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DEVELOPMENT OF EARTHQUAKE OBSERVATION NETWORK IN AND AROUND ASHGABAT, TURKMENISTAN

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BACKGROUND

This paper presents the purpose and progress of the project "Improvement of the Earthquake Monitoring System in and around The Ashgabat City in Turkmenistan" funded by Japan International Cooperation Agency since 2017. Turkmenistan is located in the south-west of the Central Asia region. Due to orogenic activity located close to the border with Iran, many earthquakes have occurred, especially in 1948 Ashgabat city suffered severe damage. Up to now, many buildings and infrastructures have been constructed following economic activities. If the same scale earthquake hit the capital city again, we can estimate much more damage of human and economic losses. The Government of Turkmenistan announced the strategy for implementation of seismic hazard estimation for the national and provisional level up to 2030. Under these circumstances, the Government of Turkmenistan requested Japan to provide technology transfer project on improvement of earthquake monitoring system and seismic hazard assessment based on geophysical surveys on the ground condition.

The Project had started in July, 2017 and continues to January, 2021 targeting areas in and around Ashgabat City. Counterpart Organizations is Institute of Seismology and Atmospheric Physics, Academy of Sciences of Turkmenistan, with related organizations such as Seismic Resistance of Construction Institute, Ministry of Construction, Head Department of Civil Defense, Ministry of Construction, Ministry of Communication, Ashgabat City Municipality. Overall goal in the project is that reliable information on earthquakes in Turkmenistan is timely disseminated to relevant organizations to be utilized for emergency response, and earthquake hazard assessment is conducted for the whole Ashgabat City. Project purpose is the capacity for earthquake observation and earthquake hazard assessment in the project area are improved. Four activities will be conducted to achieve project purpose as shown in table below.

Table 1. Outputs in the Project.

Output 1	Digital real-time earthquake observation system is put into operation.
Output 2	Digital real-time strong motion observation system is put into operation.
Output 3	Calculated hypocenter location, magnitude of earthquake and seismic intensities are determined rapidly.
Output 4	Areal distribution of calculated seismic intensities in pilot project area is estimated by the latest techniques.

PROGRESS TO DATE

As for Output-1, observation stations, instruments for observation, operation, data analysis are studied by interview in

Institute of Seismology as well as by visiting stations, then a baseline report was prepared. Possible observation sites are examined on the map at first, then visits to candidate site were made. Existing stations of Institute of Seismology will be used, however, new observation stations are needed. Several candidates for broadband and velocity seismographs to be introduced are selected and consultation with counterpart is carried out. Broadband seismographs need to be installed on a stable ground, avoiding the influence of temperature change. However, one station cannot avoid installing in the desert. A design plan for the observatory housing in the desert was prepared for this purpose.

As for Output-2, We comprehended the flow of observation points, observation equipment, operation and data analysis by interview, observation of the earthquake observation point and earthquake observation point, and prepared a baseline report. We prepared a draft plan based on a policy to arrange equally in populated areas in the city, consulted with counterpart, conducted field inspections and decided to allocate observation points. Several candidates for strong motion accelerographs to be introduced are proposed and selected instruments for procurement in consultation with counterparts. Design of housing for new station was supported.

As for Output-3, the procedure of observed earthquake waveform data is studied. Waveform data gathered offline to the Institute of Seismology is processed by software developed by the Institute, dealing with four types of information (origin time, location, depth, & magnitude). To record and accumulate the earthquake history, arrival time of the P wave and S wave at each station, origin time, the location and depth of the hypocenter, and magnitude are written in the list, and the IT staff posts it to the electronic data list to include it into a database. Annual report is made using this database.

As for Output 4, Geographical and geological information, expected seismic intensity distribution, seismic intensity data, standard specifications on building and micro zoning, etc. were collected. A total of 13 regular meetings were held by the end of December 2017. During the period when experts were dispatched, discussions were held once every 1 to 2 weeks. Topics include information gathering, ground survey policies, earthquake amplification evaluation method, etc. Experimental drilling using the boring machine of the Seismic Resistant Construction Institute was conducted. Test measurements for the geophysical exploration using TROMINO seismographs owned by Institute of Seismology was also conducted. To procure the geophysical equipment of the S wave velocity of the ground, necessary equipment and their specifications were examined and defined. Four pilot areas in which to calculate areal distribution of seismic intensity and boring sites were selected.

CHALLENGES AND SOLUTIONS

For the installation of new stations, many procedures such as land use permission, construction of new stations, application to install communication lines are required. Such process is complicated and time consuming as it is necessary to proceed in order. Further, real time earthquake observation is composed of observation, data communication, analysis, and dissemination to the end users, thus requires involvement of many organizations and experts to be workable.

In order to establish and utilize earthquake monitoring system, inter-institutional cooperation among organizations is a must from the early stage of the project. To appeal the project, working group within counterpart and related organizations was formed, Joint Coordination Committee was held twice a year, and seminar to promote partnership among stakeholders. Besides, in order to share knowledge, in country training regarding earthquake disaster prevention was made in October 2018.

As Copetdag mountain along Turkmenistan Iran border is a potential source of major earthquake that affects Ashgabat, exchange of scientific knowledge between neighbouring countries is important to improve quality of monitoring as well as exchange of knowledge and common problems.

Observed earthquake data can be used to better respond emergency immediately after an earthquake. However, the data can be used to improve seismic code for building and infrastructure, urban planning, and hazard and risk assessment disaster management plan in the longer term as well. As Sendai Framework for Disaster Risk Reduction puts hazard identification as the first priority action, and the Government of Turkmenistan approved national seismic risk reduction program in 2019, we hope improved earthquake monitoring will contribute to improve seismic safety in Ashgabat.

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