Blue Economy :

Opportunities and sustainable concern

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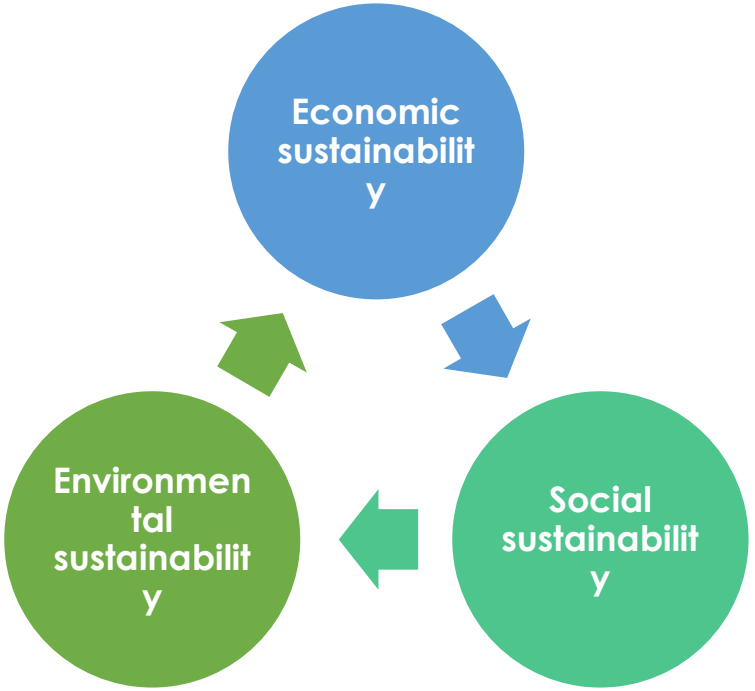
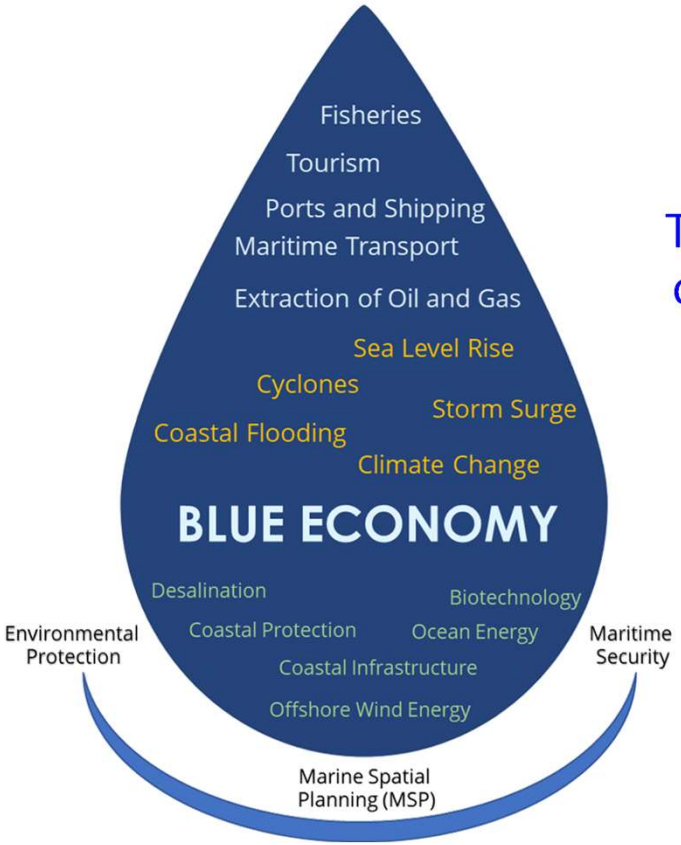
Outline

- Blue Economy – why it is important
- Emerging sectors – opportunities !
- Technological demonstrations
- Environmental sustainable concerns
- Blue growth – India's initiatives
- Blue economy governance framework



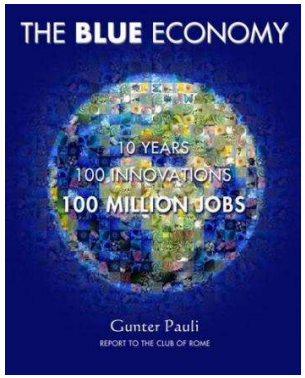


Blue Economy

The Blue Economy is sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of marine and coastal ecosystem.

The World Bank

Prof. Gunter Pauli



- Blue Economy stimulates economic growth through the sustainable utilization of ocean resources with technological inputs to improve livelihoods and meet the growing demands for jobs without hampering the health of the ocean ecosystem.
- Blue Economy supports food security, manages and protects the ocean environment, creates new jobs and has diversification to add new resources for energy, drugs, chemicals, food and minerals for human welfare.
- Blue Economy builds resilience to climate change.

The idea of 'Blue Economy' was first articulated by Prof. Gunter Pauli in 1994

Blue Economy Concept

- The Blue Economy conceptualizes oceans and seas as **development spaces**
  - It incorporates new technologies such as oil & gas, tourism, shipping, marine fishing & marine aquaculture
- Blue Economy is an ocean economy
  - It aims at the improvement of human well-being & social equity, which reduces environmental risks & ecological disasters
- Blue Economy simply defined as all economic activities of the oceans, seas and coasts
- Blue Growth comprises
  - The novel technologies for high growth & job potentials such as wave, tidal, offshore wind etc.

UN Sustainable Development Goals

193 members of the UN General Assembly adopted "Transforming our world: the 2030 Agenda for Sustainable Development" : on 25th September 2015

15 Years **17 Goals** **169 Targets** **230 Indicators**

3 Pillars of SDG

Economic growth

Social inclusion

Environmental sustainability

THE OCEAN

Economic Value

Regulates weather & Climate
Produce **half** the **oxygen Carbon sequestration-**
absorb 30% of CO_2 emissions

$3-6 trillion/year
Goods and services: ~ $2.5 trillion/year

Fishery - US$401 billion/year
Employment- 60 million people
20 % of avg. animal protein for 3.3 billion people

Minerals & Oil
Oil reserves- 41 Gt
(28% of the total production)
Gas reserves- 65 trillion m^3

Transportation: 70-90 % of trade

Recreation
upto 50% GDP
Major economy for coastal & Island countries
- Scuba diving
- Water sports
- Cruise liners

Ecological Value

80 % of the planet's biodiversity

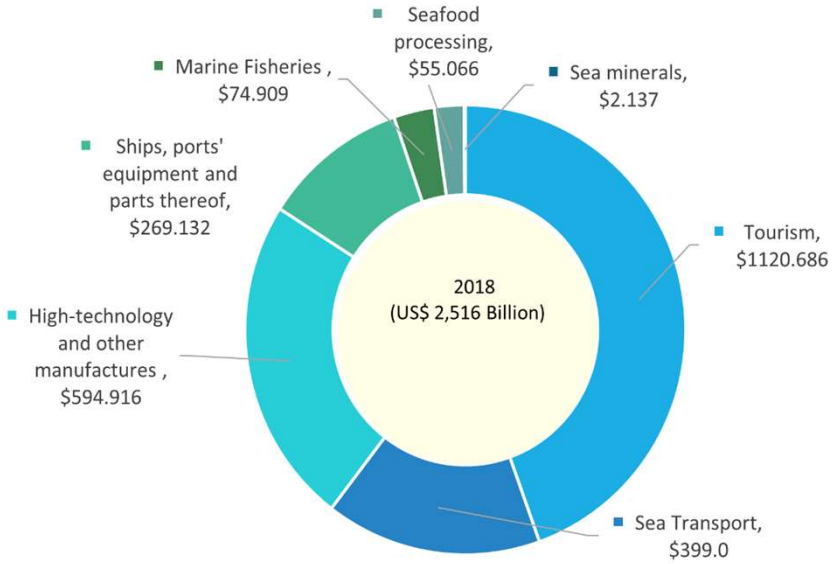
Coastal protection
Prevention of erosion
Water purification

Critical Habitats

Blue Carbon
Mangroves, seagrass & seaweeds **remove C** from atmosphere **10 times faster** than rainforest

The Blue Economy
>> E*conomy of the future*

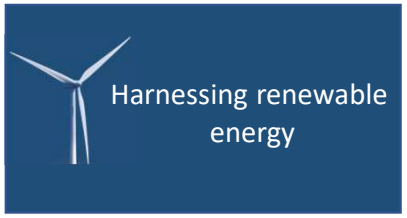
Ocean economy - 7th largest economy in the world (GDP)

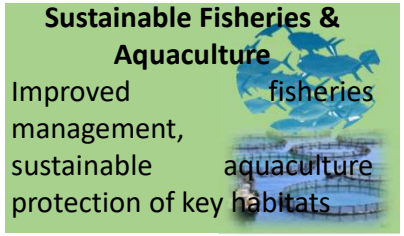


Source: UNCTAD and World Travel and Tourism Council data (2020).

Billions of people, especially the world's developing nations depend upon on healthy oceans as a source of jobs and food - underscoring the urgent need to sustainably use, manage and protect this natural resource.

Sustainable Blue Economy Sector





The World Bank has already invested $3.67 billion in its Blue Economy program

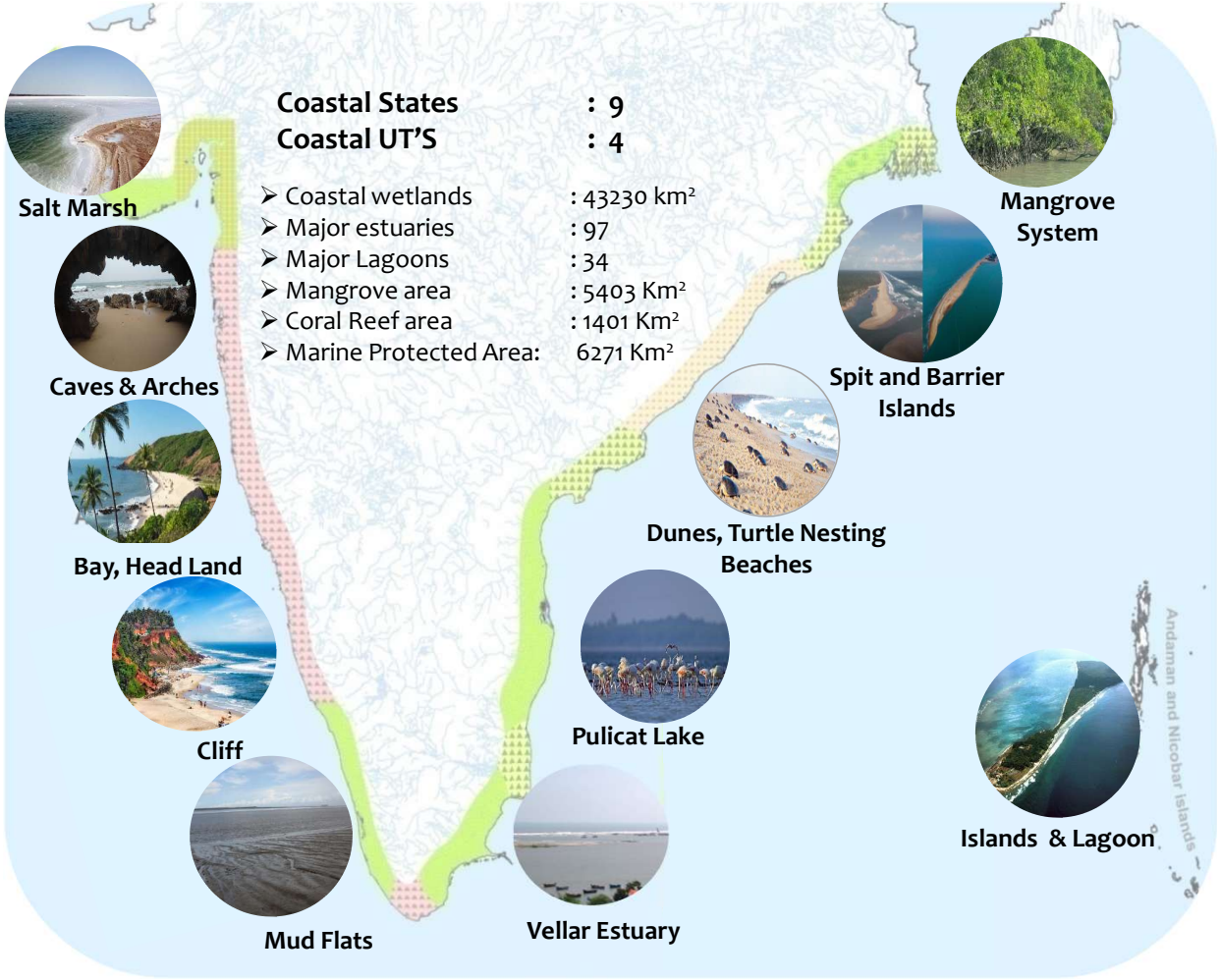
Blue economy !

- Ocean assets are valued at over $24 trillion.
- Projected growth from US $1.5 trillion in economic activity and 31,000,000 direct jobs in 2010
- Over $3.6 trillion and 45,000,000 jobs between 2010 and 2030
- The High Level Panel for a Sustainable Ocean Economy in 2020 estimated investing US $2 to $3.2 trillion would generate between $8 to $22,8 trillion from 2020 to 2050 –a net ROI of 400 to 615%.
- Every $1 invested in mangroves would yield >$3 in direct net benefit, excluding indirect benefits for blue carbon, fisheries, ecosystems etc.
- Every $1 invested in offshore wind production would yield $2-$17.
- Every $1 in decarbonisation of shipping would yield a net benefit of $2-$5 minimum
- Projects indicate though over 90% of coral reefs will die by 2050
- It is projected with current rate by 2050, more plastic then fish species in the oceans
- IUU fisheries cost a minimum $17 to $30 billion each year

Challenges to Ocean Economy

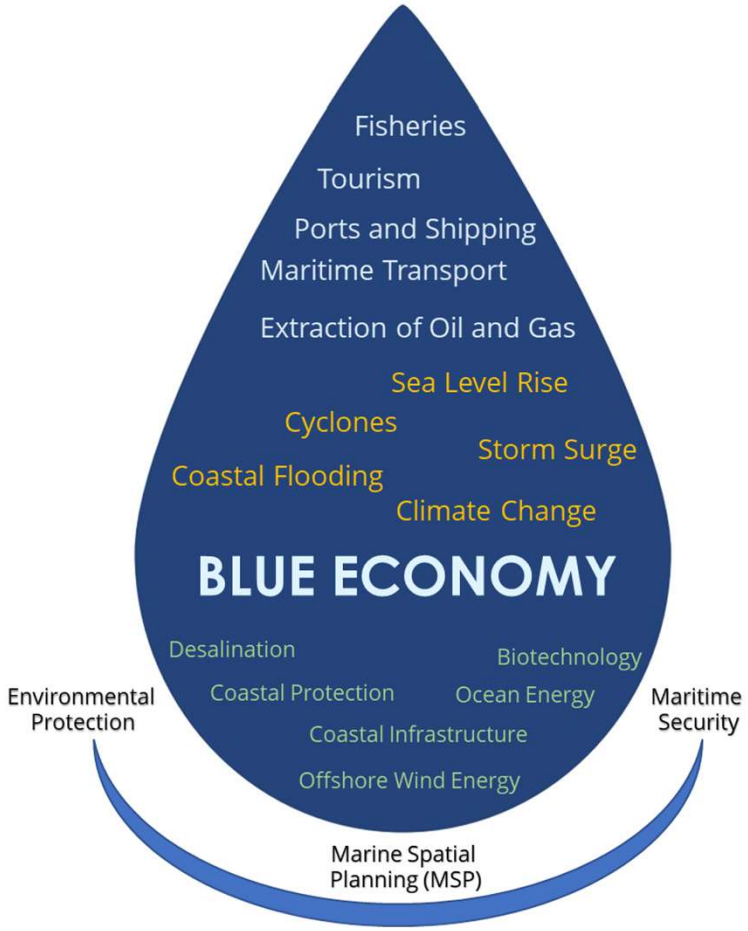
- ~ 40% of the global **population live along the coast** (>2.8 billion people, live within 100 km of the coast)
- **Overexploitation of resources** (e.g., IUU Fisheries, fish, oil & gas)
- **Increased anthropogenic disturbances** (e.g., effluent discharge, plastic & recreation)
- **Destruction of critical habitats** (e.g., coral reefs, mangroves, Species Extinction, Migration and Biodiversity)
- **Conflicts**- resources, values and cultures
- **Climate change** (increasing temperature, ocean acidification, sea level rise)
- **Increase in extreme events** (e.g., heavy rainfall & cyclone)
- **COVID19** and pandemics
- **Coastal Erosion**/Sand Mining, Seabed Mining

Coastal Systems : Benefits



Coastal States : 9
Coastal UT'S : 4

- Coastal wetlands : 43230 km²
- Major estuaries : 97
- Major Lagoons : 34
- Mangrove area : 5403 Km²
- Coral Reef area : 1401 Km²
- Marine Protected Area: 6271 Km²

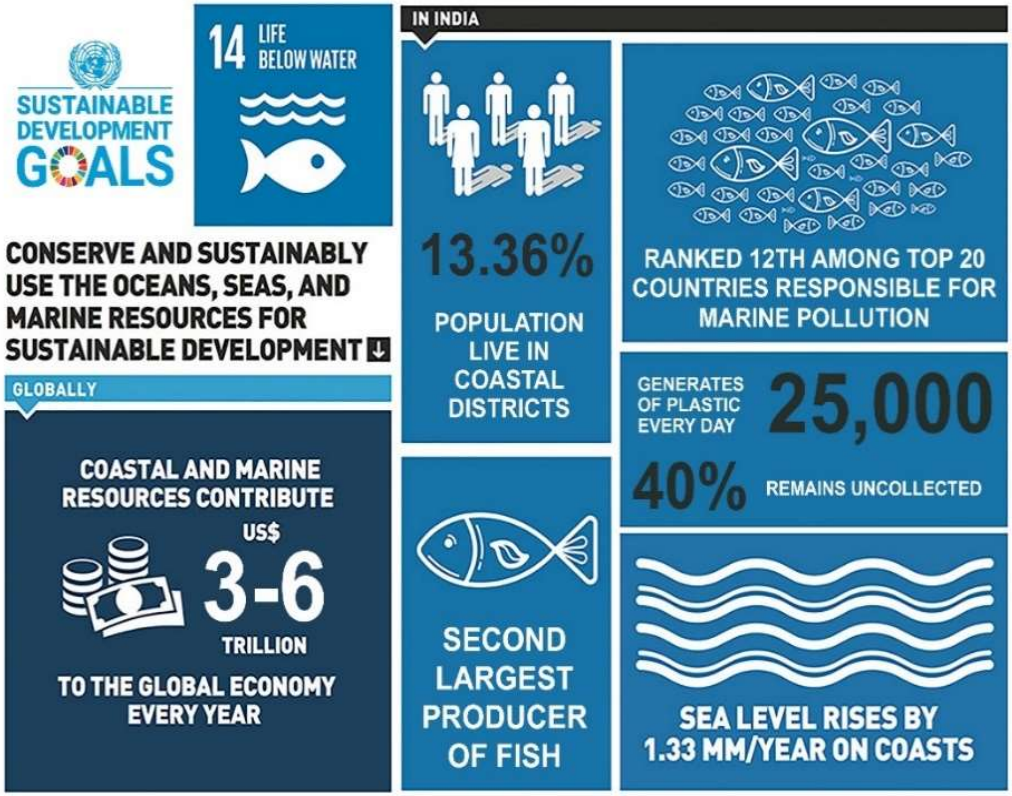


Challenges in India

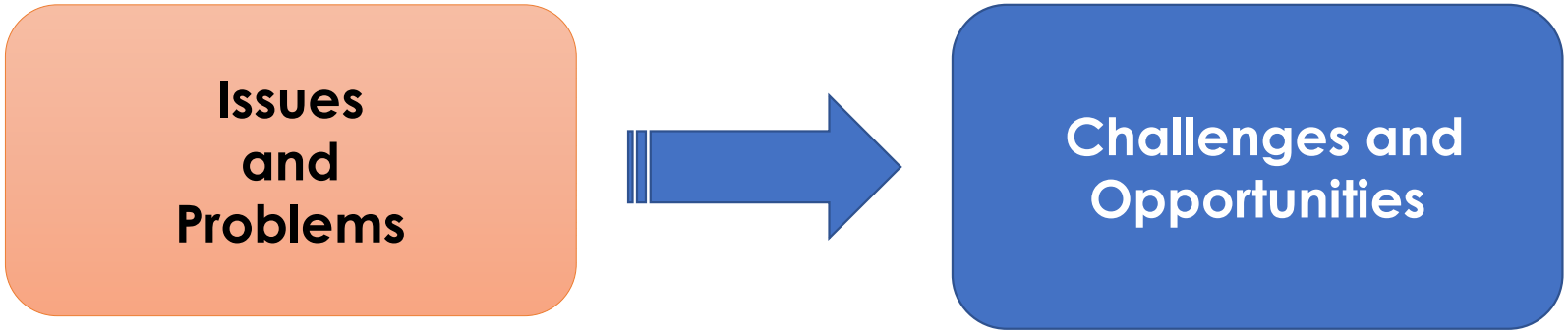
Indian Marine System

- Coastline of 7,517 km in length
- 13.36 % of population lives in 13 coastal states & Union Territories
- Second largest producer of Fish
- 3.56 MT of fishery production in 2019 (CMFRI 2020) with value of Rs. 65,000 crores contributing significantly to the economy
- Sustains & provides a source of livelihood to over 250 million people
- One of the fastest-growing economies of the world

Challenges



Source: *United Nations in India*



Blue Economy offers a suite of opportunities for sustainable, clean, equitable blue growth in both traditional and emerging sectors

Blue Economy – Potential Industrial Opportunities

Ocean Economy Activities	Emerging Blue Economy Opportunities
Fisheries, Aquaculture	Cabotage
Shipping; Transport and Ports	Marine finance, entrepreneurship and insurance; Dry Ports
Marine and Cargo Services	Undersea mining/Bioprospecting
Navies - Ocean and Coastal Governance	Drones, Robotics/Marine Protection
Offshore oil and gas	Marine Renewable Energy; Desalination
Marine, Cruise Tourism and Recreation	Marine Biotechnology; Blue Carbon
Education and Training	Maritime research and development, Technology e.g. sensors
Ship Repair	Vessel automation and conversion
Small Harbours and Marinas	Marine pollution, waste recycling and the circular economy

Emerging Sectors

Tourism

- Beach tourism
- Cruise ships
- Blue Flag accreditation

Fisheries

- Recreational
- Commercial
- Mariculture
- Cage culture

Conservation & environmental protection

- MPA
- Goods and services
- Amenity values
- Ecosystem based services

Maritime transport & ports

- Maritime industry
- International shipping
- Port and harbour facilities

Offshore Petroleum

- Crude oil
- Natural gas

Dredging & aggregate extraction

- Sand mining
- Port dredging
- Deep sea mining

Opportunities of Blue Economy with Changing climate and environment

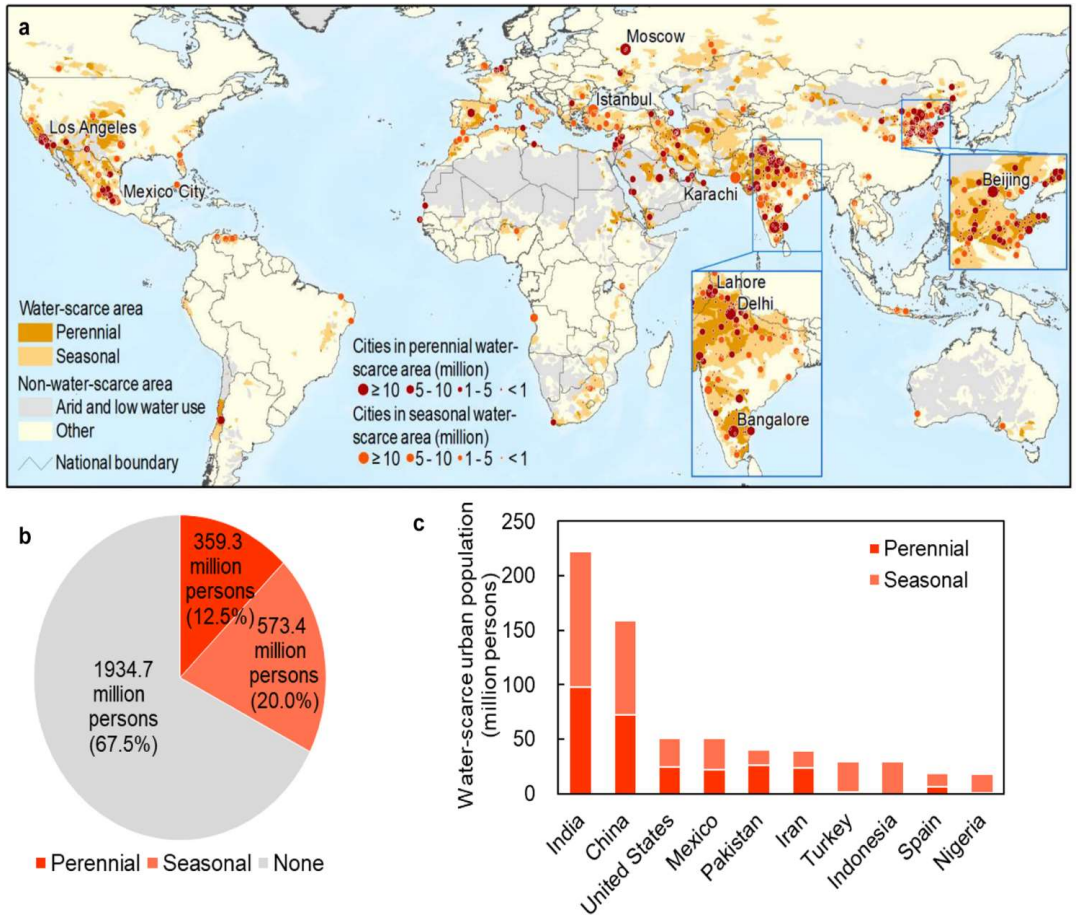
- **Water** – Desalination, dams etc.
- **Food** – PFZ, Biotechnology, culture etc.
- **Energy** – Wave and tidal, oil, Gas, etc.
- **Transport** – shipping, tourism
- **Resources** – Deep sea mining, critical habitat ecosystems
- **Pollution-** Green technologies, STPs, restoration etc.
- **Climate change -** coastal hazards etc.

- Primary Resources
  - ✓ **Water**
  - ✓ **Food**
  - ✓ **Energy**
- Secondary Resources
  - ✓ Minerals (mining)
  - ✓ Transportation
  - ✓ Waste Disposal
  - ✓ Biotechnology
  - ✓ Tourism
- Industries / intervention / technological demonstration
- Impediments
  - ✓ Climate Change
  - ✓ Overexploitation and Waste Disposal
  - ✓ Maritime securities

Sustainable concerns – SDGs

Water

- "One out of every Six persons in the developing countries lack access to clean drinking water" - WHO.
- Twenty major cities are located along Indian coastline. The water requirements are:
  - ✓ In 2008 - 6,267 MLD
  - ✓ In 2026 - 23,607 MLD
- Many large-scale desalination units are being established in the country.
- Still regions like Tamil Nadu, Sourashtra, Kutch, Rajasthan and Islands face severe drinking water shortage.



Water

Sustainable Development Goals: Vision 2030

- Ensure access to water and sanitation for all (No. 6)

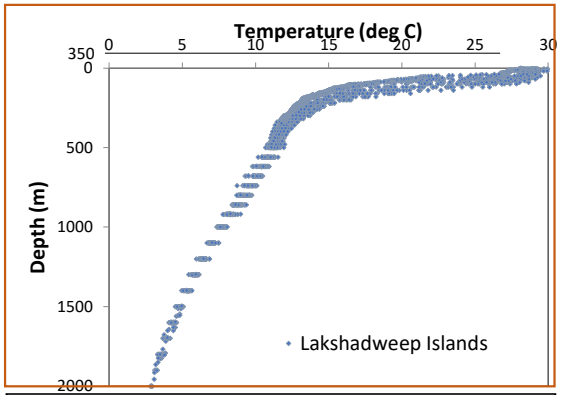
Desalination Methods- sectors

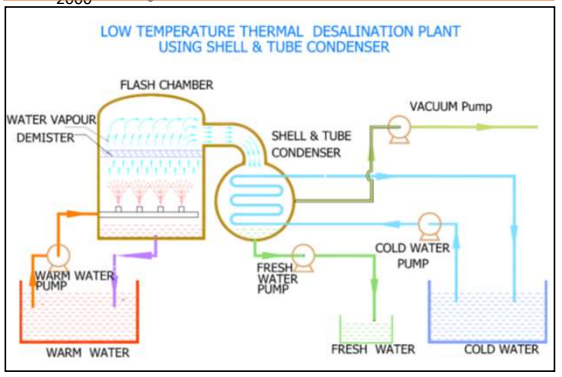
- Distillation
- Membrane
- Hybrid systems
- LTTD Technology

LTTD Principle – Technology demonstrated

- The temperature difference is utilized to produce potable water by evaporating surface sea water at low pressures and condensing the resultant fresh vapor with cold water.

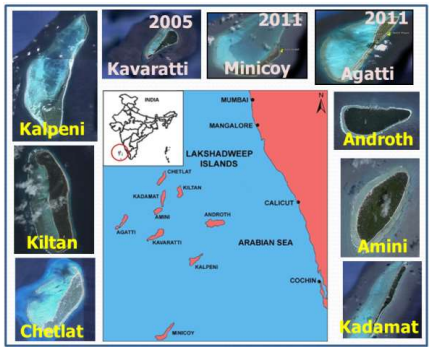
Innovative Technology : Low temperature Thermal Desalination



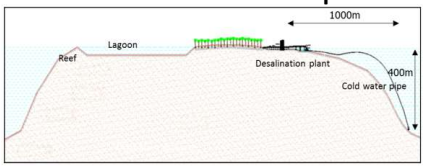


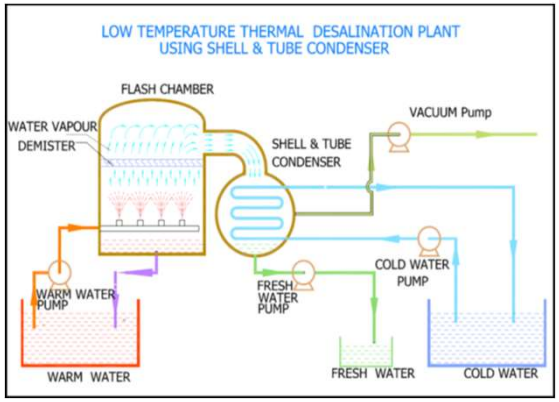
Desalination: Low Temperature Thermal Desalination for Remote Islands

- Indigenized technology to produce drinking water from the ocean.
- The 3 operational desalination plants at Kavaratti, Agatti and Minicoy each produce drinking water of 1 Lakh liters per day. Being maintained with local manpower, the plants have become the life line for these remote islands.
- Six more desalination plants of 1.5 lakh liters per day drinking water capacity are being established in UT Lakshadweep, covering the remaining inhabited islands, Amini, Androth, Chetlat, Kadamat, Kalpeni, and Kiltan. The plant in Kalpeni generated fresh water in Jan 2020.

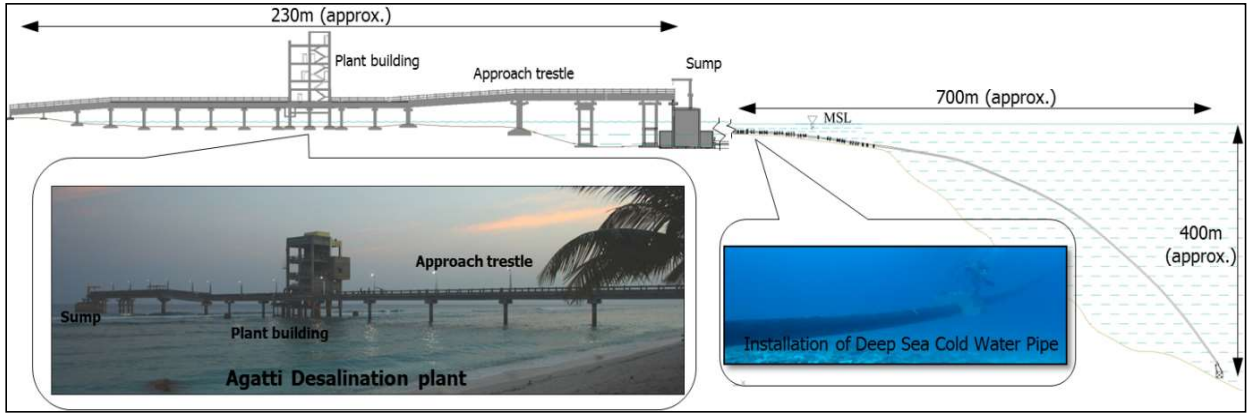


UT Lakshadweep





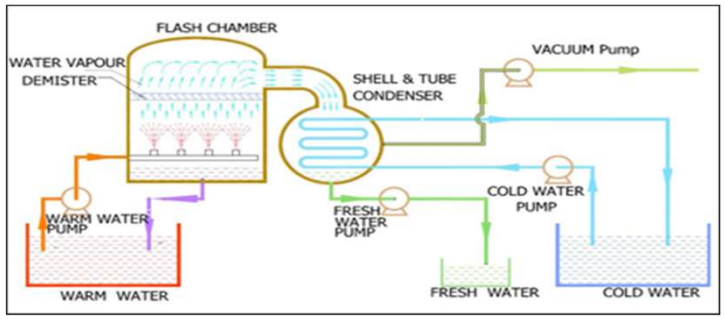
LTTD Process



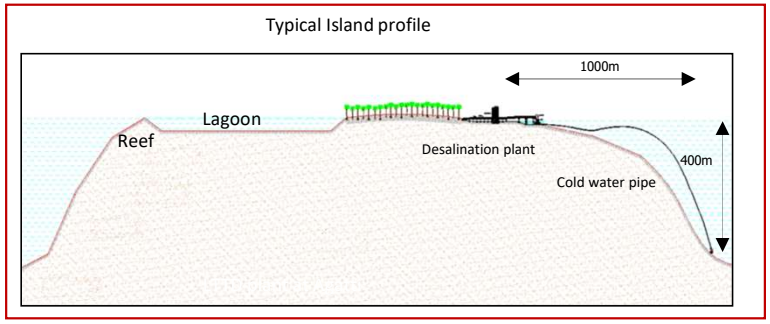
Plant Configuration

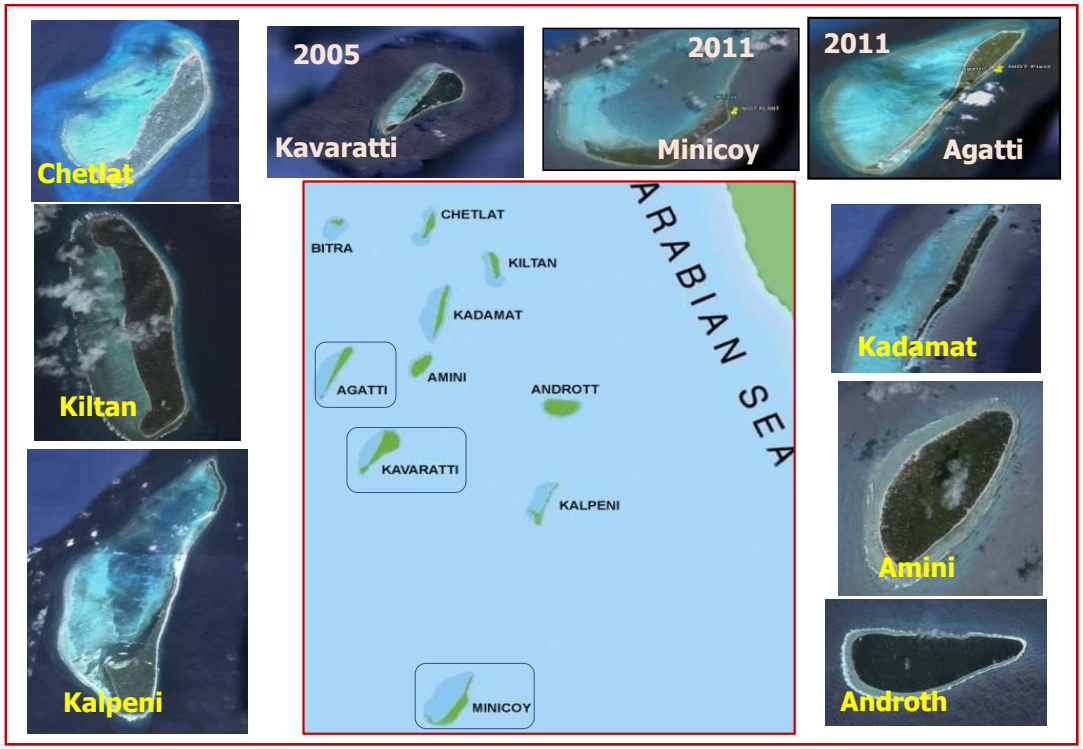
Establishment of Desalination Plants in 6 islands of UT Lakshadweep

✓ Lakshadweep islands are facing acute drinking water shortage , 3 plants built with capacity of 1 Lakh liters per day, in operation since 13 years at Kavaratti and 8 years at Minicoy and Agatti.



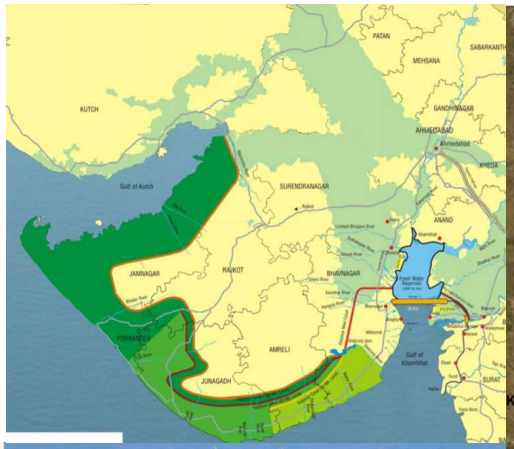
Schematic of LTTD concept

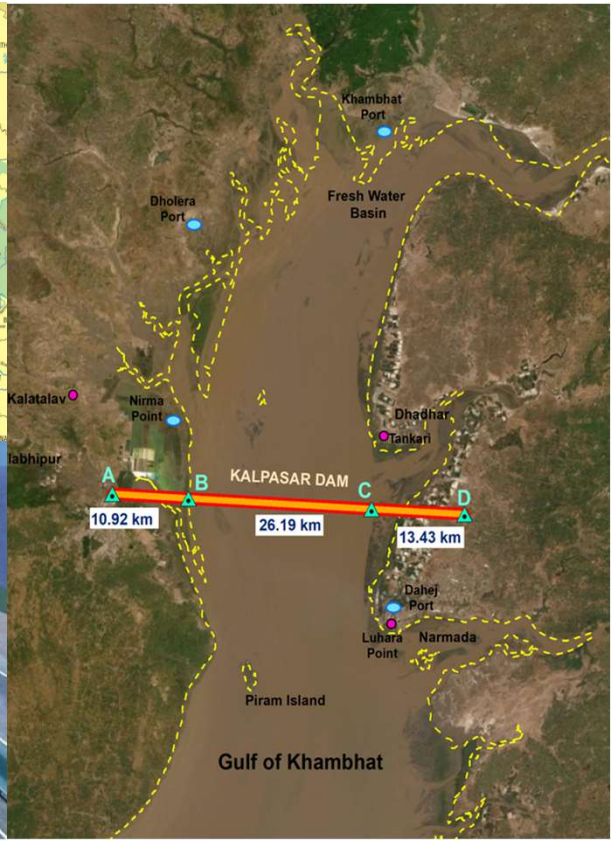




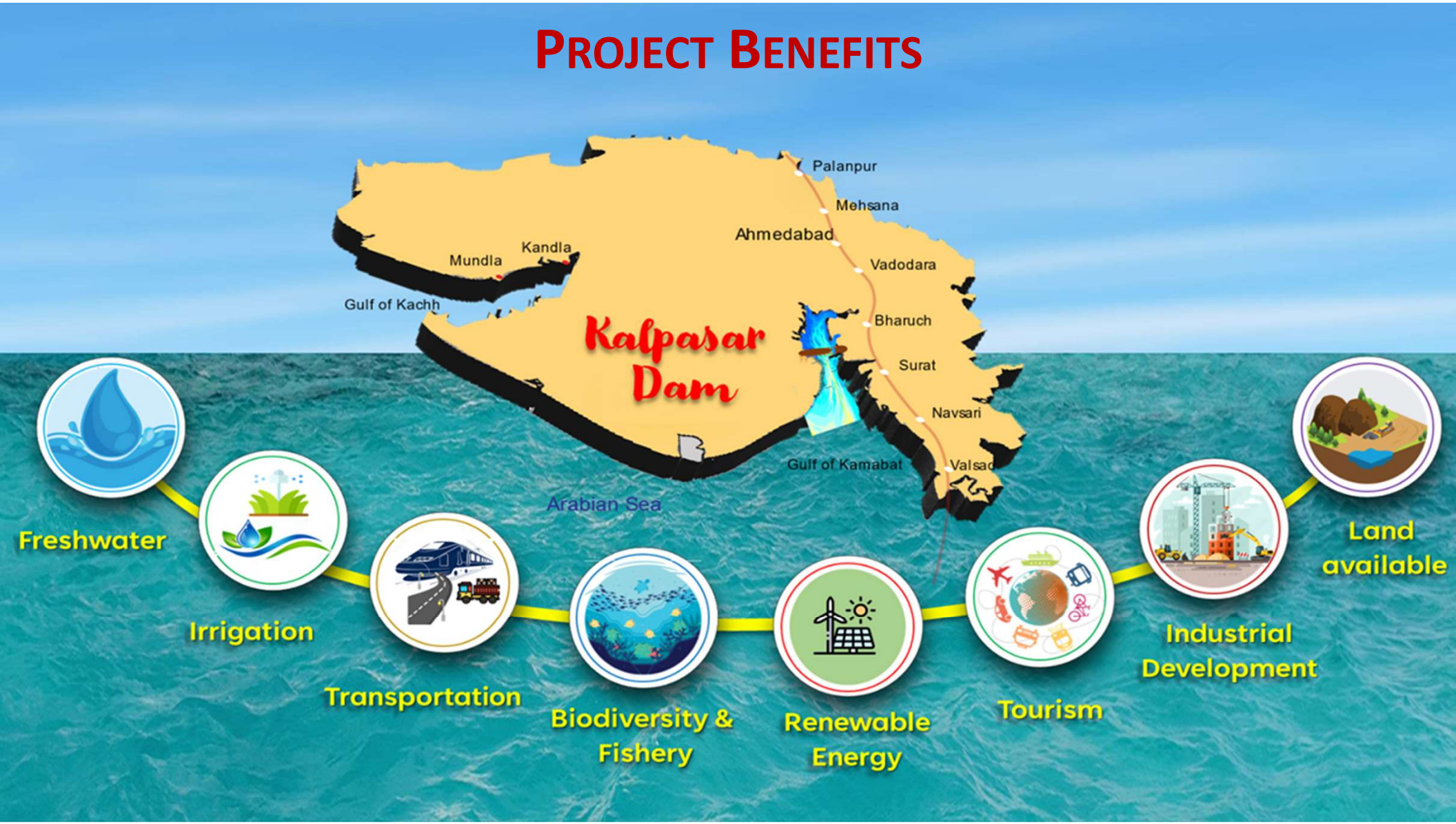
Kalpasar Dyke Project

- Saurashtra of Gujarat is facing severe water scarcity.
- To overcome the problem Govt. of Gujarat intends to create fresh water reservoir by constructing a multipurpose dam across Gulf.
- Components of the Project
  - ✓ 30 km Earthen Dam with Spillways
  - ✓ Narmada diversion canal
  - ✓ Irrigation canals along Saurashtra
  - ✓ Renewable energy for Lift irrigation
  - ✓ 10 lane road over Dam
- Benefits of the project
  - ✓ Meeting per capita demand of Saurashtra
  - ✓ Irrigation for 10.54 Lakh ha.
  - ✓ Reduces distance between Bhavnagar and Surat (350 km to 50 km)
  - ✓ Land reclamation of about 2 Lakh ha.
  - ✓ Reduction in ground Water Salinity.
  - ✓ Fisheries with direct employment to 1 Lakh





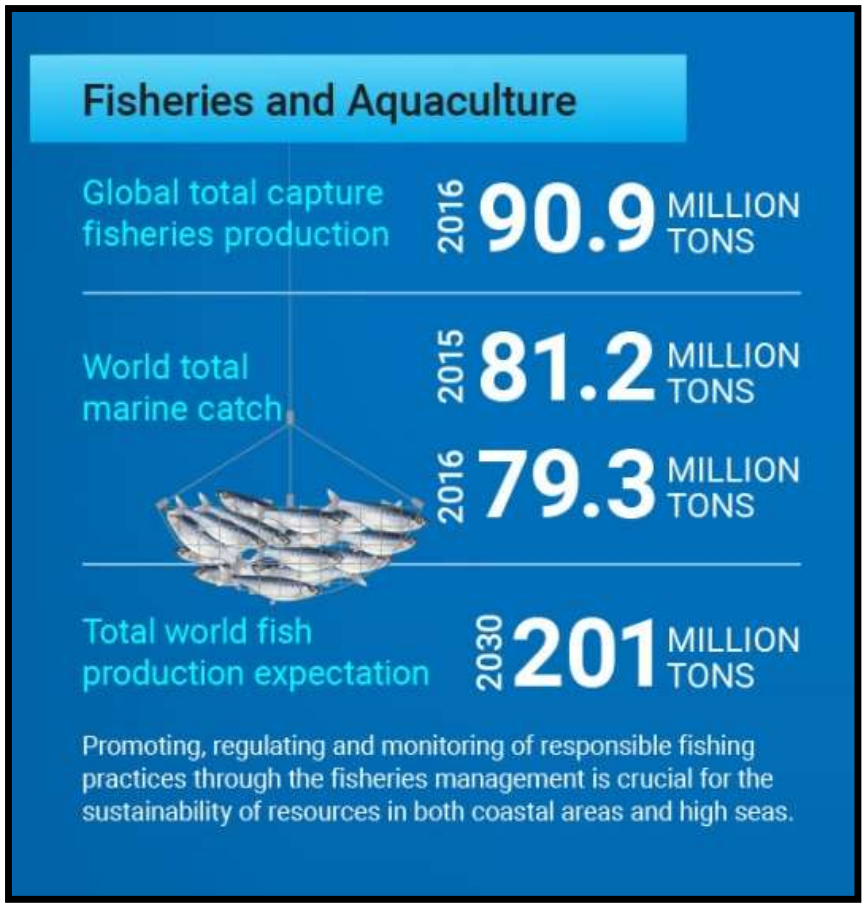
PROJECT BENEFITS



Food: Living Resources (*Fisheries & Aquaculture*)

- Important role in ensuring
  - food security,
  - poverty alleviation,
  - huge potential for business opportunities

- Aquaculture
  - Global aquaculture production (including aquatic plants) in 2016 =110.2 million tonnes
  - Global Aquaculture fish production= 80 million tonnes
  - 19.3 million people employed
  - 202 countries/ 194 active countries
  - China = Dominating
  - India= 2nd rank



Food: Living Resources

- Fish is a crucial source of animal protein.
  - ✓ 2.9 million - 20 % animal protein intake
  - ✓ 4.3 billion - 15 % of animal protein.
- 150g fish -> 50-60 % of daily protein requirement.
- Present fish production
  - ✓ Inland-3.4 MMT
  - ✓ Marine-3.0 MMT
- Potential fish production - 8.4MMT
  - ✓ West coast - 67 %
  - ✓ East coast – 33 %

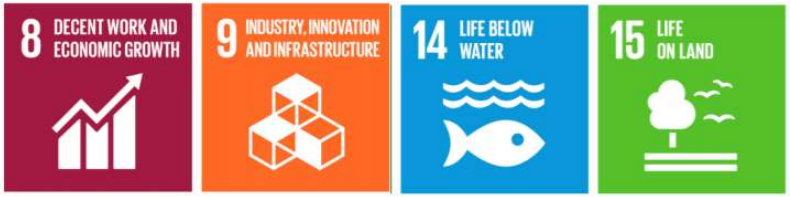
Open cage Culture

Mud Crab Culture

Aquaculture and MPA Employment Opportunities

Input/Stocks e.g. hatcheries, feed, supplies, transport, fuel, records, and other equipment/services.	Producer/Production Processes (, fertilizing/monitoring, land, construction materials, buildings with moorings and walkways
Species maturing and fish husbandry; Vets,	Cultivation and harvesting stages, packaging
Storage/Processing	Education and Training; Research, Technology
Marketing/Distribution Logistics, Insurance,	Design and construction, engineering, Security
Retailer/ -shops, Wholesaler	Recreational and game fishing/tourism and events
Restaurants, Cafes	Marine Ecological Capital -Blue Bonds
Ornamental pet fish, Aquariums and Tourism/tours	Jewellery, cosmetics
Value adding beneficiation e.g. cans, ready meals	Marine biotechnology; dieticians, medical,
HR and Recruitment, Procurement, Administration	Volunteers, Rangers
Marketing, Distribution and Logistics, IT, Environmental Monitoring	Education, Training, Testing, Research and Development, Lab Technicians, Chemists,
Diving, surveyors, salvaging, Vets,	Ferries, Refreshments, Gifts, Toys
Tourism -guides, marine archaeologists	Biotechnicians, Biologists, Psychologists, Biochemistry,
Servicing and repairing equipment/infrastructure	Value added products, Nutrition etc. Nutraceuticals,
Bioremediation, Marine Ecological Restoration	Marine ecological capital reserves, blue carbon bonds

Biotechnology



- Marine plants and animals are important sources of new medicines being developed to treat cancer, arthritis, human bacterial infections, Alzheimer's disease, heart disease, viruses, and other diseases.
- India being a tropical country, endowed with great diversity of marine micro algal species, combined with optimal environmental conditions, provides great opportunities for commercial scale algal production which has applications in the food, nutritional, cosmetic, pharmaceutical and bio-fuel industry.

		
Electrofloculation of marine micro algae	Micro algal dry biomass (25 kg)	Oil and lutein extracted from algae

Drugs from sea

Courtesy: NIOT

Marine Biotechnology Research & Development

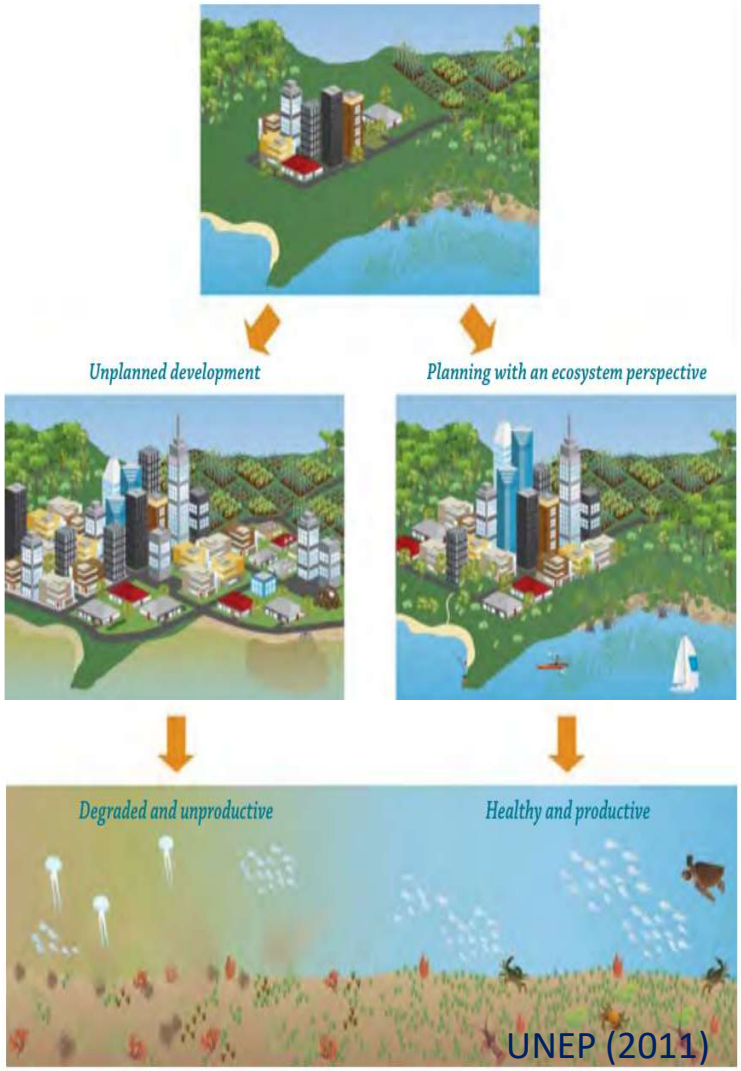
- Aquaculture, whereby new methodologies will help in:
  - selective breeding of species,
  - increasing sustainability of production,
  - preventive therapeutic measures,
  - use of zero-waste recirculation systems
- Marine biotechnology is related to:
  - the development of renewable energy products and processes, for example through the use of marine algae.
  - potentially used as novel drugs, health, nutraceuticals and personal care products;
- Environmental issues, such as:
  - bio-sensing technologies to allow in situ marine monitoring,
  - in bioremediation and in developing cost-effective and non-toxic antifouling technologies

Maritime Education and Training/Circular Economy Employment Opportunities

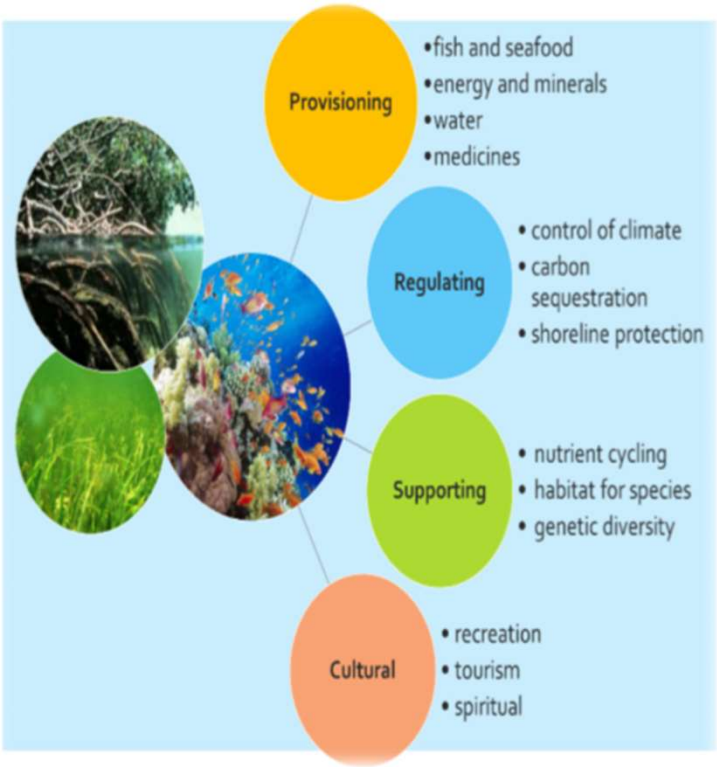
Hydrographic surveyor; geoscientist; Electronics	**Intermodal transport and storage, ports, bioprospecting**
Envionmental monitoring and modelling	Education, Training, Testing, Research and Development
Aquaculture -as per previous table, Vets,	Pharmaceuticals, Cosmetics, Gene therapy, Genetics
Wholesaler, Retailer, processing	Biotechnicians, Biologists, Psychologists, Biochemistry,
Drones, diving, inspections	Banking, Insurance and finance
Servicing and repairing equipment/infrastructure	Value added products, Nutrition etc. Nutraceuticals,
Fermentation and process; cell and tissue biotechnology	Marine ecological capital reserves, blue carbon bonds
Nanobiotechnology, Bioinformatics, Bioweaponry,	Biofuels and electricity, Biomimetic and biomaterials
Bioremediation, Marine Eco Restoration	Microbial Enhanced Oil Recovery, Chemicals,

Ecosystem-based approach

>> towards Sustainable Development of Coastal ecosystems and urban areas



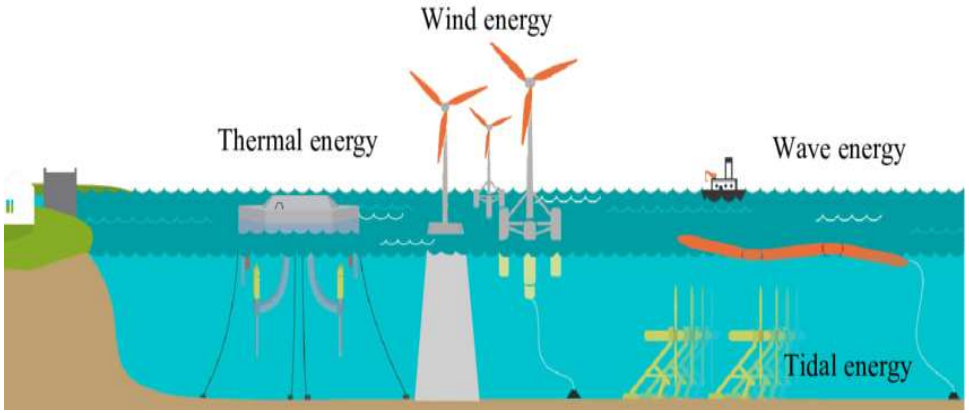
UNEP (2011)



Energy : Renewable

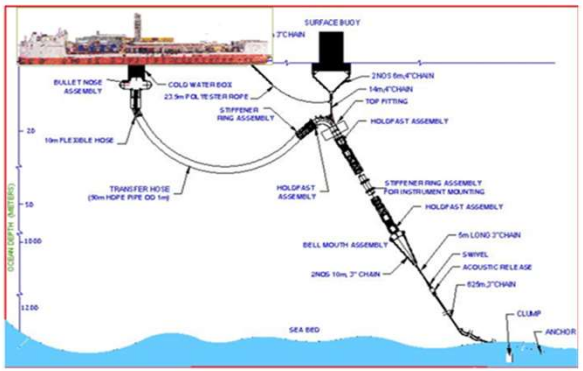
Sustainable Development Goals: Vision 2030

- Ensure access to affordable, reliable, sustainable and modern energy for all (No. 7)



- The world population is expected to increase to an estimated 9 billion people in 2050,
- 1.5 times more
- Increase demands on fossil fuels
- **"blue energy - Ocean"**
  - wind,
  - wave,
  - tidal,
  - thermal,
  - biomass sources

Energy : Renewable

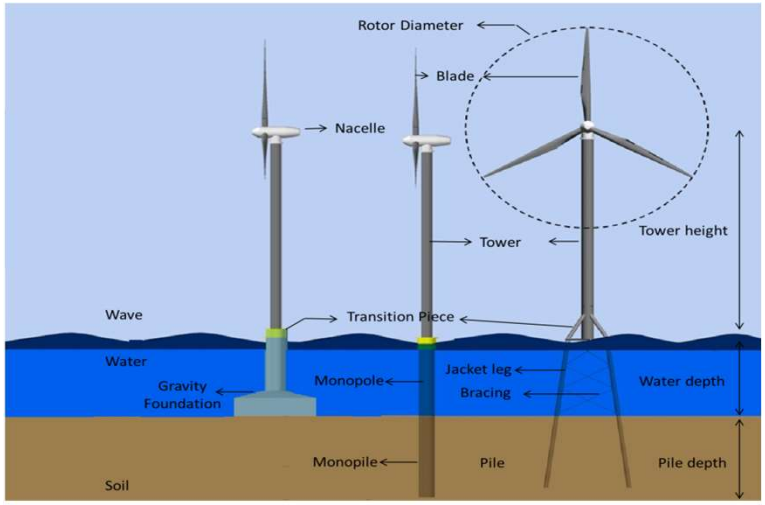


OTEC

Wave

Courtesy: NIOT

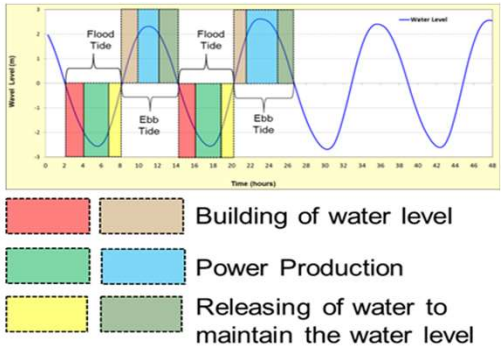
Renewable Energy



Wind

Power generation during Flood Tide

Power generation during Ebb Tide



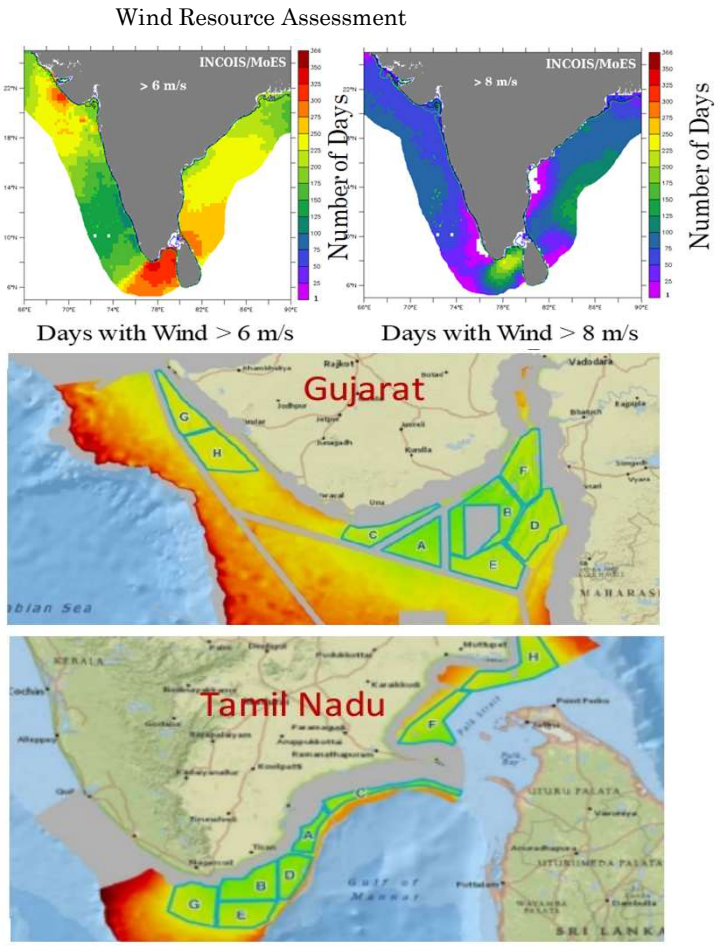
Tide

Offshore Wind Energy

- Potential sites based on Wind Resource Assessment:
  - ✓Rameshwaram & Kanyakumari (Tamil Nadu)
  - ✓Gulf of khambhat and Kutch (Gujarat)

- Offshore wind potential in initially identified blocks
  - ✓Gujarat – 36 GW
  - ✓Tamil Nadu - 25 GW

- Overall Potential along Indian Coast will be more than 100 GW, which accounts 27% by wind alone.



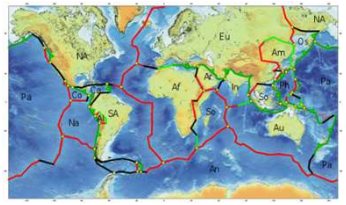
Minerals: Nonliving Resources

Sustainable Development Goals: Vision 2030

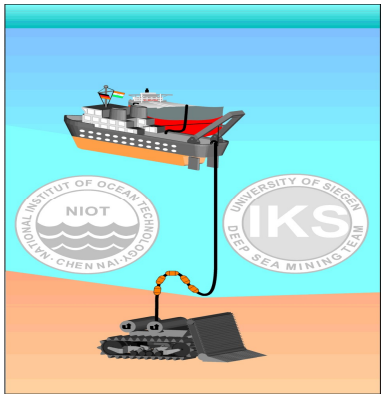
- Conserve and sustainably use the oceans, seas and marine resources (No. 14)

Minerals:

- Central Indian Ocean Basin (CIOB) and Rodrigues Triple Junction (RTJ).



Polymetallic Nodules (nodular objects lying on the ocean floor)	Mn : 24-30% Cu : 1-2%, Ni :1-2% Co : 0.15-0.3%	4000- 6000 m (CCZ, CIOB) 2000-5000 m (Cook Islands)	Mostly in plains and gentle slopes
Phosphorites (Nodules and crusts)	P_2O_5: 21-33%	~ 300 m (EEZ off TN coast)	Mostly in plains
Cobalt Rich Crust	Co : 0.7% Ti : 1.2%	400-4000 m (~1.6% - Ocean Floor)	Seamounts ridges and plateaux
Polymetallic Sulphides	Pb, Zn, Cu, Au, Ag	3000 -4000 m	Volcanic mounds



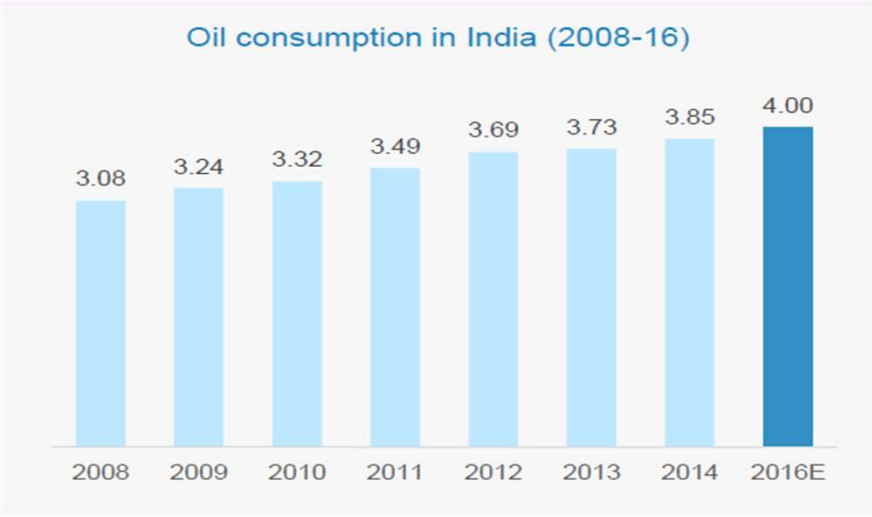
offshore drilling? / Deep Sea Mining

Oil and Gas : Nonliving Resources

Oil and gas - 37 % of total energy consumption.

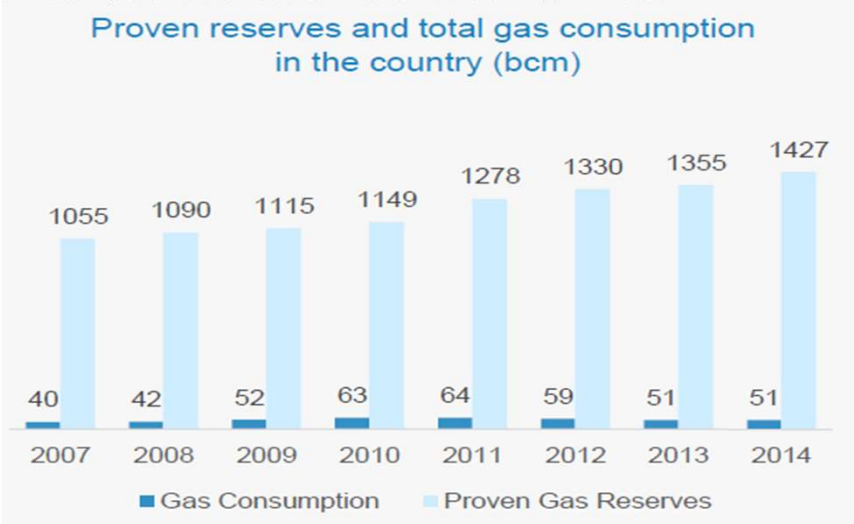
OIL

- In 2014 - 5.7 billion barrels of proven oil reserves.
- Oil production rate in 2015 - 0.75 million barrels per day.
- Oil consumption is expanding at a Compounded Annual Growth Rate of 3.3 %.



GAS

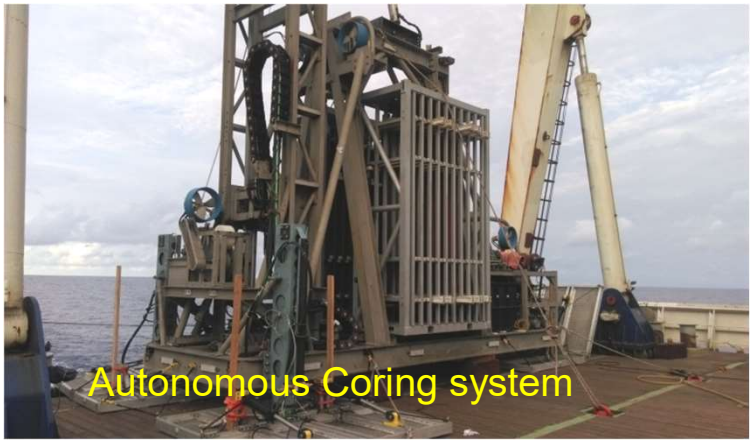
- India has 1.4 tcm of gas proved reserves & produced 33.66 bcm of gas in 2015.
- Approximately 34 per cent of total reserves are located onshore, while 66 per cent are offshore.
- India's LNG imports are increasing at an annual compounded rate of 18.67 % during FY2008–FY17.



Deep Sea Mining Resources

Gas Hydrates

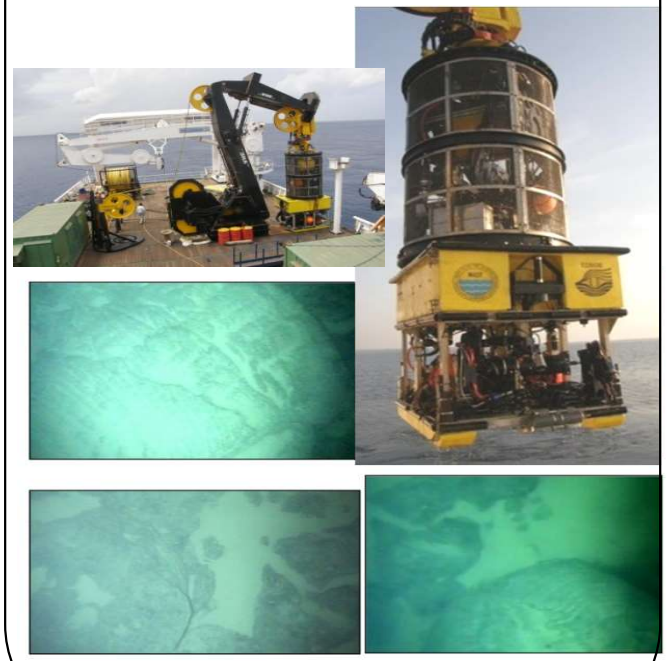
- Gas hydrates are crystalline form of methane.
- India has more than 970 Trillion Cubic Meter (TCM) of methane stored in the form of gas hydrate in the continental margins of India.
- 10% production can meet India's energy requirement for about one century.
- The research firmly established the fracture controlled occurrence of hydrate in Krishna-Godavari basin.



Courtesy: NIOT

Mining – Technological demonstration

Exploration

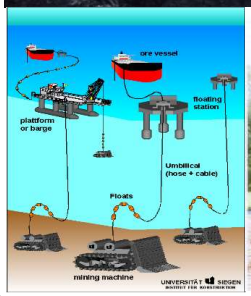


ROSUB 6000

Soil Tester

In-situ Soil Tester

Mining System



Underwater Crawler

Courtesy: NIOT

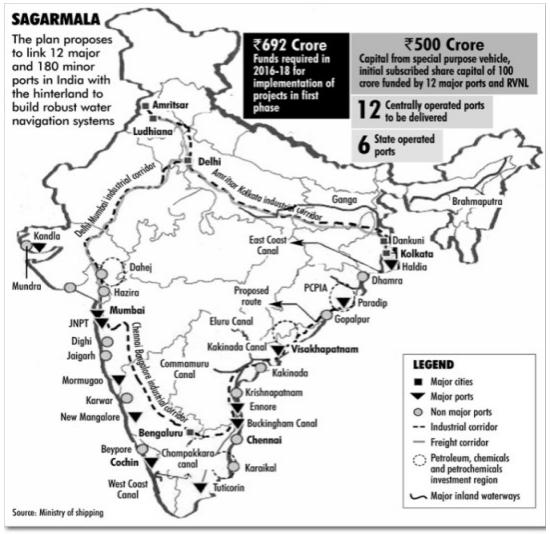
Transportation: Seaports & Shipping

- 80 % of global trade by volume
- Over 70 % by value is carried by sea and handled by ports worldwide

Marine Transportation - India

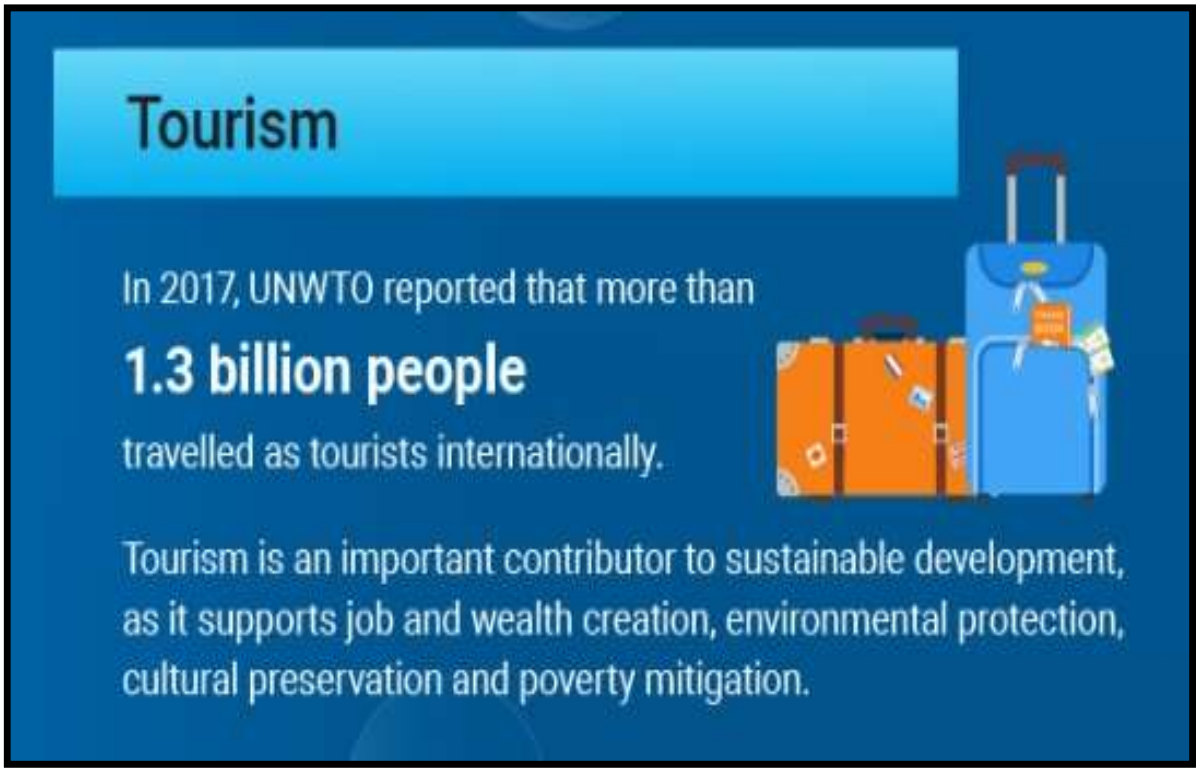
- Maritime transport is critical for the economic development of a country. It influences the pace, structure and pattern of development.
- India has 12 Major and 187 minor Ports that carry nearly 95% of India's trade volume.
- Cargo traffic at Indian ports has doubled to 1 billion tonnes per annum over the last decade (FY 2005 - 2015) and is expected to reach 1.7 billion tonnes per annum by 2022.
- To meet the increasing demand:
  - **Develop deep water ports for handling heavy vessels.**
  - **Improve cargo handing facility at existing ports**

Sagar mala – an opportunity development.



Tourism

- Marine tourism, with its related marine activities (including cruise tourism),
  - contributor to the economy of countries and for generating employment.
- Marine parks support billions of dollars of vital ecosystem services worldwide



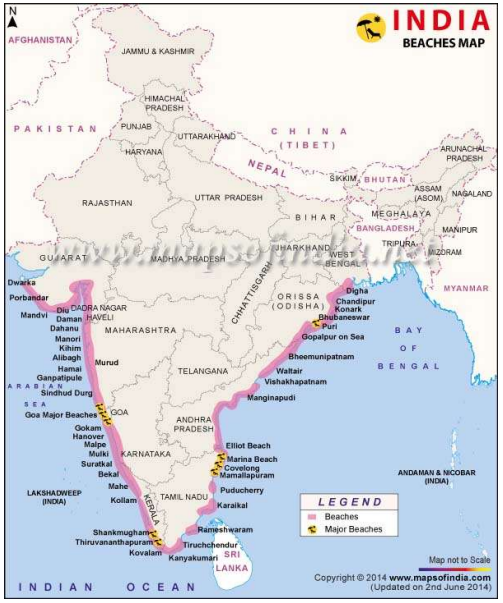
Tourism

- Foreign tourist increasing at a rate of 7 % over 2005–15.
  - ✓ 2015 – USD 147.7 billion.
  - ✓ 2022 – USD 418.9 billion

- The country's big coastline is dotted with a number of attractive beaches.

- Improve infrastructure for activities like; Angling, Swimming, Water Skiing, Surfing, Scuba diving and Beach Front resorts

- Important to integrate principles of sustainable development and environmental protection



Tourism and Marine Renewable Energy/Offshore Employment Opportunities

Construction of tidal, wave, wind, solar, current, thermal energy conversion and other energy types infrastructure, vessels, offshore platforms, tidal stream devices	Equipment -pipes, drilling, tools, lubrication, paint, spools, wind tensioning cables, turbines, various sensors, installations, operations and maintenance
Drilling/energy/mining engineer; geologists, geochemist	Vessel repair and maintenance, tugs and barges
Hydrographic surveyor; geoscientist; Electronics	Intermodal transport and storage, ports,
HR and Recruitment, Procurement, Administration	Medical, Health and Safety
Security, Legal, Environmental, Insurance,	Technology, Technicians, Research and Development
Drones, diving, inspections, ports, shipping	Catering, entertainment, bunkerage services
Subsea and pipeline engineers, Electricians	Refineries, petrol stations, pipelines, processing, retail
Banking, Insurance and finance	Desalination plants; Salinity gradient technology;
Hydrodynamicists, Sales managers,	Oceanographers, Riggers, pipe fitters and wielders
Tourism	Consultants
Decommissioning	circular economy

Coastal Pollution

Pollution impacts

AIR POLLUTION — **Global costs: $ 5,322 billion; 7.2% GDP**

- 6.5 million people die due to poor air quality including 4.3 million due to household air pollution
- Lower respiratory infections: 51 million lost or lived with disability due to household or ambient air pollution
- Chronic obstructive pulmonary diseases: 32 million life lost or lived with disability because of air pollution

WATER POLLUTION — **Global Costs: $ 306 billion; 0.4%GDP**

- 58 % of diarrheal disease due to lack of access to clean water; sanitation
- 57 million years life lost or lived with disability due to poor water, sanitation, hygiene

MARINE AND COASTAL POLLUTION

- 3.5 billion people depend on oceans for source of food which are used as waste and waste water dumps
- Close to 500 'dead zones', regions that have too little oxygen to support marine organisms
- Plastics (75% of marine litter) carry persistent bio accumulative and toxic substances

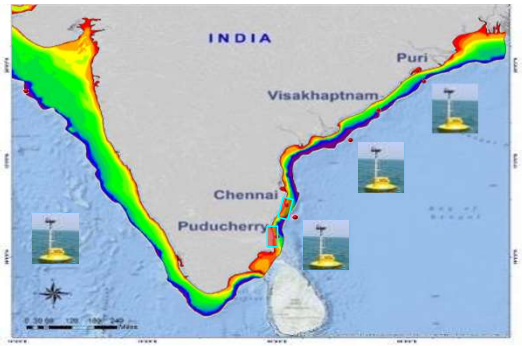
Source: WHO (2016)

Action on Pollution can achieve multiple SDGs

Coastal Water Quality Monitoring and Prediction System

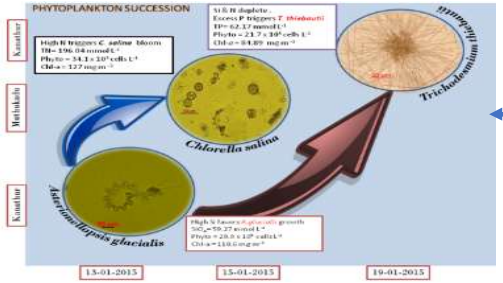
Land based pollution **(SDG 14.1)**

Water Quality Buoy System



Site specific problems

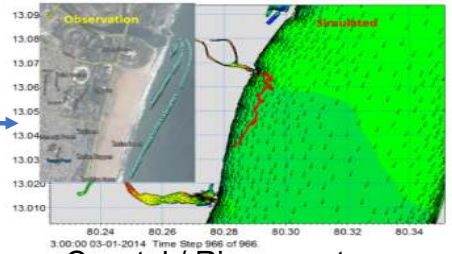
Fish kill, Oil spill, sewage



Harmful algal blooms (HABs)

तटीय स्वच्छ सेवा

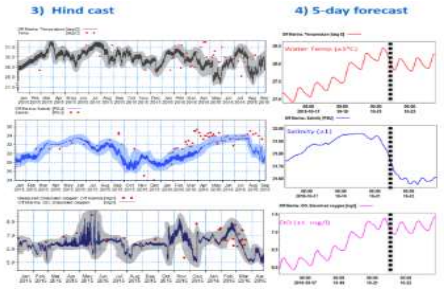
Coastal Clean Services



Coastal / Rip currents

Coastal Water Quality Index **SDG indicator**

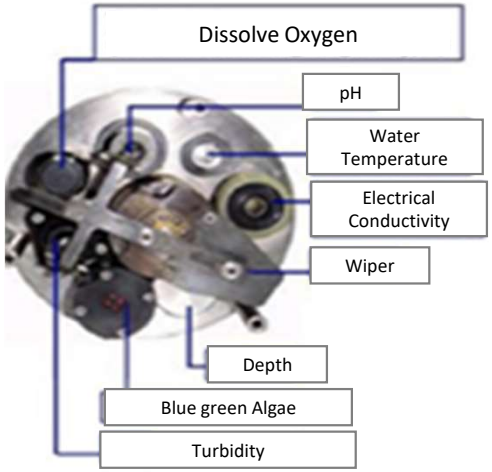
Marine Litter- Micro plastic **(SDG Target)**



5 day forecast of WQ parameters

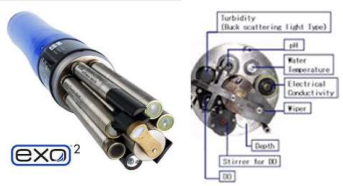
Coastal Water Quality Buoy – Realtime monitoring

Water Quality Sensors



Sensors

Water Quality sensors YSI Exo-2 WQ Sonde



Metrological sensors

Current meter

Dashboard – Data display

Meteorological Sensors

1. Air temperature; -40 to 70ºC (±0.3ºC)
2. Relative humidity; 0 to100% ((±2%)
3. Barometric pressure; 300 to 1100 hPa (±0.5 hPa)
4. Wind speed; 0.1 to 60m/s (3 to 5%)
5. Wind Direction; 0 to 359º (3 to 5º)
6. Solar Radiation; 300 to 3000nm

Water Quality Sensors

1. Temperature; -5 to 50°C (±0.2°C)
2. Conductivity ; 0 to100 mS/cm (±1%)
3. DO; 0 to 500% air sat (±1%)
4. pH; 0-14 (±0.1)
5. Chlorophyll; 0 to 400 µg/L (0.01 µg/L)
6. Turbidity; 0 to 4000 NTU (0.01 NTU)
7. Blue Green Algae; 0 to 280 µg/L (0.01 µg/L)

Oceanographic Sensors

1. Current Speed; ±5m/s (1%)
2. Current Direction; 0 -359 (1º)
3. Wave Height; (±0.5cm)
4. Wave Period; (0.001s)
5. Wave Direction; 0-360º (±4º)

WQ Buoys – off Puducherry

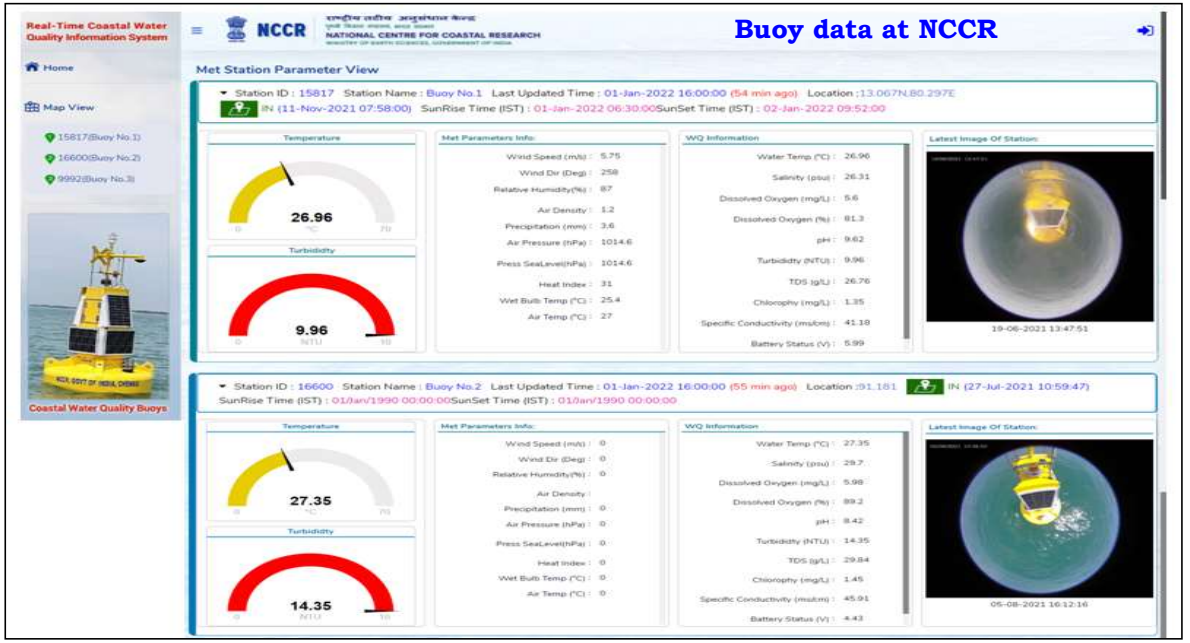
NCCR, Chennai

Water Quality Buoy : Deployment & Data

(https://www.nccr.gov.in/nccrtems2/Home.aspx)

Unveiling of Buoy

Buoy data at NCCR



Chennai:

Location: 13.067191 N, 80.297576 E
Depth: 10m
Deployment On : 07 / 03/ 2021
Data (10min) : NCCR , Sate government
Meteorology, Water quality

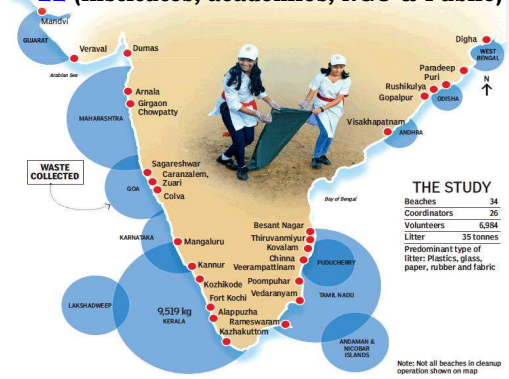
Puducherry :

Location: 11.919518 N, 79.84643 E
Depth: 12m
Deployment On : 27 / 07/ 2021
Data (10min) : NCCR , PPCB, Puducherry
Meteorology, Water quality

Marine Litter and Microplastics

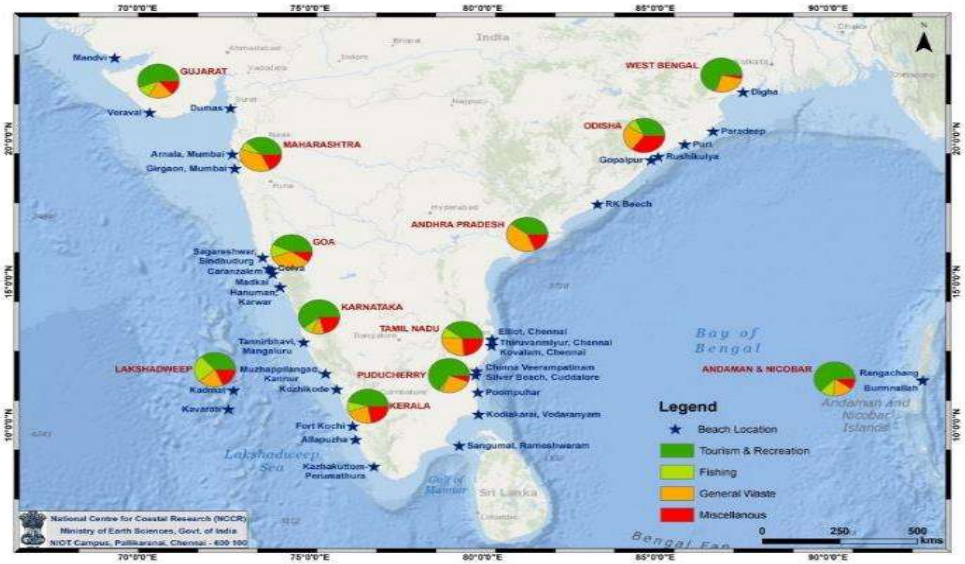
- National Marine Litter Policy is being framed with an objective to clean up the oceans, in line with UN Environment's global 'Clean Seas Campaign' that India joined on World Environment Day 2018.
- India's plastic consumption is 10 times lower than US (109 kg/capita)
- Projections indicate that there will be 18.7% increase in mismanaged plastic mass from 0.6 to 2.88 MMT/ yr. from 2010 to 2025.
- Ministry of Earth Sciences will gauge marine litter and its origin, fate and transport from source to sink.
- Multinational joint efforts / collaborations have been signed (MoU with Norway, UK, SACEP etc.)
- Proposed to adopt 50 Indian beaches for periodical coastal cleanup activities, and monitoring of beach litter.

34 Beaches (26 Coordinators, 6984 Volunteers)
35 tonnes (Total Litter weight)
1-2 km (each beach length covered)
22 (institutes, academics, NGO & Public)



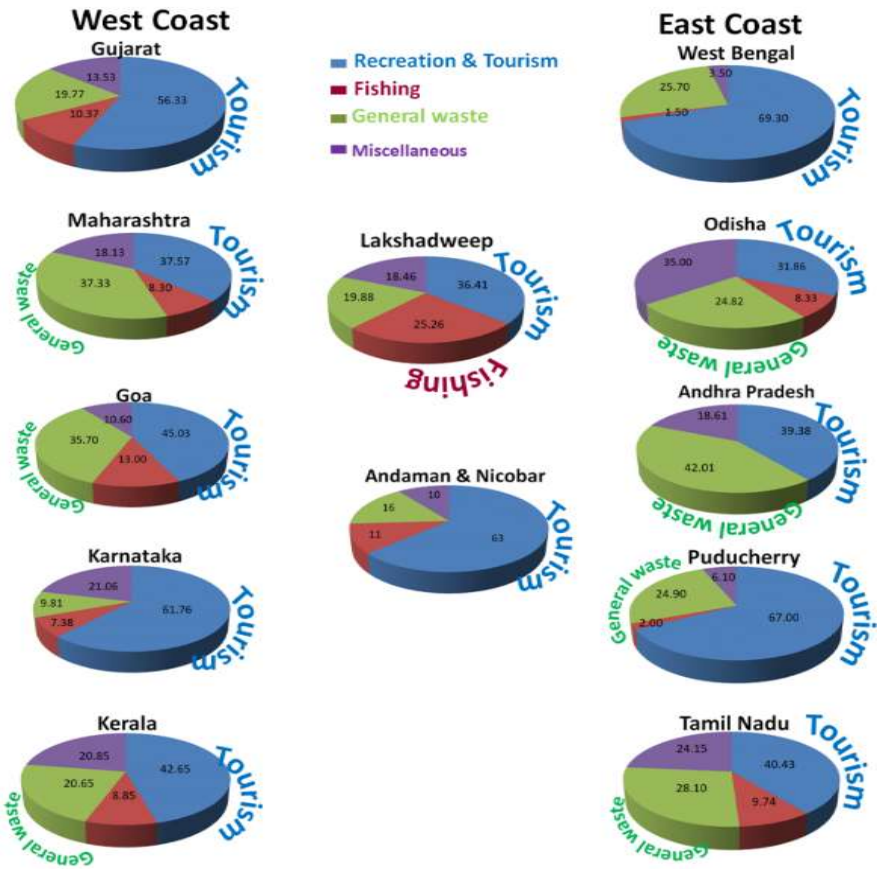
Marine Litter & Microplastics

Coastal Cleanup Day



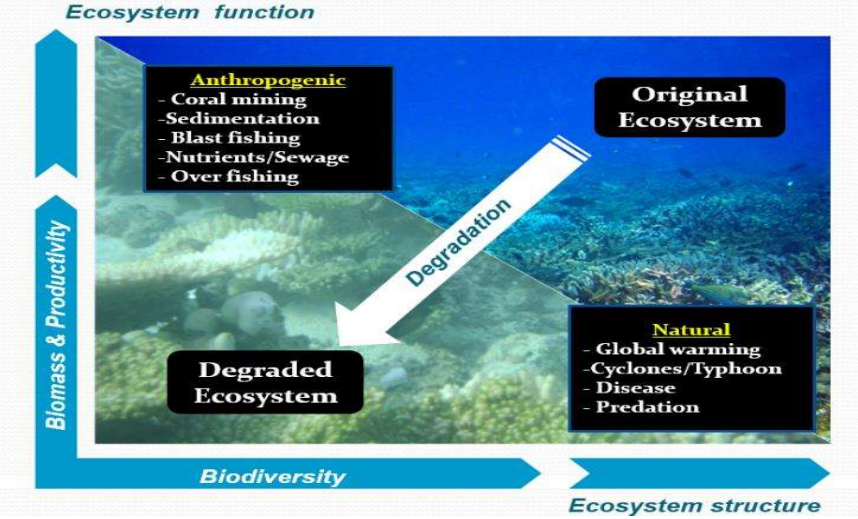
- **34 Beaches, 26 Coordinators, 6,984 Volunteers (ICG, Schools, College, Institutes, NGO & Public)**
- **Total litter : 34.993 tonnes (Plastics & Glass)**
- **Major source: Recreation & Tourism, Fishing**

State-wise composition of Beach Litter



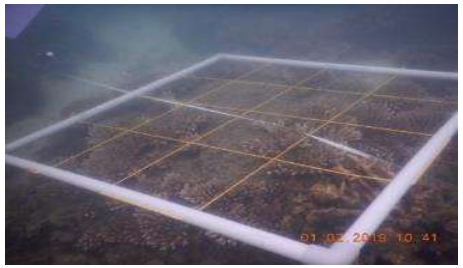
Restoration of coral reefs at Gulf of Mannar

- Coral Reef Monitoring Studies - Impact and Health Status.
- Restoration of Coral Studies - Seasonal and Growth rate.
- Bleaching of corals observed - due to Marine higher SST.
- Coral Reef Health Index – Draft report



Coral Reef Ecosystems in India
- Gulf of Mannar
- Lakshadweep Islands
- Malvan, Maharashtra
- Andaman & Nicobar
- Gulf of Kutch

Monitoring – Status of coral reefs



Bleaching – a major threat to coral ecosystem

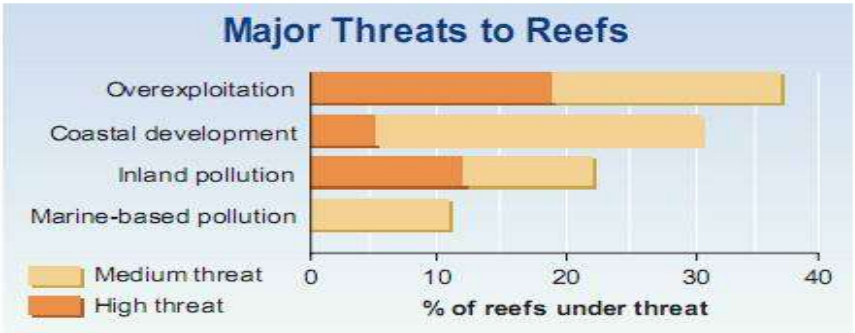
Restoration

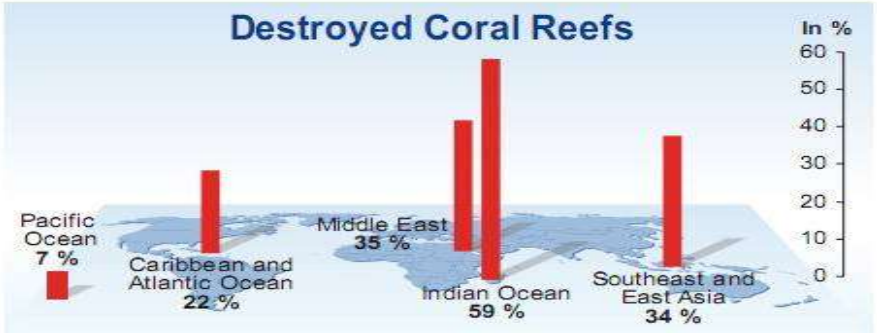
Reefs at Risk

Major Observed Threats to the World's Coral Reefs

Categories

- Tourism
- Poison fishing
- Overexploitation
- Sedimentation
- Coral harvesting
- Dynamite fishing
- Pollution





Source: Bryant et al., *Reefs at Risk: a Map-Based Indicator of Threats to the World's Coral Reefs*, World Resources Institute (WRI), Washington DC, 1998.

Climate Change

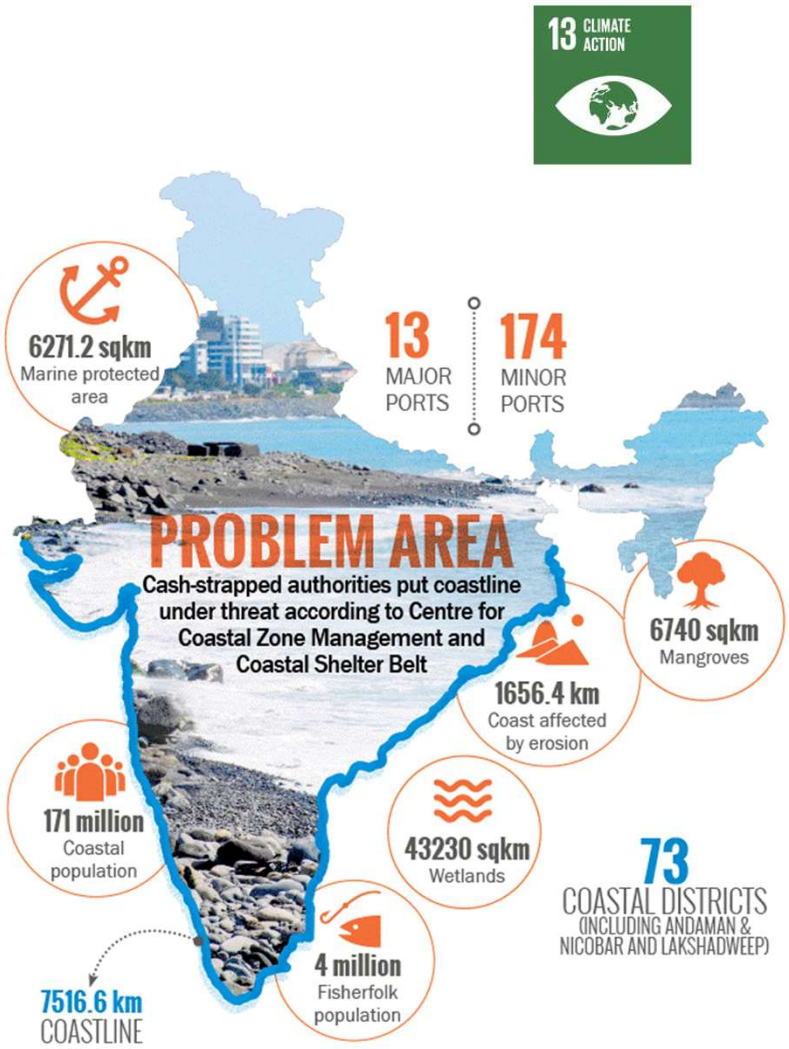
Sustainable Development Goals: Vision 2030

- Take urgent action to combat climate change and its impacts (No. 13)

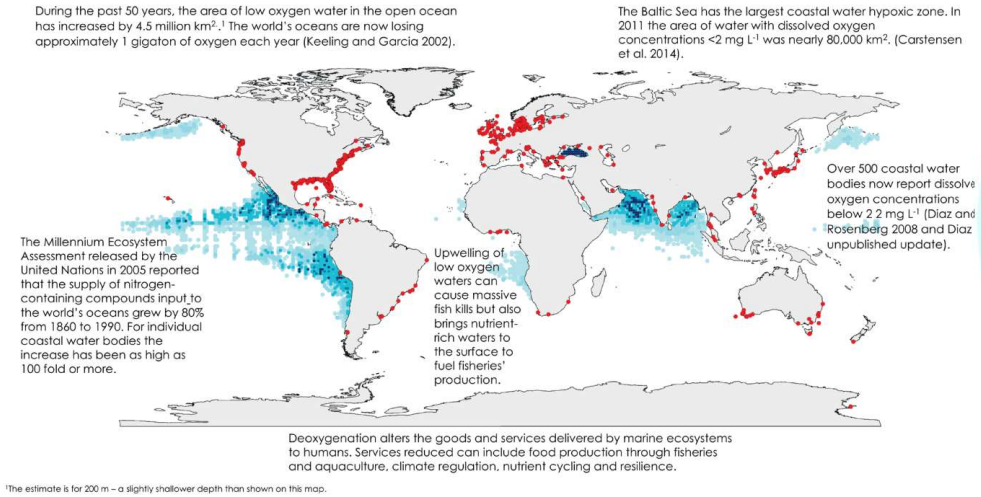
Threats to the Coastal Zone

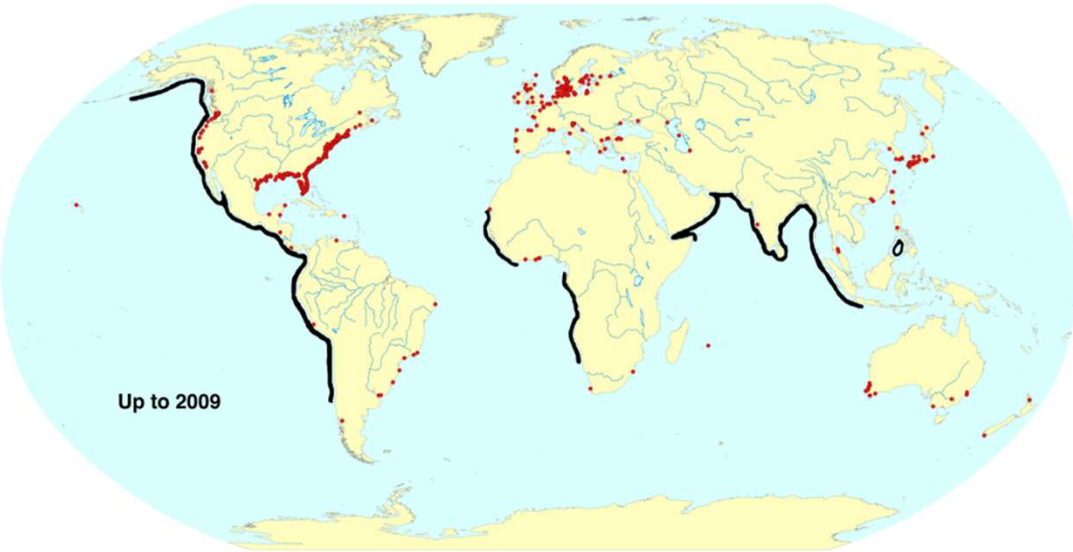
- Sea level rise
- Coastal hazards – cyclone, storm surge, floods etc.
- Geomorphological changes, Erosion/ chocking
- Ecological Risks

- Coastal and Marine Pollutions - land based, oil spill etc.
- Coastal Security



Oxygen Minimum Zones and Coastal Hypoxia Zones





OMZs (blue) and areas with coastal hypoxia (red) in the world's ocean

(Isensee et al., 2015; Breitburg et al., 2018; including oxygen effects from Keeling and Garcia, 2002; Diaz and Rosenberg, 2008; Carstensen et al., 2014).

- **550 Hypoxic Areas**
- **60 Hypoxic Areas in recovery**
- **250 Eutrophic Areas in Danger of Hypoxia**
- **OMZ Touching 1,150,000 km^2 of Seabed**

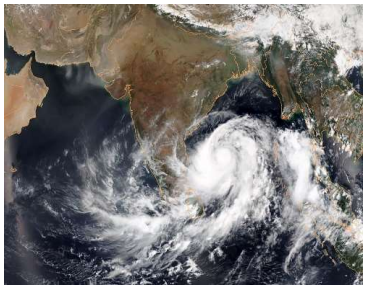
Helly & Levin 2004
Diaz et al. 2010

Coastal Hazards

Coastal hazards are natural and human-made hazards that occur at the interface between the ocean and the shoreline. Coastal hazards are categorized as rapid-onset (fast moving) or slow-onset hazards

Rapid-Onset Hazards
Storms
Flooding
Storm Surge
Tsunamis

Storms



Floods

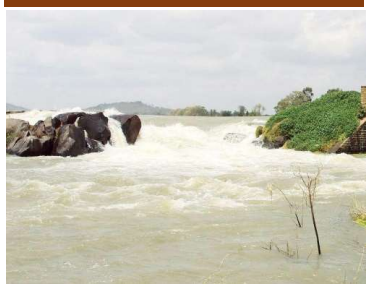
Coastal Flooding

Storm Surge

Slow-Onset Hazards
Shoreline Erosion
Sea Level Rise
Saltwater Intrusion
Land Subsidence

Coastal Erosion

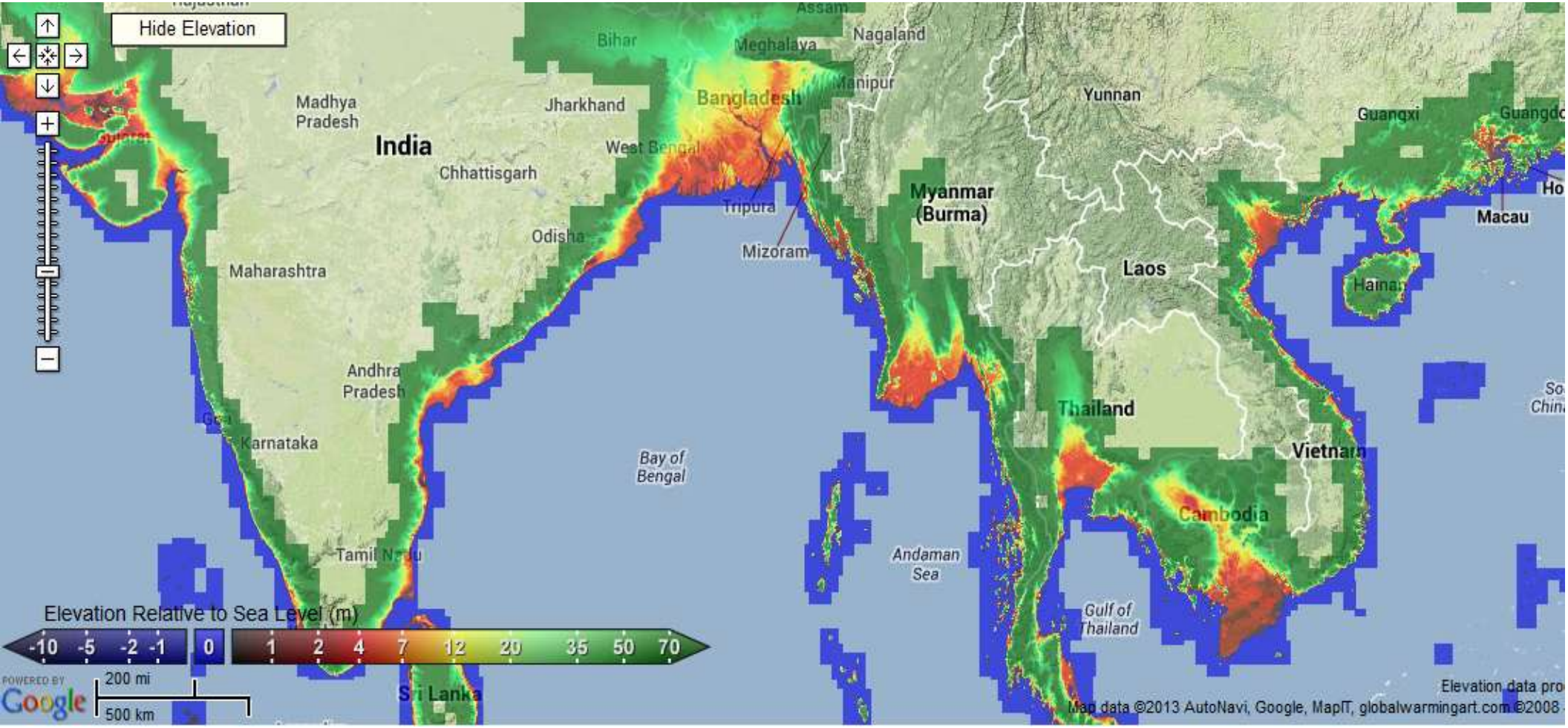
Saltwater Intrusion

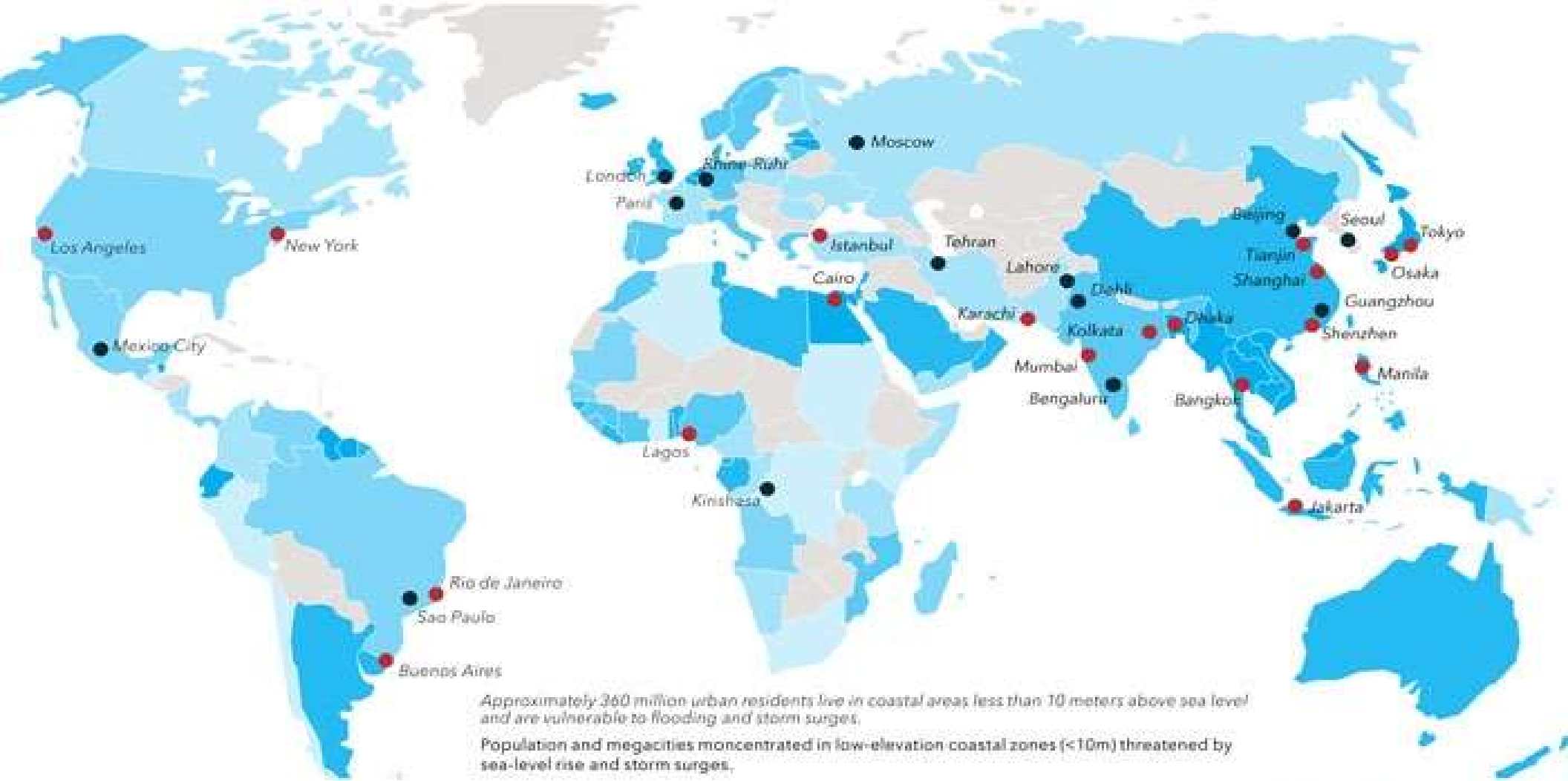


Sea Level Rise

Land Subsidence

Sea Level Change in Southeast Asia

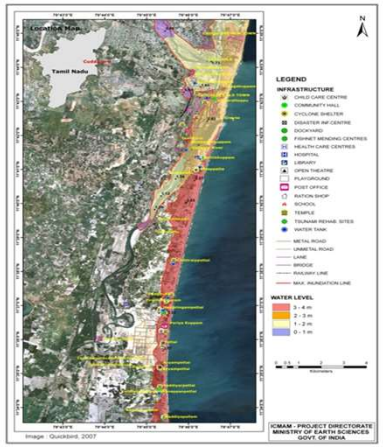




Cities most at risk from sealevel rise and storm surges

Coastal inundation

Tsunami

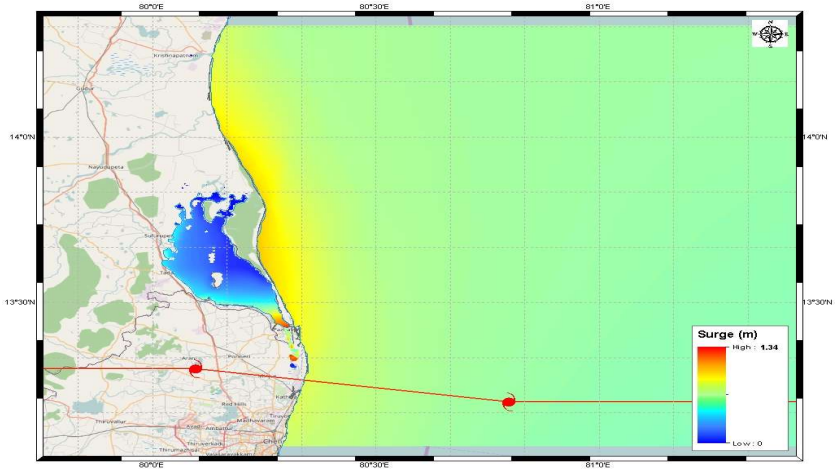


Urban Flood

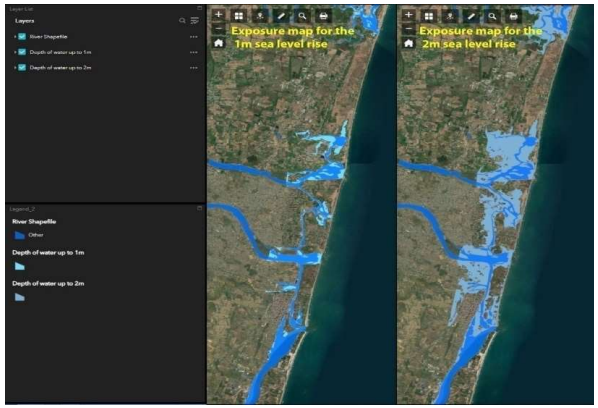
Chennai
1 Dec 2015 : 494mm in 24 hours,

Mumbai
26 July 2005 : 944mm in 24 hours,

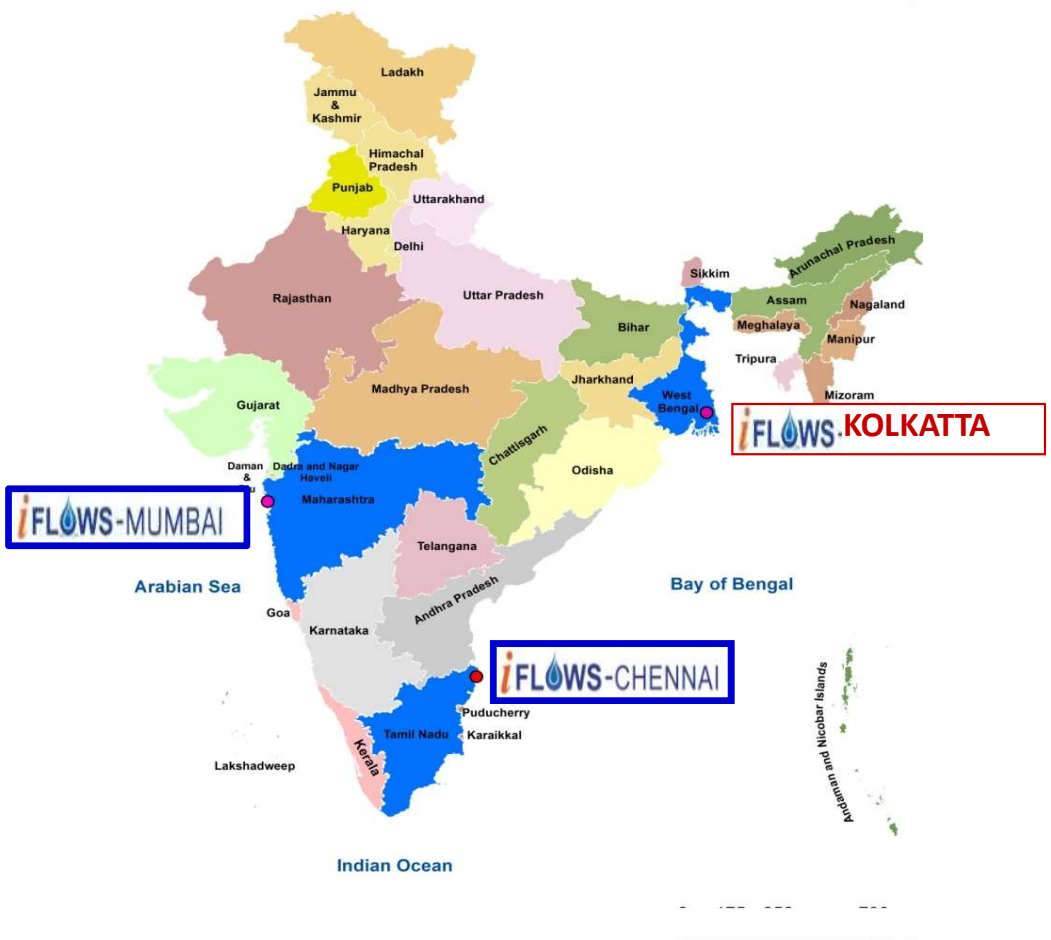
Strom Surge



Sea Level Rise



Integrated Flood Warning System



I-FLOWS is an integrated approach to flood modelling and mapping within the disaster risk reduction framework, leveraging weather models, field data, numerical flood models, and Web GIS technologies for operational purposes.

Developed and made Operational

- **iFLOWS-Chennai (CFLOWS ver 2.0)**
- **iFLOWS-Mumbai**

In the Pipeline

- **iFLOWS-Kolkata**

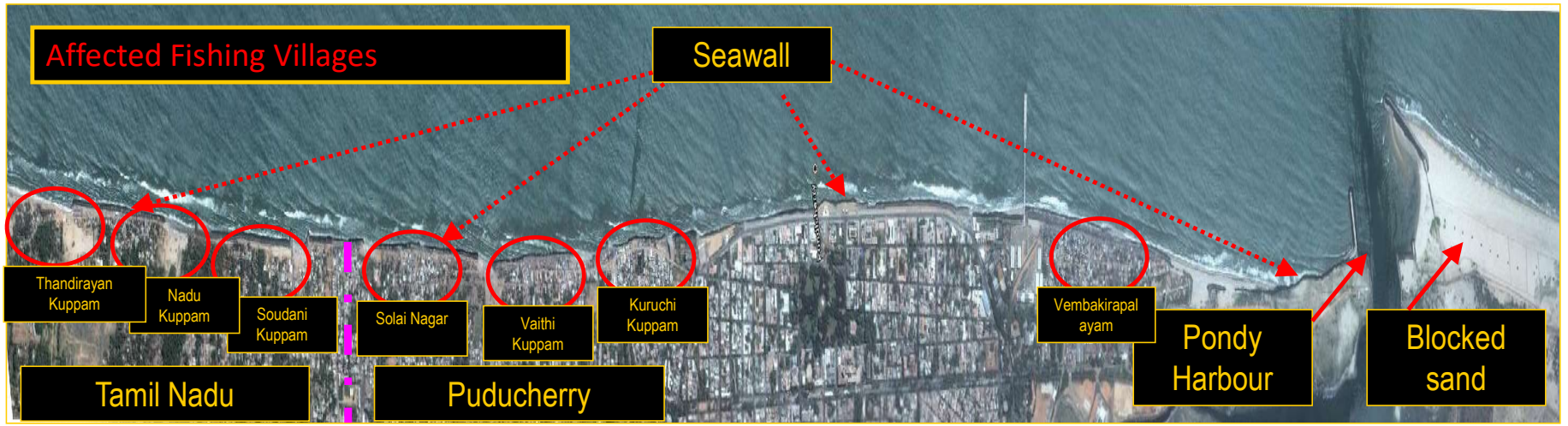
A collaboration of MoES Institutes (IMD, NCMRWF, IITM, NCCR)

Erosion along Pondicherry coast

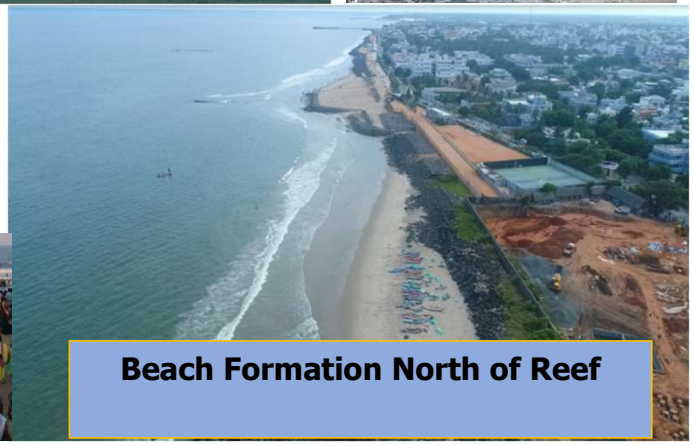
Mid 19th Century

Before constructing harbour

After constructing harbour



Beach Restoration along Pondicherry coast



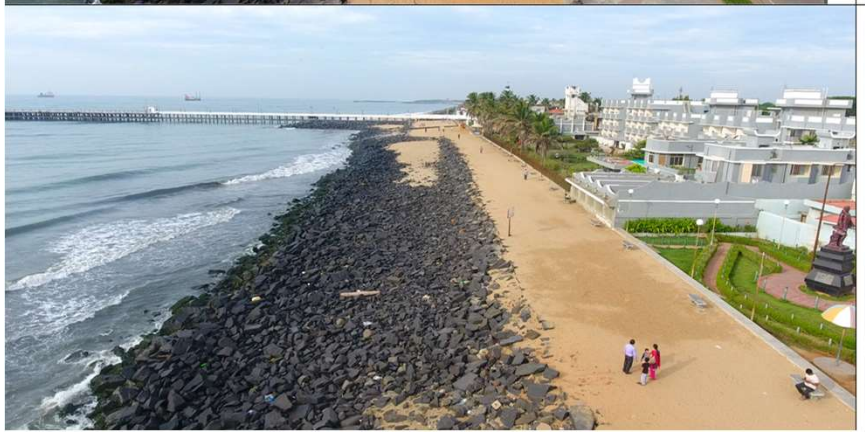
Major Challenge Launching Wedge Reef

Steel caisson of 60 m long, 50 m wide and 2.5m tall and weighing about 900 tons

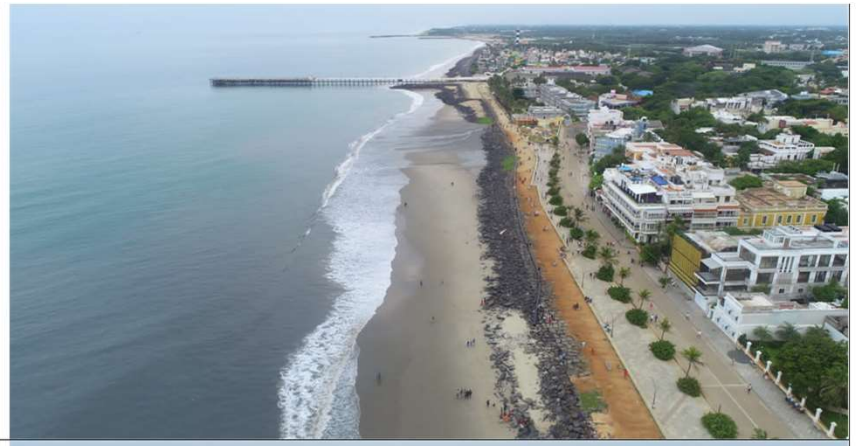
Puducherry- Beach Restoration

Status of Puducherry beach- Before and After nourishment

Before

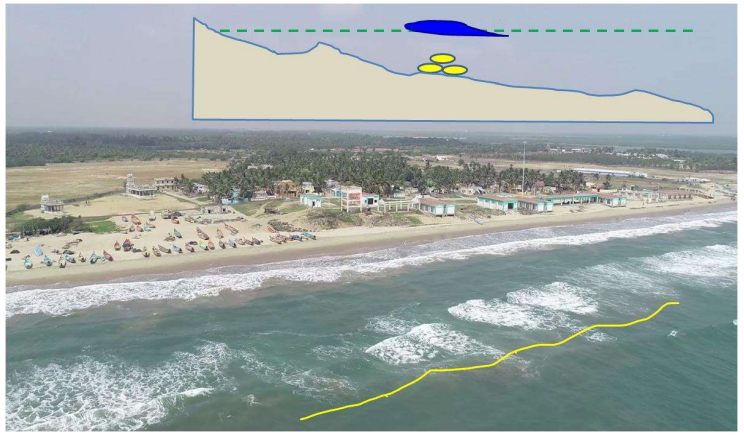


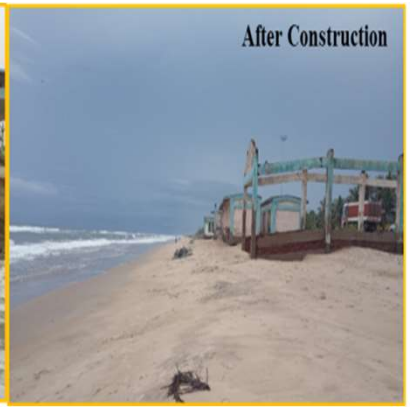
After

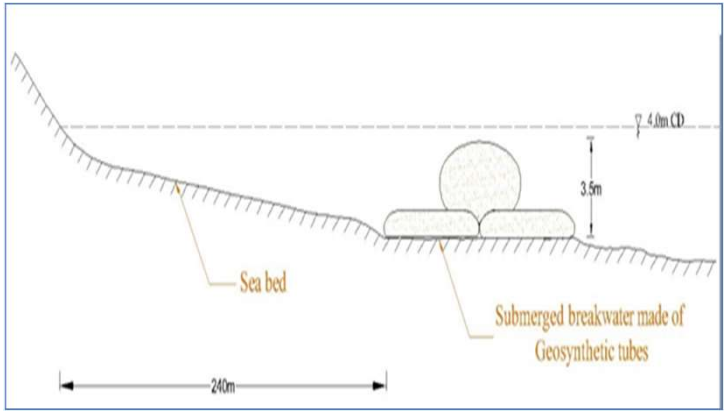


Kadalur Periyakuppam- Erosion

- Severe erosion observed following Nilam, Thane cyclones
- Field monitoring of beach profiles, current, wave, tide and geotechnical parameters carried out for over 4 years
- Proposed Offshore submerged dyke using geosynthetic tubes (25m long 15.7m circumference) designed for shore protection







Kadalur Periyakuppam-Beach Restoration

Developments initiated by India

- The Sagarmala Project
- O-SMART
- Deep Ocean Mission
- Integrated Coastal Zone Management (ICZM)
- Coastal Economic Zones (CEZ)
- Marine Spatial Planning (MSP)
- National Fisheries Policy

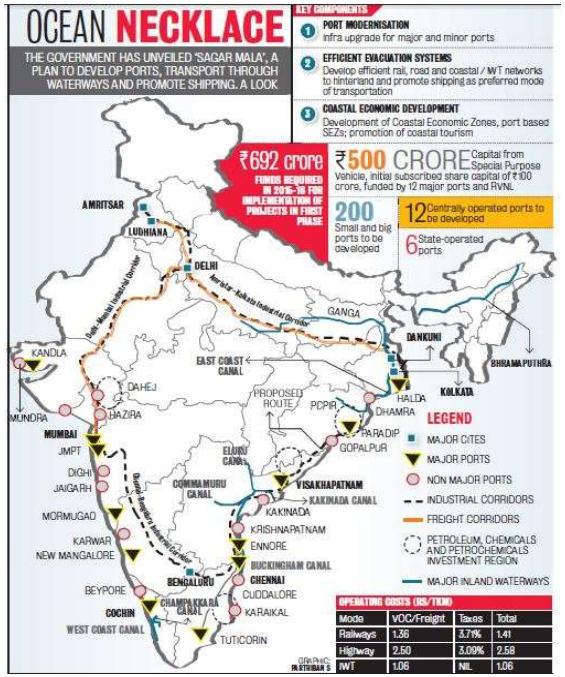
for promoting 'Blue Growth Initiative'

Sagar Mala

Maritime India Vision 2030

Port-led Development

Port Modernisation	Connectivity Enhancement	Port-led industrialisation	Community Development
▪ Capacity improvement at existing ports ▪ New ports ▪ Deep water and dry docking ports	▪ Highways ▪ Railways ▪ Inland waterways ▪ Pipelines ▪ Multimodal Logistics Hubs	▪ Industrial clusters ▪ Industrial corridors ▪ Coastal Economic Zones	▪ Skill Development ▪ Coastal Tourism Development ▪ Marine Fisheries Development



Healthy, resilient & productive marine environment, Ocean governance, Technology, research & development, Business development, investment & finance, Maritime surveillance & enforcement, Infrastructure, Education & capacity building

Deep Ocean Mission

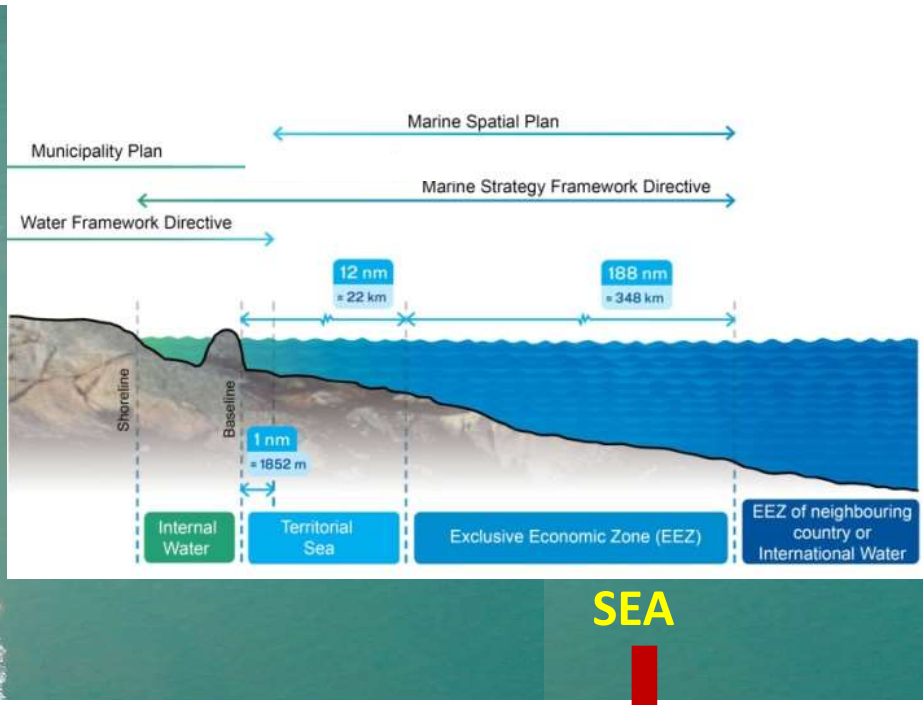
- Technological innovations for exploration and conservation of deep-sea resources.
- Manned submersible for 6000m water depth for under water exploration
- Deep Sea Mining System for extraction of polymetallic nodules

- *With this*,
  - The first country to demonstrate deep sea mining technology beyond 5000 m depth
  - Sustainable harnessing of ocean resources (water, minerals, biodiversity and energy)
  - India will join select club of 5 nations to have manned submersible for ocean exploration

Marine Spatial Planning (MSP)

MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in coastal and marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process.

India – Planning Procedures and Policies



LAND

Landuse Planning -
Central Government prepares Model Acts, Policies / programmes and Guidelines for the benefit of the State Governments

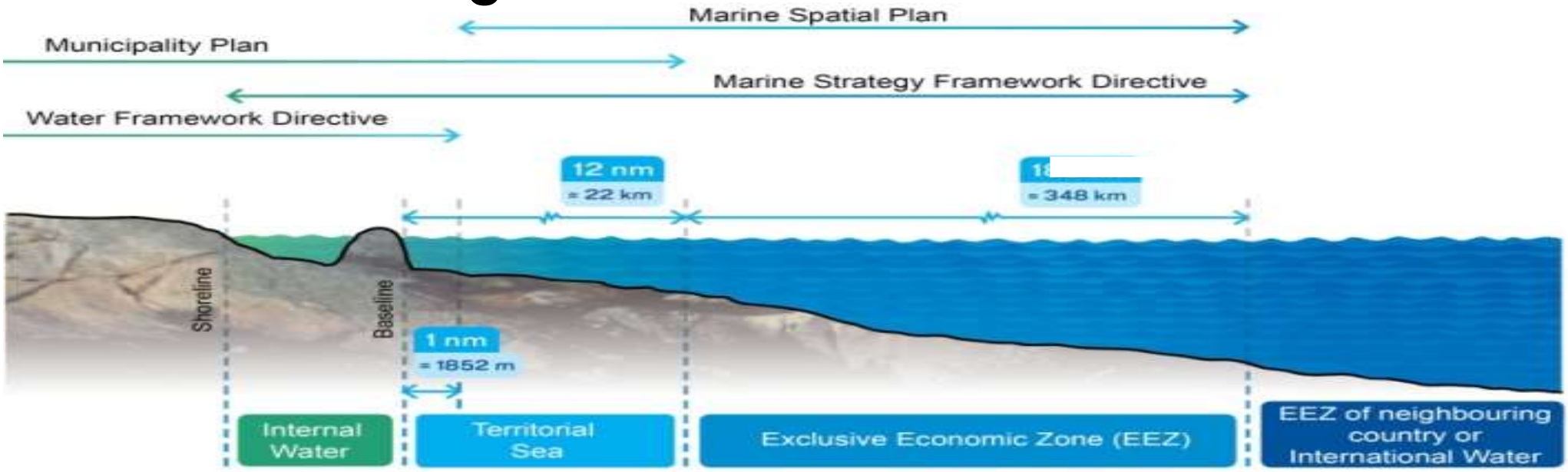
COAST

ICZM Plannning -
Coastal Regulation Zone (CRZ) notification was issued in 1991 under the Environmental Protection Act, 1986, by the Ministry of Environment and Forest - *CRZ-2018*

SEA

Marine Spatial Planning

India – Planning Procedures and Policies



Landuse Planning - Central Government prepares Model Acts, Policies / programmes and Guidelines for the benefit of the State Governments

ICZM Planning -

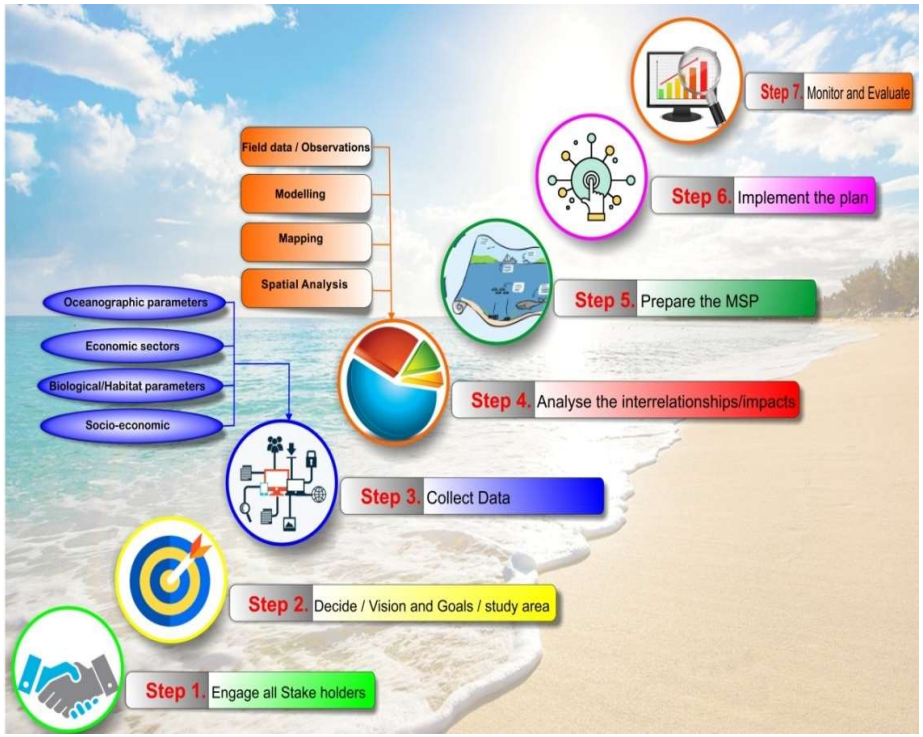
Environment and Forest

ICZM is a subset of MSP

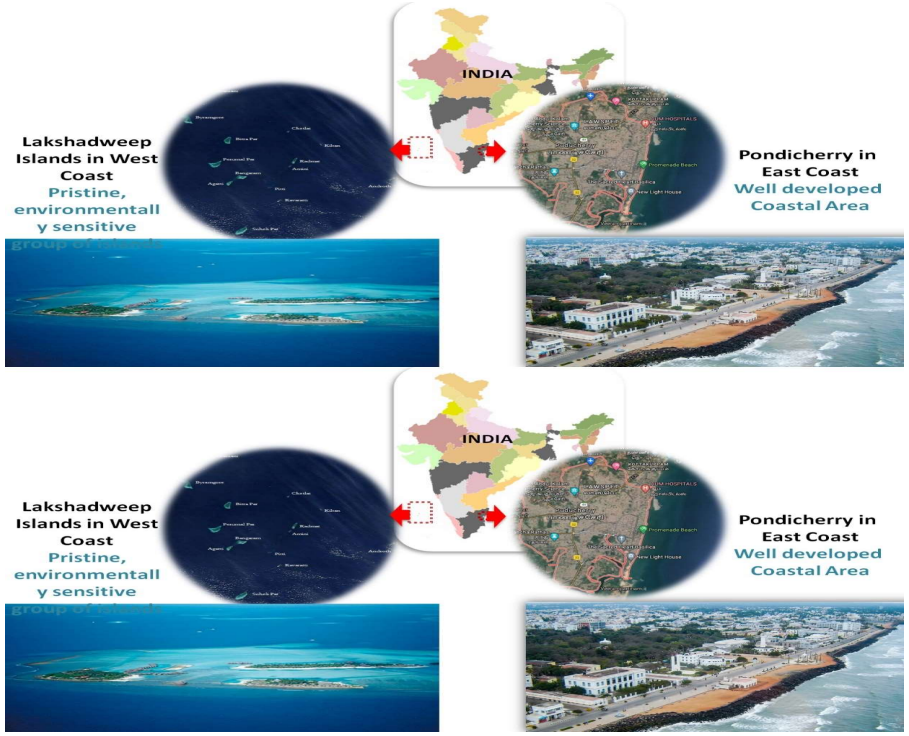
Marine Spatial Planning

Marine Spatial Planning – Integrated Ocean Management

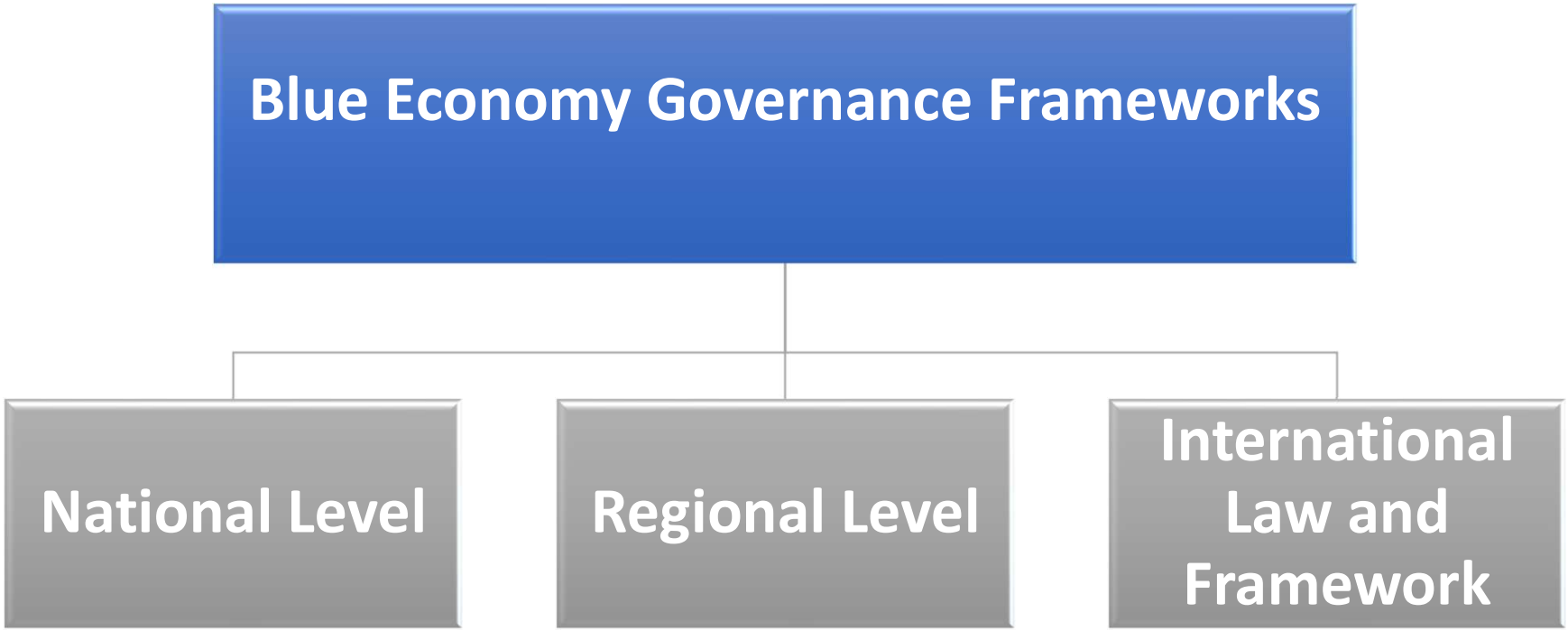
MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in coastal and marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process.



Workflow in Marine Spatial Planning



Pilot Areas : Puducherry and Lakshadweep


Blue Economy Governance Frameworks
National Level
Regional Level
International Law and Framework

National Level

- The country has enacted many policies and laws
  - The **Environment** (Protection) **Act**, 1986,
  - Wildlife Protection Act, 1972,
  - Biological Diversity Act 2002,
  - National Environment Policy, 2006,
  - National Biodiversity Action Plan, 2008,
  - National Action Plan on Climate, 2008
- Fisheries have a separate dedicated regulation
  - Indian Fisheries Act, 1897,
  - Coastal Aquaculture Authority,2005

Regional Level

- IORA | Indian Ocean Rim Association
  - Established in 1997, related to climate change and food security
- IOC | Indian Ocean Commission has developed a Regional Climate Action Plan 2016–2020
- SACEP | South Asia Co-operative Environment Programme
- BoBP-IGO | Bay of Bengal – Intergovernmental Organisation
- Management and Development of the Marine and Coastal Environment of the Eastern African Region,
- Association for South East Asian Nations (ASEAN)

International Law and Framework

- United Nations Framework Convention on Climate Change (UNFCCC),
- Convention on Biological Diversity (CBD),
- Convention on Migratory Species (CMS),
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES),
- United Nations Convention on the Law of the Sea (UNCLOS),
- Food and Agriculture Organisation (FAO),
- Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

Global Agreements that Regulate the use of Oceans

The United Nations Convention on the Law of the Sea (UNCLOS) was adopted in 1982. It lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. The Convention also provides the framework for further development of specific areas of the law of the sea.

Twelve key provisions:

1. Setting limits
2. Navigation
3. Exclusive Economic Zone (EEZ)
4. Continental shelf
5. Deep seabed mining
6. The exploitation regime
7. Technological prospects
8. The question of universal participation in the convention
9. Pioneer investors
10. Protection of the marine environment
11. Marine scientific research
12. Settlement of disputes

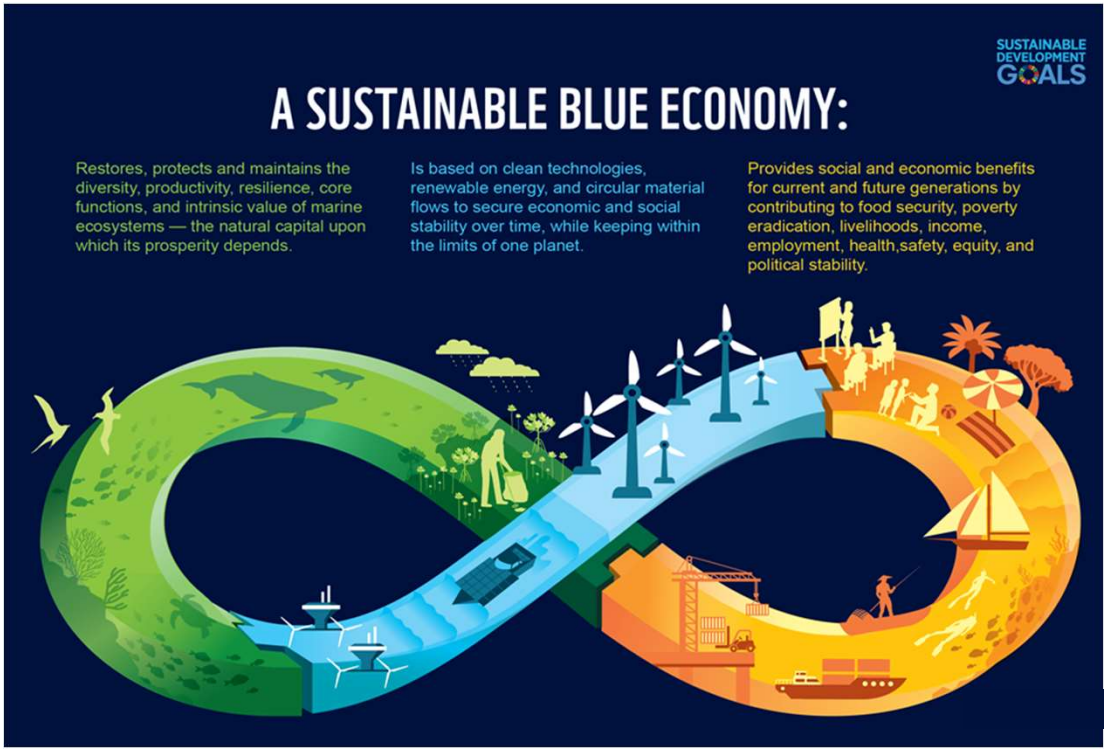
Moving Forward

Innovative technologies, new products and services, and demand for 'green' infrastructure and processes for reshaping the traditional ocean economy to Sustainable Blue Economy

Achieving the blue economy goals would require extensive cooperation between the community of coastal states and stakeholders for economic growth, job opportunities, meeting food, water and energy demands and climate resilient natural resources and it's sustainability

A sustainable Blue Economy -

- **Investment in Nature-Based Climate Solutions**
- Harnessing Ocean-Based Renewable Energy
- Decarbonizing Ocean Industries
- **Securing Sustainable Food for the Future**
- Deployment of Carbon Capture &Storage
- **Expanding Ocean Observation and Research**




Thank You
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