OCEAN MATTERS!

The oceans are vast reservoirs of resources, and various research and development projects under the Union Ministry of Earth Sciences are tapping their potential. From desalination plants to deep-sea mining, the oceans could be our cornucopia of the future.

On the picturesque island of degrees in Lakshadweep, a filtration plant on a small plot of land is bringing joy...and precious fresh water to the people. Fresh water is a commodity that is scarce on these beautiful islands, so this desalination plant, along with two other similar plants on the islands of Kavaratti and Agatti, were set up under a flagship Drinking Water Programme of the Ministry of Earth Sciences (MoES), Government of India, through its National Institute of Ocean Technology (NIOT). Today, these desalination plants are being managed by local communities. "This is an ideal situation, because we want the local community which benefits from such projects to be able to manage them," says Dr Shailesh Nayak, secretary, Ministry of Earth Sciences.

This is only one of the many programmes initiated by the MoES, Government of India, established in 2006 by bringing the meteorological agencies and ocean development department under one umbrella. This was done considering the importance of the ocean atmosphere and its impact on every aspect of the weather, as also its vast, hitherto untapped potential to provide resources and raw materials for the future. The MoES mandate is to emerge as a knowledge and information technology enterprise, enhancing technology to procure better information which in turn will serve the citizens. Bringing these together has enabled the various agencies working under it to issue weather advisory specific to agriculture, monsoon, shipping, sports, disasters (cyclone, earthquake, tsunami, sea-level rise), living and non-living resources (fishery, poly-metallic nodules and gas hydrates), climate change, coastal and marine ecosystems for the benefit of the people. While on the one hand it is encouraging expensive and long-term research and development of technology like the recently tested Remotely Operable Vehicle (ROV), exploring never-seen-before depths of the sea to both study and tap them, on the other, it is encouraging its scientists to work on small community-based models that can both benefit and be managed by the community —much like the desalination plant projects in regions where fresh water is scarce and the vast seas provide both an economically and environmentally viable option for such plants.

This indigenously developed desalination plant at Lakshadweep has thus set a precedent. There are some aspects of these plants that are noteworthy. One, they do not produce the undesirable waste of concentrated brine. Two, they don't use polluting chemicals. And three, they are low on power consumption.

HOW WAS THIS ACHIEVED?

While large-scale desalination typically uses extremely large amounts of energy as well as specialised, expensive infrastructure, making it very costly compared to the use of fresh water from rivers or groundwater, the desalination plants at Lakshadweep use technology that is both economically viable and efficient. These plants follow the low temperature thermal desalination (LTTD) process. This makes use of the availability of a temperature gradient between two water bodies, or flows, to evaporate the warmer water at low pressure and condense the resultant vapour with the colder water to obtain freshwater. The temperature of the ocean varies at different depths, and being an island, the required temperature gradient of 15 degrees C was available at about 600 metres from the shore, at a depth of 350 metres (the water was 12 degrees C at this depth, while it was 28 degrees C at the surface). This provided the scientists at NIOT with the perfect scenario of temperature gradient. The plants draw cold water from the depth of the sea, and the waste water that is generated is neither polluted nor is it highly saline, making it perfectly safe to be pumped back into the sea!

Not only has the project brought fresh water to the population of over 3,000 living on these islands, it has also seen a drop in the cases of water-borne diseases like hepatitis, diarrhoea, dysentery and cholera!

This is only one of the many ways in which the various agencies under the MoES are tapping the vast potential of the oceans. While desalination plants are best suited for islands, since they offer the temperature gradient, which is not available on the mainland coast as one will have to venture further into the ocean, one never knows what newer and viable solutions oceanography has to offer in the future. As Dr Nayak says, "Eventually, as our land resources dry up and are fast consumed, we will have to tap our oceans."

A similar plant is also being run in Chennai. In this case, to create the temperature gradient, the scientists

THE VARIOUS UNITS, RESEARCH ORGANISATIONS AND INFORMATION AND OTHER SERVICE PROVIDERS UNDER THE MINISTRY OF EARTH SCIENCES ARE:

- India Meteorological Department (IMD),
- National Centre for Medium Range Weather Forecasting (NCMRWF),
- Indian Institute of Tropical Meteorology (IITM) Pune,
- Earthquake Risk Evaluation Centre (EREC) under the Atmospheric Sciences and Seismology sector;
- National Institute of Ocean Technology (NIOT) Chennai,
- National Centre for Antarctic & Ocean Research (NCAOR) Goa,
- Indian National Centre for Ocean Information Services (INCOIS) Hyderabad,
- Integrated Coastal and Marine Area Management Project Directorate (ICMAM-PD) Chennai,
- Centre for Marine Living Resources & Ecology (CMLRE) Kochi

used the warm water discharged by the condensers of power plants. It is an effective way of using the heat available in the condenser-reject water: it reduces the load on the cooling towers and the subsequent thermal pollution when this water is discharged into the surrounding environment. This concept is workable in thermal power plants located near the coast.

In their current form, these desalination projects are ideal only for smaller population, and may not address our growing need for water.

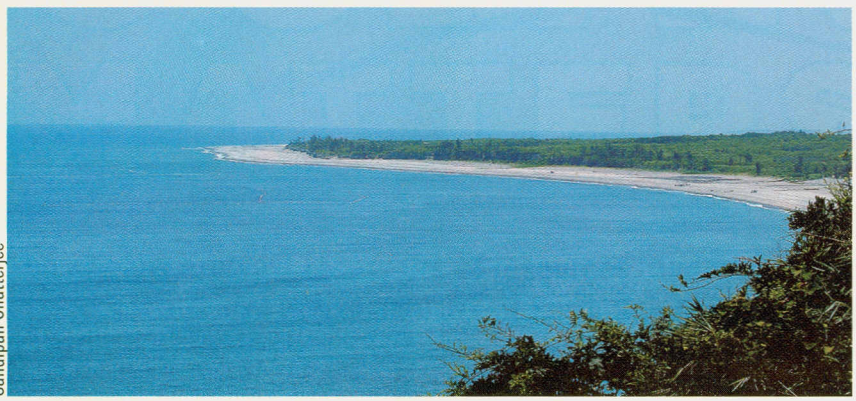
THE DEEP SEA DIVER

Science and technology are helping us understand and utilise the vast potential of the oceans better. Yet, there are several uncharted territories. Last year, a 2.53 metres long, 3,700 kg heavy unmanned Remotely Operable Vehicle (ROV) named ROSUB-6000 plunged into the sea, diving to a depth of 6,000 metres (6 km) to explore these never-seen-before ocean systems. Developed by the NIOT, Chennai, under the Ministry of Earth Sciences, in association with Experimental Design Bureau of Oceanological Engineering, Russia, the ROV opened up an absolutely untouched expanse for the exploration of oceans in India.

WHAT LIES BENEATH?

Oceans, which cover over 71 per cent of the earth, are abundant storehouses of both living and non-living resources. As we consume our land resources at an alarming rate, mankind will eventually have to learn to harness the potential of the seas. To meet future demands, a programme to harness these resources from the oceans was initiated in the 1980s, by the Department of Ocean Development (now MoES, Government of India). As part of technology development to explore these depths of the oceans, the ROV concept was initiated at NIOT in the year 2002. The ROV now enables scientists to make detailed observations of the sea floor, and support future exploration and exploitation strategies.

The ROVs can work under deep sea conditions and perform exploratory and maintenance activities, and through its findings, support the offshore mining and oil and gas industry. These under water robots allow the vehicle's operator to remain in a comfortable environment on the surface, while the ROV is deep in the ocean. It is connected to a control van and the operators on the surface by an umbilical cable, a handling and launch system and power supply. The cable carries the power and command and control signals to the vehicle and sends the status and sensory data back to the operator on



Sandipan Chatterjee

SEA OF INFORMATION

These are some of the many other programmes being run under the various departments of the MoES

POTENTIAL FISHING ZONE

The Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, creates Potential Fishing Zone (PFZ) advisories for use of the fishing community. Traditionally, basic knowledge of currents, upwelling areas, eddies and thermal fronts have been used to asses these zones. Now INCOIS uses Remote Sensing observations and satellite technology for wide spatial coverage with repetivity at short intervals to forecast PFZ information. Sea Surface Temperature (SST) and chlorophyll over the Arabian Sea and Bay of Bengal retrieved from thermal infrared channels and optical bands are used for identifying PFZ along the Indian coastline and island regimes. Multi-lingual PFZ Advisories are generated by INCOIS, every Monday, Wednesday and Friday and flashed to about 500 fish landing centres / fishing villages covering the entire coast line of India. These include the states of Gujarat, Maharastra, Karnataka, Goa, Kerala, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal, Lakshadweep Islands, Andaman Islands and Nicobar Islands. Telephones, fax, e-mail, website, Doordarshan, radio and local news media are used to disseminate the information. Electronic Display Boards flash the advisories at major fishing harbours.

TSUNAMI EARLY WARNING SYSTEM

A state-of-the-art tsunami warning system now forewarns of an impending disaster in less than 10 minutes of an occurrence of an earthquake. The National Tsunami Early Warning Centre (NTEWC) managed by INCOIS is operated 24X7. So this ensures that the warning of a possibility of tsunami is given out ahead of it actually hitting the coast, allowing people to evacuate ad take necessary precaution. A network of seismometers, data buoys, tide gauges have been employed for receiving real-time data for generation and issue of tsunami alert. Data from roughly 329 seismic stations (27 national and 302

ROSUB-6000 being launched from the *TDV Sagar Nidhi* in the Central Indian Ocean Basin

the surface. The Remotely Operated Submersible (ROSUB) is equipped with multifunctional tools and sensors for offshore applications and is rated for operations at the depth of up to 6,000 metres. It is fitted with a five-function robotic arm, used to accurately position the ROV by holding on to a support, and a seven-function manipulator is then used to perform assigned tasks. The manipulator has a number of joints, a rotating wrist and a hand-like claw.

Last April, atop the Sagar Nidhi that sailed off from the Mangalore coast, scientists tested the ROSUB, deploying it for exploration in the Central Indian Ocean Basin, which is about 2,000 km south of Kanyakumari. Following the successful trial, Dr Atmanand, director of NIOT, said, "This is the first time any ROV has gone beyond the depth of 5,000 metres in the Central Indian Ocean Basin."

The trials were a major success as all the systems of the ROSUB-6000 were found to be in full working condition below 5,000 metres depth, where it's pitch dark and an immense pressure of 500-550 bars is experienced.

BENEFITS

ROVs include multifunctional tools and sensors for offshore applications, deep ocean mineral exploration, pipeline routing, submarine cabling, among others. Of late, they are also being used for maintenance and repair activities offshore. ROSUB 6000 has been specifically developed for deep ocean exploration of polymetallic nodules in the Central Indian Ocean Basin, gas hydrates in the Bay of Bengal and hydrothermal vents in the Arabian Sea. Many Indian companies involved in offshore mining are emphasising on the acquisition of this kind of technology for their specific requirements. While it took six years to develop this vehicle from design to deepwater qualification sea trial, with its successful trials, ROVs can be built in about two years, depending on the user's needs, say the scientists. •

international) is received and processed. Further, INCOIS has been receiving data from 60 international tide gauge stations in the Indian Ocean in real-time. The early warning system monitors potential tsunamigenic earthquakes, sea level propagation of tsunami waves in the ocean, and consequent sea-level changes. This centre has been recognised as a Regional Tsunami Watch Provider for the Indian Ocean Region and started operation of Level-1 services to the Indian Ocean Rim countries.

CENSUS FOR MARINE LIFE

The MoES implements research and development programmes to understand the productivity of ocean life. One of the important tasks under this is also to ensure the health of the oceans and its various living and non-living resources. The Census for Marine Life documented 43,000 species in the entire Indian Ocean region. It studied the oceanic biological and geographical systems. When these systems are routinely monitored, they provide clues into the changes, how and why they happen and affect the marine ecosystems, whether these are linked to the sea surface temperature etc.

A programme under the MoES also monitors the health of our ecological heritage, the coral reefs, how they are affected by the activities in the ocean, climate change and pollution among other factors.

Along with this, several projects also monitor the health of coastal seas, which is necessary to assess the status of pollution, detect radical changes of pollutants to alert the government and public institutions of their implications. Data on 25 environmental parameters, including physical, chemical, biological and microbiological characteristics of water and sediment at about 76 locations are being collected with the help of seven R&D institutions in the 0 to 10 km sector of India's coast.

Other projects being run by the MoES include Ornamental Fish Culture run in Agatti island of Lakshadweep for captive breeding of marine ornamental fishes and transfer of technology to the islanders. This will help in enhancing livelihood of the people and protect marine biodiversity. Analysis of over 13,000 marine samples for bioactive compounds to develop drugs is also being carried out in the various research institutes under the ministry.