Preface

Charting a new course for the oceans

What is the role of oceans in shaping our future and ensuring sustainability of the planet Earth? We know that life originated in the ocean almost three billion years earlier than on land which means that oceans make the planet Earth habitable. We need to focus our attention on 'oceans' as they control weather, climate and hazards, provide us energy, food and mineral resources as well as an ecosystem to survive.

Hence, the agenda for the country includes exploration of oceans for resources, discovery of new ocean phenomena, understanding oceanic processes and their interaction with anthropogenic activities and application of this knowledge for sustainability of oceans and building services for humanity. In this regard, the MoES–National Institute of Ocean Technology (NIOT) has contributed significantly during the last 25 years. NIOT's commitment and dedication for indigenous development of technology for ocean observations, survey and exploration of mineral resources, renewable energy, harnessing freshwater from ocean, marine biotechnology, coastal engineering, and related areas have been praiseworthy.

The Indian Ocean has been poorly observed. The efforts put in by NIOT have strengthened and sustained the ocean observations and have facilitated the understanding of oceanic processes and air–sea interaction especially seasonal monsoon variability and frequency and intensity of cyclones. Indigenous efforts to develop moored buoys, tsunami buoys, tide gauges, floats, drifters, etc. having INSAT-based communication system have been exemplary. Moored buoys have been providing data for the upper ocean and atmosphere which have proved to be useful in understanding the response of the upper ocean, especially during cyclones. Such an indigenously developed Mooring System has been successfully deployed in the Arctic Sea and it is being planned to establish similar systems in the Southern Ocean as well. HF radar data, available for more than a decade have provided new insight into coastal circulation patterns. The drifter buoys having INSAT communications have provided high-resolution temporal data sets on ocean currents and large numbers of such drifters should be deployed in the coming years. The deployment of tsunami buoys has ensured our readiness to a face tsunami. The ocean and coastal research vessels have provided much needed high-resolution data to understand the oceans. A large volume of data has been organized around GIS as the Ocean Data and Information System (ODIS). This end-to-end system has matured as a prime vehicle to provide advisory services such as potential fishing zone, ocean state forecast, tsunami, coral reef alert and various ocean parameters to many stakeholders.

Ocean resources, both living and non-living resources, in our Exclusive Economic Zone (EEZ) and high seas, are vital for our economy. Various technologies have been developed to explore mineral resources, such as *in-situ* soil tester, remotely operable vehicle, autonomous coring machine, autonomous vehicles and mining equipment. Remotely operable vehicle (ROV) has high-resolution video imaging systems, scientific payloads and multi-beam sonar and can operate up to 6000 m depth. A small ROV for polar climate has been made as well. These ROVs have provided new information on sea bed characteristics as well as marine life, both fauna and flora, which were hitherto unknown. Deep water wire-line autonomous coring machine for obtaining cores up to 100 m especially to collect gas hydrates samples with custom built *in-situ* pressure core sampler has also been tested successfully. A mining machine to harvest poly-metallic nodules is under development. The remotely operable soil tester (ROSIS) can measure soil properties at 5500 m depth. The development of human-occupied vehicles is critical for exploring sea bed. The designing of such a submersible has been initiated.

While developing deep water technologies, an acoustic positioning system which facilitates deep sea positioning and tracking, wide-band transducers, etc. are critical. Several ambient noise measurements and techniques like vector sensor arrays are being developed for underwater surveillance system. Wide-band transducers have been providing information on bottom-profiling and buried object detection.

Mariculture is one of the promising avenues for increasing marine fish production. Cage culture for fattening lobsters and mud crabs has been developed. The adoption of these technologies by fishermen is expected to increase their earnings. Many marine fauna and flora have bio-active properties. Many deep cores have been examined to isolate deep sea bacteria having anti-microbial peptides having potential to produce novel bio-active molecules.

Water is scarce in many coastal regions of India and in the Lakshadweep Islands. Freshwater from sea is an attractive solution. A Low Temperature Thermal Desalination, developed by NIOT, an environment-friendly technology that utilizes natural ocean thermal gradient, has been providing drinking water to Lakshadweep Islands. Water-borne diseases have reduced considerably on the Islands, wherever these plants have been set up. Similar plant for 2 million litres/day is being set up at the Tuticorin Power Plant using the condenser reject waste heat. The performance of such plants is being improved by studying behaviour of non-condensable gases. This technology is being now scaled up to a 10 million litres/day offshore plant in deep waters. The challenge is

to design a suitable seawater intake system and an appropriate ocean platform. To this end, studies related to nonlinear behaviour of the floating and mooring components for such offshore plants have been undertaken.

India is one of the largest consumers of fossil fuel, however, indigenous production is only 30% of requirement. The ocean is also a storehouse of energy and likely sources include wave, wind, tide and thermal energy. Hence, NIOT has been addressing developing technologies for harnessing wave energy through floating wave powered devices, offshore wind turbines, ocean currents and ocean thermal energy. Attempts are being made with the help of computer simulations, model studies in towing tanks and open sea trials towards development of suitable wave and hydrokinetic turbines. Marine microalgae with efficiency to utilize carbon dioxide and potential to yield higher oil production per hectare compared to land crops is promising as a source of renewable energy. Experimental mass culture systems developed have yielded encouraging results.

The coastal zone is being utilized for creating port and shipping infrastructure for tourism and fishery while ensuring conservation of ecosystem. At the same time, large tracts of the Indian coast are under severe erosion. Information on waves, tides and currents is critical for all coastal engineering projects. A wave atlas has been created for the entire Indian coast based on wave data and modelling. Innovative techniques have been developed, such as artificial reef and beach nourishment for restoring beaches.

The research vessels, both for coastal and deep sea research, have played a vital role in all tasks. Continuous efforts are being made to enhance the performance of all the NIOT vessels.

This special section showcases some of the major technological and engineering issues addressed for designing offshore structures, underwater vehicles for deep sea research, ocean observations, coastal engineering, etc. The investments made in NIOT towards stewardship of oceans shall pay dividends for generations to come. I am sure, that at this juncture when the Silver Jubilee has been completed, the leadership and members of ESSO–NIOT have renewed their commitment to chart a course to ensure sustainability of coasts and oceans for the benefit of mankind.

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