

Terms of Reference (ToR)

For

Baseline / Feasibility Study for Seismic, Tsunami and Cyclone Hazards along Coast of Sindh and Identification of Suitable Sites for Installation of Multi-Hazard Early Warning System

1. Background

Tsunami the wrath of series of waves have the potential to create large scale multi-definitional short- and long-term damages. Recent tsunamis in Indonesia and Japan which caused havoc were eye opening for rest of the world specially for coastal countries. Though, historical evidence for tsunami along the shores of the Arabian Sea is rare and in cases contradicting, still Makran Subduction Zone (MSZ) near Balochistan coast has the potential to generate large tsunami in the region, as it happened after 8.6 magnitude earthquake of November 1945 which generated tsunami in the region. Record of the event suggest that majority of fatalities happened in villages along or near tidal creeks specially in Indus Delta. Cyclones and tsunami are key hazards to coastal belt of Sindh. Small fisherman villages and towns are scattered along the coast of Sindh and many of them still lack basic communication infrastructure. These villages and towns are extremely vulnerable to coastal hazards when personal notification is the only way of evacuation warnings. Most of these villages do not have landlines, electricity, roads, and mobile phone networks, etc.

Tsunami normally triggered by seismic activity and also by other reasons / activity in ocean likely land sliding etc. In addition to seismic and tsunami, cyclone hazard is also associated with major coastal areas of Sindh Makran. Karachi, the largest city of Pakistan lies 150 km east of the triple junction between the Arabian, Indian and Asian Plates and is surrounded by active faults. Karachi is thus prone to high intensity Tsunami- genic earthquakes and Cyclone threat.

End-to-end Early Warning System (EWS) is one of the key factors in minimizing disaster losses. In modern technological era, prediction development and monitoring of cyclone and tsunami is possible and consequently, dissemination of timely alerts and warning to the communities at risk can be achieved. This project funded by National Disaster Risk Management Fund and Government of Sindh aims to strengthen tsunami and earthquake preparedness in coastal areas of Sindh.

2. Introduction

Tsunami Early Warning System (TEWS) is efficient and viable method to broadcast and disseminate real-time warnings at local level in vulnerable communities. This system is already installed along the coast of Balochistan with technical and financial assistance of Government of Pakistan and UN organizations / INGOs. At site, the system is comprised of siren pole, solar panels, batteries and Seismic Network along with early warning center. The system is controlled by remote command and control center, which in case of Pakistan is National Tsunami and Cyclone Warning Center at Pakistan Meteorological Department, Karachi. This system can be used for multi-hazards EWS with certain additional equipment and associated SOPs for all types of coastal hazards.

Provincial Disaster Management Authority (PDMA), Sindh with the financial assistance of National Disaster Risk Management Fund (NDRMF) and share of Government of Sindh is planning to install TEWS in coastal belt of Sindh in close association of Pakistan Meteorological Department (PMD), PDMA

Balochistan. In initial phase of the project, system is planned to be installed at suitable locations in Korangi, district East & West of Karachi division and districts Thatta, Sajawal & Badin.

Before installation of TEWS, baseline study and survey are required for coastal hazards (particularly tsunami) risk assessment w.r.t. populations and physical infrastructure; and then identification of most feasible and suitable sites for installation of TEWS (Alarms) and equipment. PDMA Sindh invites the services of reputable and experienced consulting firms / companies / organizations to conduct this study.

3. Objectives

The objectives of Baseline / Feasibility Study for Seismic, Tsunami Cyclone Hazards and associated Risk Assessment Coast of Sindh and Identification of Suitable Sites for Installation of Equipment for Seismic monitoring, Tsunami Early Warning and Cyclone storm surge, track, intensity prediction System are:

- a) Hazard Assessment regarding tsunami, cyclone and seismic risks along coastal belt of Sindh;
- b) Risk assessment and mapping and identification of elements at risk in detail (human settlements (including socio-economic), critical physical infrastructure and high loss facilities);
- c) Determine the overall feasibility of the proposed project and evaluate the anticipated impacts;
- d) Zonation (low, medium, high) of coastal belt in Sindh in terms of tsunami, cyclone and seismic hazards following SOPs of PMD / NDMA / relevant international organizations;
- e) Taking detailed historical account, current status and operational analysis of such EWS installed in coastal belt of Pakistan. It also include any ongoing or planned activity as well.
- f) Identification of most suitable sites / alternate sites in close coordination and consensus of PMD for installation of Tsunami & Cyclone Early Warning System in terms of maximum services to the most vulnerable communities, and ensuring sustainability of TEWS sites in multi-hazard environment (cyclones, winds and other weathering effects), for durable and dependable services etc. Later on, TEWS will be handed over to PMD for O&M, therefore, PMD ownership is critical;
- g) Identification of residual (manmade and natural) risks associated with the selected sites.

4. Scope

- i. Risk Assessment and Mapping of 03 Km inland corridor extending from coast of Sindh (entire coast up to Tharparkar district) with the help of high-resolution satellite imageries for detailed land use and land cover with specific emphasis on human settlements and strategic assets with verification of physical survey, Geographic data / maps must be prepared using Survey of Pakistan coordinates.

Risk Assessment and estimation of tsunami, cyclone and seismic risk along coastal belt of Sindh on the basis of documentation of historical events with the help of software simulation modelling and impacts, geological and geophysical knowledge of the sources and of their dynamics, tsunami generation, propagation, Tsunami and Cyclone inundation modelling, the exploration of an expected range of scenarios. (consultation with PMD, National Tsunami Warning Center (NTWC), NDMA (Policy Guidelines for Conduct of MHVRA-2016) UN- ESCAP SOPs on Tsunami, UNESCO Regional Working Group on Tsunami and Japan Metrological Agency (JMA) in order to monitor information on the Indian Ocean. Also consultation with DDMA, Local

NGO's and coastal rural and urban communities' structures, Pakistan Coast Guards / Pak Navy should also be consulted).

- ii. Population / population density mapping within the corridor (based on National Census 2017).
- iii. Infrastructure and housing mapping (high resolution / large scale – 1: 1000 to 1.5000 scale).
- iv. Estimation of seismic, cyclone and tsunami risks using relevant models or previously conducted documented studies on the subject matter (special reference and compatibility be made with Multi-Hazard Risk Assessment of all Districts of Sindh – PDMA, funded by World Bank); and NDMA Policy Guidelines on MHVRA.
- v. Zonation of corridor according to seismic, cyclone and tsunami risk (low, medium, high), following SOPs of PMD / NDMA / relevant international organizations.
- vi. Identification, mapping and analysis of already installed EWS in the past for similar purposes under any organization (whether working or abundant); OR any other similar activity going on in the coastal belt of Pakistan.
- vii. Identification of technically suitable sites / alternate sites for installation of Equipment of Earthquake Monitoring ,Tsunami and Cyclone EWS in terms of optimum benefits, safety and security of site equipment, durable operation-ability and accessibility, in consultation with PMD, as PMD has officially mandate to issue earthquake and Tsunami / cyclone warnings. Moreover, later on, TEWS will be handed over to PMD for O&M.
- viii. Conduct detailed topographic survey of identified sites and surrounding areas for final selection, and installation of Equipment for Earthquake monitoring ,Tsunami and Cyclone EWS including Alarms system.
- ix. Preparation and submission of hard and soft copies of maps, reports and technical details of site (exact location and topographic survey) in GIS (MXDs/shapefile/Package Files with satellite images), AutoCAD formats, (including Physical Survey) etc.
- x. Identification and risk assessment of any adverse impact (Environmental / Social / Gender etc.) due to installation of EWS on the selected sites.

5. Deliverables & Payment Schedule

Sr.	Deliverable	Duration in Months (after signing of contract)	Payment (% of total contract price)
1.	<ul style="list-style-type: none"> • Submission of Inception Report. Inception Report to cover, detailed methodology, detailed project plan, detailed data description, data collection mechanism, study progress monitoring mechanism etc. • Payment for this deliverable is contingent upon acceptance of the Inception Report duly endorsed and signed by the respective authorized person of the Client. 	01 month	20%
2.	<ul style="list-style-type: none"> • Mapping and site selection for sites along coast of Karachi Division (district East and West). • Payment for the deliverable is contingent upon issuance of acceptance letter by the Client for approval of Mapping and sites selection along coast of Karachi Division (district East and West). 	2 months	25%

3.	<ul style="list-style-type: none"> • Mapping and site selection for sites along the coast of Thatta, Sajawal and Badin districts • Submission of clean GIS and Remote Sensing and Auto CAD data in its original formats • Submission of Draft Report. • Payment for the deliverable is contingent upon issuance of acceptance letter by the Client for approval of Mapping and site selection along the coast of Thatta, Sajawal and Badin districts. 	3 months	25%
4.	<ul style="list-style-type: none"> • Submission / approval of complete and Final Report. • Payment for this deliverable is contingent upon acceptance of the Final report duly endorsed and signed by the respective authorized person of the Client. 	4 months	30%
Total Duration		04 Months	

6. Timelines

The total time for the consultancy will be 04 months.

7. Number, Qualifications of Experts and Man-Months

The Consultant should select a team of highly qualified and experienced staff relevant to the assignment. The following will be the minimum technical staff requirement with indicative man-months given / provided against each:

Sr. #.	Staff	Person-months
Key Staff <i>(person month will be applicable after initiation of project / work)</i>		
1	Project Manager / Team Leader [1] Qualification / Experience: Masters or equivalent degree in Disaster Management, Urban and Regional Planning (Hazard Planning), Geography, Environmental Sciences, Engineering, Economics, or closely related field with specific expertise in the field of DRR. Minimum 15 years relevant experience in similar nature projects.	04
2	Seismologist [1] Qualification / Experience: Masters or equivalent degree in Seismology, Earthquake Engineering, Civil / Structural Engineering, or closely related field with specific expertise in seismology. Minimum 07 years relevant experience in similar nature projects.	03

Non-Key Staff <i>(person month will be applicable after initiation of project / work)</i>		
3	Meteorologist [1] Qualification / Experience: Masters or equivalent degree in Meteorology, Geography, Hydrology or closely related field with specific expertise in seismology. Minimum 07 years relevant experience in similar nature projects.	03
4	Technical Officer [1] Qualification / Experience: Masters or equivalent degree in Disaster Management, Urban and Regional Planning, Demography / Population Studies, Geography, GIS & Remote Sensing or closely related field with specific technical expertise. Minimum 07 years relevant experience.	04
Total =		14

8. The Consultant

The Consultant must be registered with Survey of Pakistan (SOP) according to Survey and Mapping Act 2014.

9. Method of Selection

A Consultancy firm, will be selected through 'Quality & Cost Based Selection (QCBS) Method' giving weightage of 80% to Quality & 20% to Cost.
