

Request For Expression of Interest

INDIA

**WORLD BANK AIDED NATIONAL CYCLONE RISK MITIGATION PROJECT- II
(NCRMP-II)**

OF

NATIONAL DISASTER MANAGEMENT AUTHORITY (NDMA)

CREDIT No. IDA-5693-IN

**Selection of Consultant for Development of Dynamic Web Based
Composite Risk Atlas & Decision Support Tool for Cyclone and
Associated Impacts Including Storm Surge & Inland Flooding for 13
Coastal States/UTs**

Reference No. IN-NDMA-8677-CS-QCBS

1. The Government of India received financing from the World Bank toward the cost of the National Cyclone Risk Mitigation Project-II and intends to apply part of the proceeds for consulting services on the subject as mentioned above.
2. The consulting services include developing a Web Based Dynamic Composite Risk Atlas(DCRA) and a Decision Support Tool for cyclone and associated impacts including storm surge and inland flooding for 13 coastal States/UTs of India falling within 10 mtr. elevation from Mean Sea Level (MSL). The duration of the study is 24 months. The study will involve mapping of coastal line depicting cyclone and the storm risk/inland flooding risk which will help communities and infrastructure operators to evaluate their vulnerability and associated risk. The real-time product will take into account the dynamic information from a real –time cyclone(issued by IMD) and estimate the potential flooding scenarios and the products generated shall be used for purpose of evacuation planning and protection of assets. Capability is to be added in web-CRA to work in offline(desktop) mode for updating of exposure database. The scope of work also includes developing impact graphics and standardizing the products in consultation with IMD, NDMA, MHA and other key Government and scientific institutions. The Development phase shall be of 06 months and the Experimental phase will be that of 18 months during which the communication protocol on the products developed, enhanced analytics and

prediction capability will be tested in real time situation. The Consultant shall also provide training and capacity building support on Decision Support Tool to the designated officers of the National and State/UT administration and the Coastal District Administration. In addition, the Consultant shall also be developing a Dynamic CRA App. enabling users to access features of DCRA during hydro-meteorological events, specific to study area through location based technology.

3. The finally selected consultant will be provided with the previously developed deterministic web based Composite Risk Atlas along with procured/available data by the Project Monitoring Unit of NCRMP and will also help in obtaining relevant data from other Government Departments, if required.
4. The Project Monitoring Unit (PMU), National Cyclone Risk Mitigation Project, National Disaster Management Authority now invites eligible consulting firms to indicate their interest in providing the Services. Interested Consultants should provide information demonstrating that they have the required qualifications and relevant experience to perform the Services (in form of brochures, description of similar assignments, past experience in similar services, availability of appropriate skills among staff etc.).
5. Consultants may associate with other firms in the form of a joint venture or a sub-consultant to enhance their qualifications.
6. Consultants may also send their comments on the objectives and scope of the required service.
7. A consulting firm will be selected in accordance with the procedures set out in the “ World Bank Procurement Regulations for IPF Borrowers- Procurement in Investment Project Financing of Goods, Works, Non-consulting & Consulting Services ”, issued in July 2016, which is available on the World Bank website www.worldbank.org/procurement following Quality Cost Based System (QCBS) method.
8. The consulting firms should also indicate information relating to any conflict of interest that they know may impact objective performance and imparting advice for their services.
9. Interested consulting firms may obtain further information on eligibility, pre-qualifications etc. at the address given below between 1000 to 1700 hours on

all working days or at project website www.ncrmp.gov.in or NDMA website www.ndma.gov.in . The Expression of Interest will also be appearing on <https://eprocure.gov.in/cpp> .

- 10.** Expression of Interest must be delivered to the address below by 1700h on 21st July, 2017 through Registered/Speed Post/by Hand in a sealed cover addressed to:-

Project Director
National Cyclone Risk Mitigation Project (NCRMP),
National Disaster Management Authority (NDMA),
NDMA Bhawan, A-I, Safdarjung Enclave,
New Delhi-110029

Tele: . 011-26701749, Fax: 011-26714321

- 11.** The interested consultant firms must provide the following information indicating that they are qualified to perform the required services:-

- (a) The organization shall provide its name, address, facsimile number, e-mail ID and website address.
- (b) The organization shall provide the number of coastal States/UTs in the country in which the firm has branches/offices, giving full addresses of the branches/offices.
- (c) The organization shall furnish information regarding the year wise annual turnover for the last five years. A certificate to this effect from a Chartered Accountant, in original, must be submitted.
- (d) The organization shall also provide details of organizational structure & availability of key staff of the firm with relevant experience in similar projects and their qualifications.
- (e) The organization shall furnish details of relevant Disaster Management and Risk Assessment assignments undertaken during the last five years. A certified copy of the order received for these projects must be submitted.
- (f) The organization shall also provide details of relevant assignments undertaken for large Public Sector/ government organization.
- (g) The organization shall also provide details of relevant assignments undertaken for externally funded projects e.g. World Bank, ADB etc.

- (h) The organization shall provide a copy of valid PAN/TAN number from Income Tax Department.
- (i) An undertaking (Self Certificate) is to be submitted that there has been no outstanding bankruptcy, judgment or pending legal action that could impair operating as a going concern.
- (j) An undertaking (Self Certificate) is to be submitted that the organization has not been blacklisted by any Central/State Government Department/Central Government funded organization/State Government funded Organization/World Bank or other UN agencies and is not under investigation by any Government or UN member country.

12. On the basis of the above mentioned parameters, Expression of Interest shall be evaluated and interested consulting firms shall be shortlisted for Request for Proposal (RfP) stage.

DRAFT TERMS OF REFERENCE

for development of

Dynamic Web Based Composite Risk Atlas and Decision Support Tool for Cyclone and associated impacts including Storm Surge and Inland Flooding under National Cyclone Risk Mitigation Project-II (NCRMP-II)

1. Introduction

India is one of the most densely populated countries in the world with over one billion people and is exposed to a wide range of geological, hydro-meteorological hazards such as cyclones, floods, earthquakes, landslides etc. Approximately 5,700 km of total 7,500 km of coastline is exposed to severe cyclones, and an estimated 40% of total population lives within 100 km of the coast. On an average, one third to one half of the tropical cyclones affecting this region hit the Indian coastline, which is particularly susceptible to storm surge due to effects including shallow coastal bathymetry and tidal characteristics. Low-lying terrain, high population density and limited community capacity makes the population in these coastal States/Union Territories (UTs) extremely vulnerable to the cyclone and storm surge events. In Orissa super cyclone of 1999 killed over 10,000 people and further millions suffered severe physical and financial losses. In subsequent cyclones, Phailin in 2013 and Hudhud in 2014, the death toll reduced significantly because of timely evacuation of a large number of population from risk prone areas. However, the state had to bear significant physical and financial losses.

Along the coastline, storm surge is often the greatest threat to life and property from a cyclone. In the past events, large deaths have resulted from the rise of the ocean associated with many of the major cyclones that have made landfall. 1999 Orissa supercyclone is a prime example of the damage and devastation that was caused by surge. Close to 10,000 persons lost their lives during

the 1999 supercyclone and many of those deaths occurred directly, or indirectly, as a result of storm surge.

Risk assessment and vulnerability studies are underway in several coastal states and it is envisaged to further develop comprehensive decision support system for emergency response and disaster risk mitigation.

2. Background and Context

National Cyclone Risk Mitigation Project (NCRMP) initiated by Government of India takes a view to comprehensive address cyclone risks across the coast. The overall objective of the project is to reduce the vulnerability of coastal communities to cyclone and other hydro meteorological hazards. National Disaster Management Authority (NDMA) under the aegis of Ministry of Home Affairs (MHA) with World Bank assistance is implementing the Project in coordination with participating State Governments.

As part of NCRMP Phase-I, Hazard, Vulnerability and Risk Assessment (HVRA) study has been conducted and a Web-based Composite Risk Atlas (Web-CRA) has been developed having deterministic hazard scenarios that would be used by these States/UTs for mitigation planning. This web-based risk assessment system provides the concerned stakeholders with a comprehensive risk assessment framework that offers cross-cutting decision support for mitigation planning at all levels from Central; Government, State, District, Taluka/Tehsil/Mandal (Taluka), City/Town and Village.

The various components of this study are:

- **Hazard:** The deterministic scenarios cyclone hazard model development consisted of modeling historic cyclonic winds and storm surge using ADCIRC (ADvanced CIRculation) and flooding due to cyclone induced rainfall using HEC tools (HEC HMS, RAS and 2D). These deterministic hazard scenarios are available in Web-CRA as static layers.
- **Exposure:** The exposure data development consisted of inventory of the coastal assets at village and city levels. These are population, buildings (residential, commercial, industrial); cyclone shelters, schools, hospitals, fire stations, police stations, administration headquarters, religious places, heritage buildings; infrastructure elements, such as roads, railway line, airports, ports etc., utilities networks such as communication towers, water and sewerage, electrical lines etc.; ecological assets such as coastal plantation and mangroves. The exposure data of all these exposure elements are available in Web-CRA as dynamic data layers that could be further updated.
- **Vulnerability:** As part of physical vulnerability, a set of physical vulnerability functions are developed for various exposure elements and are available in the web-CRA as dynamic curves that could be further updated.
- **Risk Assessment:** For mitigation planning, the Web-CRA has provisions to estimate risk and generating various exposure and risk assessment reports (detailed and summary) at different administrative levels for decisions making including Hot Spot analysis.
- **The Web-CRA** is based on the GeoNode platform with extension built using python.

Operationally, a risk assessment system is required that caters for both mitigation planning (*static pre-event planning*) and response (*responding to a real-time cyclone- dynamic response*)

needs of cyclone prone States/UTs. A range of products are envisaged as part of this second phase of assessment.

- This initiative will aim to develop national level storm surge inundation maps which in turn will make it clear that the risk extends from the immediate coastline into several kms inland. A coastal line depiction of the cyclone and the storm surge risk / inland flooding risk will help communities and infrastructure operators to evaluate their vulnerability and associated risk. The district administration can make use of these maps to undertake advance planning of evacuation and identification of inland evacuation destinations. It is expected that this study will use a representative sample of hypothetical cyclones to estimate the near-worst case scenario of flooding for each cyclone category (*Cyclonic Storm, Severe Cyclonic Storm, Very Severe Cyclonic Storm, Extremely Cyclonic Severe Storm, Super Cyclone*). The product generated will be used for development planning and emergency preparedness plans.
- Using the past climatology information and exposure database created in the Phase I of the risk assessment, total exposure and event based exposure of the assets can be tracked across the coastline (it shall not suggest or predict future impacts or exposure).
- The coastline contain a large tract of coastal/marine infrastrucure and several ports are in the dircet path of the cyclones. There is also a strong potential for future investment in the coastal areas. It is important to guide the infrastructure planners to benefit knowing the historical exposure to cyclones and plan for reducing existing infrastrucure vulnerabiity ad protection of new assets planned in the near future.
- The real-time product will take into account the dynamic information from a real-time cyclone (*issued by IMD and other global products*) and estimate the potential flooding scenarios and the products generated shall be used for purpose of evacuation planning and protection of assets.

3. Study Area

The study area is coastal Talukas of the States/UT's falling within 10 m elevation from mean-sea level (States: Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal; Union Territory: Dadra and Nagar Haveli, Daman and Diu, Puducherry).

4. Objectives

With the overarching goal of providing a robust scientific and practical basis for assessing qualitative and quantitative risk information for the Coastal States/UTs, the key objective of the study is to:

- Develop probabilistic products for depiction of cyclone risk and storm surge flooding / coastal flooding vulnerability maps for the coastal line of India (not a real-time product)
- Enhance Web-CRA with capability for dynamic risk assessment of an impending cyclone (Web-DCRA)
- Provide specific and quantitative information of the exposure to a real-time cyclone event and generation of information products to support decision making at the State/District and Local level (real-time product, including development of Decision Support Tool)
- Add capability in Web-CRA to work in offline (*desktop*) mode for updating of exposure database
- Develop impact graphics and standardize the products in consultation with IMD, NDMA, MHA and other key Government and Scientific Institutions

- Develop communication protocol on the products developed and enhance the analytics and prediction capability over a period of 18months after development (experimental phase)
- Provide training and capacity building support on the Decision Support Tool to the designated officers of the National and State/UT administration and the Coastal District Administration (during the experimental phase)
- To develop a **DCRA App**. This App. will enable users to access features of DCRA and geological events specific to study area through location based technology. For example, in the event of a hazard it helps people to prepare their family and home, find help, facilities/ evacuation routes and let others know they are safe in the hazard event. Perhaps one of the most comforting features on the App is the “We’re safe” button. At the press of a button this message is sent to anyone entered on your preloaded list of contacts.

Note: The firm engaged for undertaking this initiative will not issue advisories and warnings during the development or the experimental phase. The engagement is meant for developing impact forecast products, decision support tool, establish required protocols for decision making under the guidance of the national weather agencies and disaster management institutions and support the designated national agency (during experimental phase) to formulate the mechanism to issue explicit warnings that could be implemented in the next couple of years.

5. Scope of Services

The scope encompasses development of probabilistic products (not a real-time product) and a real time product for decision making.

Probabilistic Risk Assessment Maps / Products

The scope will include analyzing and improving the probabilistic products for depiction of cyclone risk and storm surge flooding / coastal flooding vulnerability maps for the coastal line of India (not a real-time product). Based on the climatology analysis the service provider will use a representative sample of hypothetical cyclones to estimate the near-worst case scenario of wind-speed information, storm surge and inland flooding for each cyclone category (*Cyclonic Storm, Severe Cyclonic Storm, Very Severe Cyclonic Storm, Extremely Cyclonic Severe Storm, Super Cyclone*). The product generated / outputs will be in the form of maps which shall be used for development planning and emergency preparedness plans.

The potential storm surge and coastal flooding map will map target areas along the east coast and the west coast of India at risk from storm surge during a cyclone event.

The map shall show:

- Cyclone track and related information of key events
- Measure and quantify location exposure to cyclone tracks and wind events
- Geographical areas where inundation from storm surge and coastal flooding could occur
- The potential heights of water above ground could reach in those areas for a given storm intensity and inundation represented by different colors on the map based on the water depth

- Exposure database (population at risk, critical/emergency infrastructure, utilities, marine infrastructure, environmental infrastructure)
- The map generated will be displayed on the website in an interactive map viewer

The preparation of the maps shall take into account:

- Flooding due to storm surge from the ocean and adjoining features of the coast to determine the surge
- Normal astronomical tides
- Topography Data (DEM) / Land elevation
- Historical cyclone track and related characteristics of the events

The preparation of the maps will not take into consideration:

- Wave action
- Freshwater flooding from rainfall
- Riverine discharge
- Overtopping from existing coastal embankments or other structures

Purpose and key audience:

The purpose of this map/decision support tool is to provide information which enables users to make decisions related to demarcation of risk prone areas and protection of life and property from storm surge flooding. The tool can be used to tackle specific ocean challenges, marine infrastructure planning, economic development and undertaking conservation measures. The key audience for use of these maps/products are Government officials at State/District/Local level, State Disaster Response Force (SDRF), Development agencies and communities/general public.

Real-time Decision Support Tool (Web based Dynamic Composite Risk Atlas)

The scope is to determine exposure to a particular category of real-time cyclone event and generate impact forecasting on the coastline and the landfall region (including associated storm surge, rainfall, inland flooding). Modelling will use deterministic approach using single simulation based on accurate meteorological forecast provided by IMD. The model will run based on the information release cycle by IMD and for surge forecast the location and the timing of the cyclone landfall will feed to determine which areas will be inundated by the storm surge. The model will keep a track of the changes in the cyclone path, intensity, size, forward speed and the determined landfall location to generate impact forecasting. The impact forecasting will aim to provide an accurate depiction of the cyclone event and the storm surge / coastal flooding vulnerability. This data will be used by the disaster manager and emergency responders to make evacuation decisions.

The impact forecasting is an event based exercise and will be operational initially in an experimental phase for 18months for cyclone events occurring in Arabian Sea and Bay of Bengal with a potential for landfall along the Indian coastline. The emergency evacuation phase is a short window and for planning purpose the administration would be on a standby or state of readiness prior to T-48 to T-72 hours of landfall. As the event is dynamic, average track errors prior to 72hours is considerable. For decision making purpose the time period of T-24hour and T-48hour window is crucial. A worst case storm surge estimation summarized with local impacts shall be generated for the coastline and the inland areas. The decision-makers will make informed decisions taking into consideration the current forecast limitations.

The map products shall provide a reasonable flooding information at particular landfall location for storm surge. This information products shall be conveyed to the respective institutions for decision making and evacuation.

The decision support system will develop a feedback method to obtain real-time information from the field (ground truth) and compare with the forecast information. This will provide information for technical assessment of the model results and improve the forecast results.

The map shall show:

- Real-time Cyclone track and related information from IMD and other global datasets
- Show exposure database (population at risk, critical/emergency infrastructure, utilities, marine infrastructure, environmental infrastructure)
- Identify geographical areas where inundation from storm surge and coastal flooding could occur
- Map potential heights of water above ground could reach and represent inundation by different colors on the map based on the water depth
- Activate the interactive map viewer platform and display information based on the event onset information release by IMD
- Generate impact / risk map on the interactive map viewer / decision support tools. During the experimental phase, the map shall be made available approximately 120mins following the advisory release by IMD for a potential landfall

The preparation of the maps shall take into account:

- Flooding due to storm surge form the ocean and adjoining features of the coast to determine the surge
- Normal astronomical tides
- Topography Data (DEM) / Land Elevation
- Real-time cyclone track and related characteristics of the event

The preparation of the maps will not take into consideration:

- Local factors that play a crucial role in determining actual surge or flooding impacts (for example, topping of flooding water from embankments or any other structure).

Purpose and key audience:

The purpose of this tool is to provide information which enables users to make decisions related to demarcation of risk prone areas and protection of life and property from storm surge flooding. The key audience for use of these maps/products are trained officers of the Government at various levels, State and District/city Emergency Operations Centre, Disaster Management Authority (State/District/Local), and emergency responders.

In order to undertake the Probabilistic Risk Assessment Maps / Products and development of the Real-time Decision Support Tool (Web based Dynamic Composite Risk Atlas), the following indicative list of activities are envisaged:

- 1. Understanding existing Web-CRA and Models:** The consultant should understand that existing models and risk assessment developed as part of NCRMP Phase-I
- 2. Methodology development:** The consultant should explain the methodology for enhancing the Web-CRA for dynamic computation of cyclone hazard, exposure,

vulnerability and risk. The consultant should also explain the working of the enhanced Web-CRA in offline mode for updating the exposure database. The methodology should consider risk assessment needs at a hierarchy of spatial scales from macro to micro, spanning State/District/Tehsil/ Taluka/Mandal/Village levels.

3. **Hazard and Risk Model Automation and Impact Forecasting:** The Web-CRA should bring in capability for dynamic hazard assessment and referred as a decision making tool. It should take into consideration:
 - Existing model for cyclonic wind, storm surge and rainfall induced flood hazards should be extended for dynamic use
 - Ability to model real time cyclone and associated impacts
 - Process cyclone data and estimate risk and generate information products that is used for deployment of first responders and essential stocks/supplies, staging response and timely evacuation of people
4. **Desktop Version of Web-CRA:** The desktop version of Web-CRA should have capability to work in offline (*desktop*) mode for exposure updating at State/UT local server with provision of auto upload of exposure data once connectivity to the Web-CRA host server is available.
 - Create off-line version of Web-CRA for exposure data updating
 - The offline version should be capable of running on a desktop, if required. Also, the offline version should run in a client server mode with users updating different datasets
 - Ability to sync and upload the updated exposure data to Web-CRA
 - The look and feel of desk-top version should be same as that Web-CRA

Experimental Phase: The development phase is envisaged for a time frame of six-eight months followed by 18months of experimental phase which will take into consideration real-time cyclone risk assessment and related product development, finalizing the interactive map viewer platform, protocol development for warning etc.

5. **Quality Assurance:** An appropriate QA process should be implemented throughout the development process. The enhanced Web-CRA shall undergo a proper testing plan and activities such as system, functional and non-functional testing. The Consultant is required to devise performance test criteria to ensure that the system functions as required in the production environment. The User Acceptance Test (UAT) will be done at the NIC Server at the time of the handing over of fully operational Geonode based enhanced Web-CRA.
6. **Documentation and guidelines:** Produce an updated *Technical User Guide* for the Web-DCRA. The User guide should be simple, practical and easy to understand for system users.
7. **Training and Capacity Building:** In addition the consultant shall also provide technical support to the National, State and District Level agencies through training and capacity building programme.

6. Deliverables & schedule for completion of tasks and services

The consultancy must be completed within 8 months from the date of signing the contract. The schedule for completion of tasks and deliverables is as follows:

No	Deliverables	Timeline w.r.t signing of contract
1	Inception Report	15days
2	Development of probabilistic risk assessment maps/products and display through interactive map viewer	4 months
3	Development of Alpha version of Web-DCRA/Decision Support Tool, DCRA App. Demonstration and Presentation to key stakeholders, draft Technical User Guide	6 months
4	Demonstration of Beta version of Web-DCRA & DCRA App. for User Acceptance Test	8 months
5	Closure Report and fully operational Web-DCRA and offline Desktop version of Web-CRA	8 months
6	Experimental Phase	24 months
7	Training Workshops and capacity building activities (this is an ongoing activity and will get initiated after the development and approval of the Decision Support Tool/Web-DCRA)	24 months

7. Staffing Requirements

The assignment is expected to be implemented by a highly experienced and professionally qualified team. The key experts should have the relevant qualification and experience requirements. The consultant team will consist of the following key experts. In addition, the consultant can include the required support team for software development requirements in order to meet the objectives and scope of services.

S.No	Title and Description	Indicative effort in months
1	<p>Team Leader Post Graduate with minimum 20 yrs experience in a hazard risk assessment field. S/he should have led at least 3 multi-hazard HVRA assignments. S/he should have expertise in hazard models, exposure database, risk assessment, software for disaster risk management along with developing risk atlas. The Team Leader must have proven experience in leading consultancy teams for projects funded by the Multilateral/Bi-lateral agencies, UN agencies, or the Private Sector. S/he must have experience of working on national and international assignments</p>	6
2	<p>Deputy Team Leader Post Graduate with minimum 15 yrs experience in a hazard risk assessment field. S/he should have led at least 3 multi-hazard HVRA assignments. S/he should have expertise in disaster risk management. The Deputy Team Leader must have proven experience in leading consultancy teams for projects funded by the Multilateral/Bi-lateral agencies, UN agencies, or the Private Sector. S/he must have experience of working on national and international assignments</p>	2

3	Hydrologist/Flood Risk Modeler Advanced/ Post Graduate degree in Hydrology related subject, and at least 15 years experience in flood hazard assessment/ modeling and customizing flood models for automation. S/he must have experience of carrying out similar assignments.	3
4	Modelling Expert (specialization in Cyclonic Wind and Storm Surge Risk Modelling) Advanced/ Post Graduate degree in oceanography / geophysics related subject, and at least 15 years' experience in cyclone hazard assessment studies. S/he must have experience of carrying out similar assignments	3
5	GIS Expert Post Graduate in Geology or GIS or related field and atleast minimum 10 years' experience in all aspects of Remote Sensing and GIS related database development for hazard and exposure data. S/he must have experience of carrying out similar assignments.	6
6	IT Expert (software development) - 2 persons Graduate in Computer Science/IT with at least 5 yrs exp in design and development of web-based software with specific experience of developing risk atlas with Geonode. S/he must have experience of carrying out similar assignments.	6 x 2 = 12
7	QA Engineer Graduate in Computer Science/IT with at least 5 yrs exp in QA of web-based software applications. S/he must have experience of carrying out similar assignments.	4
	Total	36

8. Project Management and Communications

The consultant will be reporting to the PMU of the NCRMP at NDMA. This is an ongoing task, in which the status of the project shall be communicated to project management, other key stakeholders through quarterly brief progress reports (10-15 pages) by the consultant and specific meetings as needed with the consultant This task also includes ongoing project management, including preparation of a project work plan following project initiation, quarterly written project management reports etc.

