECI has shared the seismic microzonation map and damage assessment map for earthquake disaster measures with municipalities upon request from municipalities.

Source: Terminal Evaluation Report, JST Completion Report, interview with CISMID.

3 Efficiency

Both the project period and project cost were within the plan (Ratio against the plan: 77% and 100%, respectively). Outputs were produced as planned. Therefore, the project efficiency is high.

4 Sustainability

<Policy Aspect>

The "National Disaster Risk Management System Act" (No. 29554) (2011) is still effective at the time of ex-post evaluation, and accordingly, its respective regulations were introduced, as well as policies and other measures for each related organization for Disaster Risk Management. Regarding INDECI, the early warning system earthquake and tsunami risks have been considered as their institutional tasks.

<Institutional Aspect>

The disaster risk management system under SINAGERD has remained unchanged since the project period, except that in 2016, the competent authority of INDECI and the National Center of Estimation, Prevention and Reduction of Disaster Risk (CENEPRED) was transferred from the Prime Minister's Office to the Ministry of Defense. INDECI has been responsible for disaster preparedness, emergency response, recovery, and CENEPRED has been responsible for disaster risk assessment, disaster risk mitigation, prevention, and reconstruction. In 2016, the Peruvian Association for Earthquake Engineering was established as a subordinate organization of the International Association for Earthquake and Tsunami Engineering. In addition, to the Minister of MVCS, the Director of CISMID also belongs to the mentioned association, and CISMID has established a collaborative mechanism with government agencies and other research institutions.

In addition, CISMID has provided seismic data and advice from an academic perspective to the "Feasibility Survey for Disaster Prevention by Japanese Earthquake Early Warning Systems" of JICA, and CISMID has taken a part in implementation of the mentioned project as an academic advisory entity for the validation of the technologies for early earthquake warning systems that the project has offered.

The research equipment provided by the project to CISMID has been utilized in experiments and research of doctoral students. The Director of CISMID has been responsible for the equipment maintenance, and three engineers have been appointed for inspection and repair. Equipment spare parts have been procured and purchased in accordance with the university regulations.

<Technical Aspect>

CISMID researchers have aimed at improving their research capabilities through participation in international academic conferences and training, and participation and presentation in national and international symposiums. CISMID has been one of the key members of the national early warning system network managed by INDECI, providing advice based on scientific evidence from academic perspectives. Also, CISMID has provided advises on hazards and disaster risks through participation in the Disaster Risk Management Information System Committee, contributing to maintenance and improvement of scientific and technological literacy of these two organizations; INDECI and CENEPRED. CISMID has sustained necessary knowledge for technical maintenance of the research equipment donated by the project while referring to the manual obtained from the manufacturer and exchanging spare parts on their own.

<Financial Aspect>

Budgets of CISMID consist of those assigned to the national government entities and the National University of Engineering, and besides, CISMID also has its own resource (revenue from external research funds and consultation fees conducted by CISMID). Budgets from the national government entities and the National University of Engineering have been 1.13 million sols (1 sol = 31.4074 Japanese yen as of September 2019) and 100,000 sols, respectively, each year since 2013. CISMID's own budget has increased from 1.1 million sols in 2016 to 1.31 million sols in 2019. These budgets have been sufficient to sustain their research activities. INDECI and CENEPRED have obtained their institutional budgets necessary for utilization of related research outcomes and training based on their institutional strategic plans established under the framework of SINAGERD. In this regard, DHN has secured certain financial resources as an organization responsible for tsunami warnings, such as developing tsunami inundation maps in other areas and conducting disaster prevention education for communities.

<Evaluation Result>

Therefore, the sustainability of the effects is high.

5 Summary of the Evaluation

The Project Purpose was achieved. Technologies and measures were developed for the assessment and mitigation of risks associated with earthquake and tsunami, and then, related plans, measures, and scenarios were developed. These technologies and measures have been in use until the time of ex-post evaluation, and they have been shared with other Latin American countries and also utilized for municipalities to prepare their tsunami inundation maps and evacuation routes. Since most of Peruvian participants are academic, the results of the project would continue disseminated to young generation of scholars. Considering all of the above points, this project is evaluated to be highly satisfactory.

III. Recommendations & Lessons Learned

Recommendations for Implementing agency:

- In order that developed technologies may not be ahead of current public policies and programs, it is recommended that CISMID would continue its dialogue and discussion with other implementing agencies so that the collaborating mechanism between the public administration and academia may be further strengthened.

- It is recommended to continue to use the knowledge and network established through the project for further research progress and technology dissemination.

Lessons learned for JICA:

- In the project, not only technologies and measures were developed for the assessment and mitigation of risks associated with earthquake and tsunami but also research outcomes have been used by other organizations and municipalities and shared with researchers of other countries. In SATREPS, although it is not an easy task to ensure the utilization of research outcomes for practical solution, it is important to take into account the establishment of the mechanism for the project implementation at the project preparatory phase and to make necessary efforts for letting research outcomes used in public entities during the project implementation phase. As an example, it would be effective to include activities for promoting and supporting collaboration between research institutions and implementing agencies of public administration. It is also advised to work together with ongoing technical cooperation projects or experts, in parallel throughout the implementation of SATREPS.