Report on - Outcome of Memorandum of Understanding (MoU) between Commission on Education and Outreach, International Association of Seismology and Physics of the Earth's Interior (CoEO-IASPEI) - an IUGG association with National Science and Technology Center for Disaster Reduction (NCDR), Ministry of Science and Technology (MoST)-Taiwan.

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The above said MoU has come in force from 8th January, 2019. The main goals and missions of the MoU are: 1) Installing a pilot test sensor network in Chukha Dzongkhag (district) for Royal University of Bhutan (RUB) for research and education related geo-hazards; 2) Sharing experience and knowledge of early warning system of earthquake and landslide; 3) Promoting knowledge-based capacity building program through introducing new technology in support of policy and decision making; 4) Enhancing bilateral partnership through an efficient collaboration; and 5) Facilitating joint publish based on outputs of the pilot test.

1. TRAINING

Based on the goals and mission, it has been decided jointly to install 12 Earthquake Early Warning Systems (P-alert) and Rain-gauges in Chukha Dzongkhag (district) and the monitoring instruments will be provided by NCDR under the project 'Joint Scientific Research on Environmental Monitoring'. Before the actual installation process, CoEO-IASPEI has organised a training programme on "Earthquake Early Warning Systems and Rain-gauges for Bhutan" at New Delhi, India from 26-27th November, 2019 (Figure 1-3). The main purpose of the training programme was to train Bhutanese researchers to be well equipped with the installation process of earthquake early warning systems and rain-gauges and how to monitor the equipments after the installation. Four researcher from RUB has attended the training programme.



Figure 1 Training participants (Photo: by the author)



Figure 2 Technical session (Photo: by the author)



Figure 3 In-house practice of installation of EEWS (Photo: by the author)

2. INSTALLATION

A general plot of earthquake data for the period 1937–2000 procured from the National Earthquake Information Center (NEIC) catalog covering the Bhutan region shows many earthquakes in neighbouring countries and some of them are: Nepal (2015), Sikkim (2011), Bihar-Nepal (1934). Due to easy access, less transportation cost and proximity to the Indian side of airport, it was decided to install 12 P-alert and Rain-gauges covering Phuentsholing and Geddu regions under Chukha Dzongkhag (district). The installation work started on 14th of December 2019 and ended by 08th January 2020. The 12 stations are located namely in, IT building at College of Science and Technology (CST), Lhawang Hostel at Reldri, CST Guest House, Thromde (City) Office, Mini Dry Port, Phuentsholing higher secondary school, Phuentsholing General Hospital, Phuentsholing Gewog Office, Chumigthang Central School, Kamji Central School, Gedu College of Business Studies and Pakshikha Central School (Figure 4). All the stations push the data to the server located at CST server room over the Internet. Due to the COVID-19, the team couldn't carry out the maintenance works and some stations are either down or not pushing data to the server.



Figure 4 Location of the instruments installed



(a)

(b)

Figure 5 (a) Installation of P-alert is underway (b)After completion of installation (Photo: by the author)



(a)

(b)

Figure 6 (a-b) Installed rain-gauges in two locations (Photo: by the author)

3. REAL-TIME DATA

The installed P-alert has recorded earthquake activity on dated 08th February 2020 in Mini City Port area just one month after the istallation and same is showing in Figure 7.



Figure 7 Real-time earthquake data recorded by installed P-alert in Mini dry port on 08/02/2020



Figure 8 Real-time heavy rainfall data recorded by installed rain-gauge in Chumithang school on 30/08/2020



Figure 9 The joint team of CoEO-IASPEI and NCDR in Bhutan

Chumithang School Data density : Hour