

## **Statement of Intent between the National Oceanic and Atmospheric Administration (NOAA) Department of Commerce of the United States of America and the Earth System Science Organization (ESSO), Ministry of Earth Sciences (MoES), Republic of India**

This text constitutes a Statement of Intent (Statement) developed pursuant to Article IV of the Memorandum of Understanding between the Government of India and the Government of the United States of America on Technical Cooperation in Earth Observations and Earth Sciences.

### **I. Purpose**

This Statement provides a framework for collaboration between the Earth System Science Organization (ESSO) Ministry of Earth Sciences (MoES), Republic of India and the National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, of the United States of America (USA) (hereinafter, "Participants") regarding research into marine fisheries and harmful algal blooms leading to improvements in forecast systems. While intended to serve as a vehicle for a long-term collaboration, it is being implemented for an initial three-year period.

### **II. Objectives**

Small pelagic fishes like oil-sardines, Indian mackerels and anchovies contribute almost 55% of the marine fish catch from the South East Arabian Sea – an upwelling system off the southwest coast of India. Though interannual variations in stock size are expected, the fishery of late has been showing marked changes in distribution, for reasons not fully understood. Taking into consideration, the economic and nutritional dependence of a vast population on this fishery, it is important to achieve better short-term predictability of the fishery through modelling efforts. Short-term Prediction of Sardines, Anchovies and Mackerels (STEP-SAM) is a step forward in this direction. Similarly, increasing frequency and extent of Harmful Algal Blooms (HABs) in the coastal and oceanic areas of the Indian Exclusive Economic Zone (EEZ) are a cause of concern, as it disrupts biogeochemical cycles and possibly enhances the spread of Oxygen Minimum Zones (OMZ) which in turn affects marine ecosystem processes such as energy flow and prey availability for mid and upper trophic predators. It is therefore necessary to strengthen our understanding of HAB formation, propagation and the influence of environmental conditions favouring their production. Further we need to understand regional HAB variations due to environmental/oceanographic and climate changes using a combination of *in situ* observations, laboratory analysis and modelling efforts.

**The two initial objectives of this collaborative agreement are:**

- **Improve the short-term prediction of sardine, mackerel and anchovies of the southeast Arabian Sea.**
- **Develop HAB monitoring and prediction System (HAMPS) for the Indian EEZ.**

### III. Context

Recognizing the importance of scientific and technical cooperation in earth observations and sciences, a Memorandum of Understanding (MoU) was signed by the Ministry of Earth Sciences (MoES), Government of India and the National Oceanic and Atmospheric Administration (NOAA), Government of United States on the 16<sup>th</sup> of April 2008 under the broad umbrella Agreement of 2005 on Science and Technology between the two countries. The MoU is an enabling mechanism for undertaking joint activities by the two countries to use combined scientific and technical skills in enhancing the observations of the Earth and use the information most effectively for the benefit of the society.

The National Marine Fisheries Services (NMFS), NOAA and the Centre for Marine Living Resources and Ecology (CMLRE) / Indian National Centre for Ocean Information Services (INCOIS), MoES, have common interest in improving assessment and prediction of marine fishery resources and HABs. Both Participants have also recognized the scope for undertaking long-term collaborative research in other areas of mutual interest namely fish and cetacean bioacoustics, fish and cetacean stock-assessments and development of multi-species ecosystem models at a later date.

The MoES centres CMLRE and INCOIS are pursuing development and fine tuning of short-term prediction systems on coastal pelagic fishery of the South East Arabian Sea (SEAS) - an upwelling system off the south-west coast of India, operational dissemination of Potential Fishing Zone (PFZ) advisories and in understanding the biology and dynamics of HABs with a view to develop species specific retrieval algorithms and models on HABs. NMFS has operational statistical models for predicting the abundance and distribution of salmon in the coastal upwelling ecosystem off the Pacific Northwest of the USA, process models to test ecosystem responses, biophysical models to relate plankton production to ocean circulation and also uses full ecosystem models to track ecological interactions from phytoplankton to top predators. NMFS also has experience and expertise in the management of the small pelagic fishes, including sardine, in the California Current on the West Coast of the USA.

Further, India has a national programme on monitoring and surveillance of HABs coordinated by the CMLRE wherein several national agencies are involved in addressing specific issues related to HABs viz; CMLRE (open ocean HAB dynamics), Cochin University of Science and Technology (Coastal HABs along South West coast and HAB culture), Kerala University (HAB cysts), Central Institute of Fisheries Technology (HAB toxicology), Indian Institute of Science, Education and research, Kolkata (coastal HABs of North East), Annamalai University (coastal HABs of South East), Goa University (coastal HABs of North West) and INCOIS (HAB retrieval algorithms and HAB modelling). NMFS has adopted an integrated approach using cell based monitoring and detection, cell culture to confirm optical signatures and toxin testing in conjunction with satellite technologies. This approach is now being considered for adoption in several member countries of North Pacific Marine Science organization (PICES).

The present plan of cooperation involving NMFS scientists and scientists from CMLRE and INCOIS enables specific research and operational initiatives on (i) short-term prediction of the coastal pelagic fishery of SEAS (ii) fine tuning of PFZ advisories and (iii) development of early warning systems on HABs through an integrated approach of *in-situ* observations, satellite oceanography and modelling efforts.

#### **IV. Area of Cooperative Activities**

This Statement includes activities such as enhanced cooperation and sharing of information, observations, and models with the intent of contributing to the following items identified in the scope of cooperative activities contained in the broader MoES -NOAA MoU :

- Support in terms of technology and expertise from NOAA to MoES on:
  - Survey design and statistical models for short-term prediction of the abundance and distribution of small pelagic fishes.
  - Refining PFZ advisory for species specific forecasts.
  - Developing early warning systems on HABs.
    - Indian scientists intend to participate in research and development of regional, species-specific models by integrating observational data, both *in-situ* and satellite derived, and culture/capture data adopting the models and concepts developed by NOAA-NMFS and fine tuning of models to operational state.
    - Both Indian and USA scientists intend to jointly document their research findings from these projects with joint publications in peer reviewed journals or through technical reports.

#### **V. Coordination of Joint Activities**

Overall coordination of the joint activities is the responsibility of the Director of NMFS Office of Science and Technology and the Program Office at Ministry of Earth Sciences.

#### **VI. Responsibilities of the Participants**

A. NOAA intends to transfer technology and share the expertise on:

- Survey design and statistical forecast models on the abundance and distribution of small pelagic fishes and biophysical models to relate plankton production to physical ocean dynamics.
- Lessons-learned from the sardine fishery management in the California Current.

- Improving PFZ advisories and developing species-specific fishing zone forecasts.
- Developing early warning systems on regional HABs.

**B. Ministry of Earth Sciences intends to:**

- Organise surveys and participate in joint Research and Development (R&D) related to utilization of statistical forecast models to explain inter annual variations in the sardine, mackerel and anchovy fishery of SEAS.
- Collaborate with NMFS scientists to test the biophysical models to relate the plankton production of SEAS to physical ocean circulation through a combination of in-situ and remotely sensed data.
- Conduct R&D to refine PFZs and develop species-specific advisories.
- Conduct field experiments, culture techniques and collect observational data to develop early warning systems on the HABs from Indian EEZ.
- Conduct planning workshops for the testing and operationalization of the models developed.

**C. The Participants intend to:**

- Promote the development of an operational short-term forecast model on the coastal pelagic fishery of SEAS.
- Test and refine the biophysical models on plankton production in varying ecosystems.
- Promote collaborative work towards refining the PFZ advisories and developing species-specific forecasts.
- Develop early warning systems on regional HABs and promoting R&D on possible mitigation measures.
- Share data and results of data analysis and jointly publish papers in the refereed literature.
- Encourage interaction and coordination with other collaborative efforts under the MoES-NOAA Partnership where synergies exist.
- Consider long-term collaborative research in other areas such as fish and cetacean stock-assessments, bioacoustics and multi-species ecosystem models.
- NOAA scientists and MoES scientists intend to meet at least every other year to plan joint research projects and discuss research initiatives and application of data.
- NOAA and MoES intend to separately cover travel costs associated with exchange visits for their respective technical and scientific personnel.

- The transfer of unclassified export-controlled information or equipment between the Participants is to be done in accordance with the relevant laws and regulations of each Participant. If either Participant deems it necessary, the Participants intend to incorporate detailed provisions for the prevention of unauthorized transfer or retransfer of such information or equipment into this Statement. The Participants intend to develop appropriate working partnerships with national research and development groups and academic institutions.
- The Participants are responsible for coordinating and engaging with other organizational entities in their own countries, as appropriate and necessary, for the completion of the tasks designated pursuant to this Statement.
- There shall be no exchange of funds between the Participants of this Statement, unless otherwise agreed. Each Participant is to provide staff, facilities, and other support necessary for implementation of this project as mutually determined by the Participants. Such support is to be subject to the availability of appropriated funds and personnel and in accordance with the laws and regulations of its respective country.
- The participants do not intend this Statement to be legally binding under International Law. To the extent any of the provisions of this Statement are considered to be obligations, the participants do not intend them to be subject to international law.

The responsibilities of the Participants may include:

- Management and coordination of activities planned under the auspices of this Statement;
- Designation of appropriate officials to manage and coordinate joint activities; and
- Provision of all necessary arrangements to facilitate entry to, and exit from, its country of the personnel and equipment of the other Participant that are engaged in or used in projects under this Statement.

Each Participant is responsible for the customs clearance, at no cost to the other Participant, of items received at customs points of entry which it has shipped to fulfil its responsibilities for scientific cooperation under this Statement.

#### D. Deliverables

This Statement intends to deliver forecast models on the coastal pelagic fishery of SEAS, species-specific PFZ advisories and an early warning system on HABs.

E. The working-level contacts for this Statement are:

For India: Dr. V. N. Sanjeevan

Director,

Centre for Marine Living Resources and Ecology (CMLRE)

6th Floor, C-Block, Kendriya Bhavan

Kochi - 682 037, INDIA

E-Mail: sanjeevanmoes@gmail.com

Phone : +91-484-2427738

+91-484-2423582

For USA: Dr. Ned Cyr

Director

NMFS Office of Science and Technology

1315 East-West Highway

Silver Spring, MD 20910, USA

E-mail: ned.cyr@noaa.gov

Phone: +1-301-427-8123

#### **VII. Review and Monitoring Mechanism**

The working level contacts for both the countries expect to submit their annual progress report to the respective internal review committee pertaining to MoES & NOAA. The Indo-US joint Committee intends to periodically review this Statement at least once a year to determine whether it should be amended, renewed, or cancelled and suggest any directional change if required.

#### **VIII. Amendments, Suspension and Termination of the Statement**

This Statement will come into operation upon its signature by both Participants. The activities carried out under the Statement are to terminate three years thereafter, but may be amended or extended by mutual written consent of the Participants. The Participants intend to review this Statement at least once a year to determine whether it should be amended, renewed, or cancelled. Either Participant may terminate this Statement by providing 60 days written notice to the other Participant. In the event this Statement is terminated, each Participant is solely responsible for the payment of any expenses it has incurred.

**IX. Nodal Agencies and Principal Investigators:**

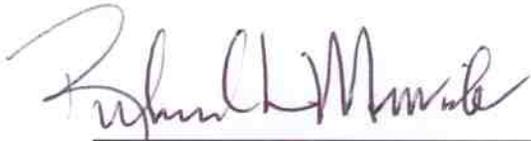
**India**

P.I.: Dr. V.N.Sanjeevan, Director, CMLRE (Fishery)  
P.I.: Dr. Srinivasa Kumar, Group Head, INCOIS (HAB)  
Co-P.I.: Dr. M.Nagaraja Kumar, INCOIS (Fishery)  
Co-P.I.: Dr. Anil Kumar Vijayan, Scientist, CMLRE (HAB)

**USA**

P.I.: Dr. Cisco Werner, SWFSC, NOAA (Fishery)  
P.I.: Dr. Vera Trainer, NWC, NOAA (HAB)  
Co-P.I.: Dr. Bill Peterson, NWFSC (Fishery)  
Co-PI.: Dr. John Stein, NWFSC (Fishery, HAB)

FOR THE NATIONAL OCEANIC AND  
ATMOSPHERIC ADMINISTRATION,  
UNITED STATES OF AMERICA



Dr. Richard L. Merrick  
Director, Scientific Programs and Chief  
Science Advisor, National Marine Fisheries  
Service, National Oceanic and Atmospheric  
Administration, United States of America

FOR THE MINISTRY OF EARTH  
SCIENCES, REPUBLIC OF INDIA



Dr. S.K. Das  
Scientific Secretary, Earth System  
Science Organization, Ministry of  
Earth Sciences, Government of India

DATE: 16 Aug 2013  
PLACE: Silver Spring, MD

DATE: 16 Aug 2013  
PLACE: New Delhi