Island Biodiversity & Climate Change

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Andaman and Nicobar Islands

- Number of Islands : 572
- Geographical area : 8249 km²
- Andaman Group : 6268 km²
- Nicobar Group : 1981 km²
- Total Cosatline : 1962 km
- Temperature : 18-34° C
- Mean annual rainfall : 3100 mm
Challenges for the 21st century

- Conservation of Environment
- Sustainable Use of Natural Resources
- Cleaner Production
- Rural & Industrial Development
- ISO 14000 Competitiveness
- Globalization
- Integrated Community Development
- Legislation
- Counteraction of Poverty
- HEALTH & WEALTH for all

SUSTAINABLE DEVELOPMENT
Major Concerns for Biodiversity

- Pollution
- Deforestation
- Desertification
- Soil erosion
- Global warming
- Urbanization
- Extinction of biodiversity
- Population
Andaman and Nicobar Islands

Water surplus and deficit periods

Rainfall (mm)  Evapotranspiration (mm)

Rainfall (mm)
0  50  100  150  200  250
ET (mm)

Season and Months

6%

~48000 ha under cultivation

Typical terrain of A&N Islands
Andaman and Nicobar Islands

- The tropical ecosystem of the A&N Islands is very unique in terms of high rainfall, extremely humid climate, undulating terrain and backwater creeks with high diversity of flora and fauna.

- The topography of the islands ranges from low range hills, narrow valleys at the foothills to coastal plains.

- The flora of the Andaman group of islands shows closer affinity to the Indo-Myanmarese-Thai flora, while the Nicobar groups of islands are closer to the flora of Malaysia-Indonesia.

- Approximately 46,000 ha land is under agricultural crops that include about 30,000 ha land under plantation and fruit crops, about 10,000 ha land under field crops and about 461 ha land as fallow land. The horticultural crops occupy 72% of total cropped area.
2500 angiosperms, and 1500 endemic species.

- More than 150 species of fruits and vegetables
- Around 10 species of oil yielding plants
- 20 species of pulses and cereals.
- Wild mangoes, Nicobari aloo, Andaman coconuts, Andaman grapes & Karen rice

The island is also very rich in medicinal and aromatic flora which includes

- 300 species of medicinal plants,
- 130 species of orchids
- 120 species of ferns
Floral Diversity

- World : 250,000
- India : 45,000
- A&N : 2,300

No. of Plant species per 1000 Km²

- World : 2
- India : 14
- A&N : 279

Aglaonema simplex

Ground Orchid
Faunal Diversity

- 215 species of butterflies
- 68 species of birds
- 1434 species of fishes
- 300 species of corals
- 120 species of sponges
- Teresa goat, Nicobari fowl, Nicobari pigs, hawa bill birds: indigenous to this island

<table>
<thead>
<tr>
<th>Region</th>
<th>Count</th>
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<tr>
<td>India</td>
<td>92916</td>
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<tr>
<td>A&amp;N</td>
<td>5,100</td>
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# Marine Protected Areas

<table>
<thead>
<tr>
<th>Marine Protected Area</th>
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</thead>
<tbody>
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<td>National parks</td>
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<td>9</td>
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<tr>
<td>MNPs</td>
<td>4</td>
<td>2 (MGMNP, RJMNP)</td>
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<tr>
<td>Sanctuary</td>
<td>515</td>
<td>96</td>
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<tr>
<td>Biosphere reserve</td>
<td>18</td>
<td>1 (GNBR)</td>
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<tr>
<td>MPA</td>
<td>7 (has 3 marine wildlife sanctuaries)</td>
<td>2</td>
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## Marine biodiversity

<table>
<thead>
<tr>
<th>Fauna</th>
<th>World</th>
<th>India</th>
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<tr>
<td>Sponges</td>
<td>8360</td>
<td>519</td>
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<tr>
<td>Mangroves</td>
<td>80</td>
<td>59</td>
<td>34</td>
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<tr>
<td>Marine mollusc</td>
<td>56235</td>
<td>32751</td>
<td>1422</td>
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<tr>
<td>Crustaceans</td>
<td>24375</td>
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<td>837</td>
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<tr>
<td>Hard Corals</td>
<td>700</td>
<td>334</td>
<td>334</td>
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<tr>
<td>Flat worms</td>
<td>400</td>
<td>19</td>
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<tr>
<td>Polychaetes</td>
<td>8000</td>
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<td>Siphoncululates</td>
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<td>25</td>
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<tr>
<td>Echinoderms</td>
<td>6226</td>
<td>765</td>
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<tr>
<td>Fishes</td>
<td>31723</td>
<td>2546</td>
<td>1485</td>
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<tr>
<td>Amphibians</td>
<td>550</td>
<td>219</td>
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<tr>
<td>Reptiles</td>
<td>5817</td>
<td>456</td>
<td>104</td>
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<tr>
<td>Birds</td>
<td>9026</td>
<td>1250</td>
<td>284</td>
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<tr>
<td>Mammals</td>
<td>4629</td>
<td>410</td>
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<tr>
<td>Fish Families</td>
<td>No. of Species</td>
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<td>----------------</td>
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<td></td>
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<tr>
<td>Carcharhinidae</td>
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<tr>
<td>Sphyrnidae</td>
<td>05</td>
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</tr>
<tr>
<td>Alopiidae</td>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squalidae</td>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristidae</td>
<td>03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhinobatidae</td>
<td>04</td>
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</tr>
<tr>
<td>Dasyatidae</td>
<td>10</td>
<td></td>
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</tr>
<tr>
<td>Rajidae</td>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myliobatidae</td>
<td>05</td>
<td></td>
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</tr>
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<table>
<thead>
<tr>
<th></th>
<th>World</th>
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<th>A&amp;N</th>
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<tbody>
<tr>
<td><strong>Elasmobranchs</strong></td>
<td>31000</td>
<td>2546</td>
<td>1463</td>
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</table>

![Shark](image1.png)

![Rajidae](image2.png)

![Myliobatidae](image3.png)

![Carcharhinidae](image4.png)

![Sphyrnidae](image5.png)

![Alopiidae](image6.png)

![Squalidae](image7.png)

![Pristidae](image8.png)

![Rhinobatidae](image9.png)

![Dasyatidae](image10.png)
### Ornamental fishes

<table>
<thead>
<tr>
<th>Fish Families</th>
<th>No. of Species</th>
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<tr>
<td>Apogonidae</td>
<td>46</td>
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<tr>
<td>Chaetodontidae</td>
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<tr>
<td>Cirrhitidae</td>
<td>05</td>
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<tr>
<td>Pomacentridae</td>
<td>77</td>
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<tr>
<td>Pomacanthidae</td>
<td>20</td>
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<tr>
<td>Labridae</td>
<td>64</td>
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<tr>
<td>Scaridae</td>
<td>25</td>
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<tr>
<td>Blenniidae</td>
<td>57</td>
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<tr>
<td>Balistidae</td>
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<tr>
<td>Ostracidae</td>
<td>05</td>
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<tr>
<td>Gobiidae</td>
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![Image of ornamental fishes](image-url)
## Food fishes

<table>
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<tr>
<th>Fish Families</th>
<th>No. of Species</th>
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<td>Clupeidae</td>
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<td>Hemirhamphidae</td>
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<td>Serranidae</td>
<td>58</td>
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<tr>
<td>Lutjanidae</td>
<td>43</td>
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<tr>
<td>Lethrinidae</td>
<td>22</td>
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<tr>
<td>Nemipteridae</td>
<td>22</td>
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<tr>
<td>Leiognathidae</td>
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<tr>
<td>Carangidae</td>
<td>46</td>
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<tr>
<td>Scombridae</td>
<td>18</td>
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<tr>
<td>Xiphiiidae</td>
<td>01</td>
</tr>
<tr>
<td>Istiophoridae</td>
<td>04</td>
</tr>
<tr>
<td>Sphyraenidae</td>
<td>09</td>
</tr>
<tr>
<td>(Flat fishes)</td>
<td>31</td>
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</table>
837 species of crustaceans have been recorded from the A & N Islands.

The commercially important species are well described.

Several cryptic species are yet to be described.
Mollusca

<table>
<thead>
<tr>
<th>World</th>
<th>India</th>
<th>A&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>56235</td>
<td>32751</td>
<td>1422</td>
</tr>
</tbody>
</table>
Crab Eating Macaque (Nicobar Monkey)
Salt Water Crocodile

Photo: Dr S S Garbiyal
Olive Ridley Turtle
White-bellied Sea Eagle
Butterfly fish (Chaetodon sp)
Oriental sweetlips (Plectorhinchus spp.)
Longfin bannerfish (Heniochus acuminatus)
Hawk fish (*Paracirrhites* spp.)
Damsel fish (*Chromis* sp.)
Corals in A&N Islands

Pavona minuta
Corals in A&N Islands

Tubustrea coccinea
Corals in A&N Islands

Leptoria phrugia with Golden sweepers
Corals in A&N Islands

Gonipora tenuidens
Platygyra Lamellina

Corals in A&N Islands
Corals in A&N Islands

Staghorn Coral (*Acropora validata*)
Corals in A&N Islands

Hedgehog coral (*Echinopora lamellosa*)
Corals in A&N Islands

Soft coral (*Lobophyton spp.*)
Coral eating starfish

Crown of Thorns (Acanthaster planci,)

[Image of a Crown of Thorns starfish]
Star fish
Feather Star
Sea Fan
Giant clam (*Tridacna Spp.*).
Oyster
Sting ray
Jelly fish
Sea anemone
Common reef Octopus
Sea grass and sea weeds
Mangroves

Middle Andaman
Mangrove Fish
Coconut diversity

Andaman Dwarf coconut

Andaman Giant coconut

Andaman Ordinary Tall (AOT)
Evaluation in WCG resulted in the identification of Niu Lekha as a promising dwarf cultivar with the highest copra content 245 g/nut. Among the dwarf coconuts (Green, Orange and Yellow dwarf), Green dwarf was found a promising cultivar for tender coconut-water.

A high yielding variety of arecanut “Samrudhi” was released by All India Co-ordinated Palm Improvement Project.
WCGC
Varieties developed

Coconut

- CARI- Annapurna
- CARI- Chandan
- CARI- Surya
- CARI- Omkar

Areca nut

- CARI selection
- MANGLA
The Karen rice land races are being grown and maintained since 1925 till date by Karen community who originally came from Burma (now Myanmar) and settled in Andaman.

These rice land races have special features suiting to their socio-cultural and consumption purposes.

Their registration with PPVFRA, New Delhi is in progress.
Intra-varietal variability detected in popular rice land race C 14-8 in A & N Islands

- Light purple furrows on husk
- Yellow husk with black tip
- Yellow husk
- Golden furrows on golden husk

C 14-8
<table>
<thead>
<tr>
<th>Crops</th>
<th>Year for collection &amp; conservation of germplasm</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
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<td>Mungbean</td>
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<td>49</td>
<td>11</td>
<td>19</td>
<td>79</td>
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<tr>
<td>Urdbean</td>
<td></td>
<td>41</td>
<td>13</td>
<td>23</td>
<td>77</td>
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</tbody>
</table>

Local Landraces of Mungbean & Urdbean
<table>
<thead>
<tr>
<th>Crops</th>
<th>Year for collection &amp; conservation of germplasm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011-12</td>
</tr>
<tr>
<td>Pigeonpea</td>
<td>26</td>
</tr>
<tr>
<td>Beachpea</td>
<td>-</td>
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</table>
Orchids Biodiversity
Specialty Flowers
Nicobari aloo (*Dioscorea alata*)
Neil Mango
Khoon phal (*Heamatocarpus validus*)
Kewadi (*Pandanus lerum*)
Noni Varieties

**CARI HD-6**
*(CARI Sampada)*

**CARI-Noni Saline-1**
*(CARI Rakshak)*

**CARI-TRA-1**
*(CARI Noni Samridhi)*

**CARI-TRA-2**
*(CARI Noni Sanjivini)*
Farm Animal Genetic Resources of A & N Islands

**Indigenous Germplasm**

- Desi cattle
- Trinket cattle
- Desi Buffalo
- Andaman local goat
- Feral (Barren Island) Goat
- Teresa Goat
- Andaman Desi Pig
- Andaman Wild Pig
- Nicobari Pig
- Brown Nicobari
- White Nicobari
- Black Nicobari
- Frizzle Fowl
- Naked neck
- Burmese fowl

**Exotic/Introduced Germplasm**

- Jersey Cross
- HF Cross
- Murrah cross
- Malabari Goat
- Boer Cross
- Large White Yorkshire
- Japanese Quail
- Duck
- Broiler
- Turkey
- Guinea Fowl
- Rabbit
Nicobari fowl - locally called as Takniet among Nicobari tribes.

- Short shank length
- Compact body with curve shape
- Efficient feed convertors under backyard rearing
- High disease resistance character

BROWN
BLACK
WHITE
Nicobari Pig

- Nicobari pig is indigenous breed of Nicobari tribes.
- It is a family asset of tribes
- Highly suitable for free range system under coconut feeding.
- High prolificacy
- Castrated male and adult female showed higher body weight (100-150 kg).
- Age at first farrowing (months): 10.91 ± 0.85
- Litter size (No.): 6.48 ± 0.31
Terese goat

- Found in Nicobar group of islands.
- Tribal community rears them for meat.
- Age at sexual maturity is about 9 months.
- Body weight at 4 years is about 60-65kg.
- Average milk yield may go up to 1lit/day.
- First kidding is 12-13 months
- Feeds on coconut leaves, bakri patti, leaves of bread fruits.
- Colour black, brown or white patches on forehead, males have beard, long straight legs, girth is more.
**VALUABLE**

- Rich in biodiversity
- Exhibit high degree of endemism
- Provide livelihood to people
- Islanders have cultures distinct from mainlanders

**VULNERABLE**

- Small size
- Similar to fragmented habitats
- Small catchments hence
- Low water retention capacity
- Greater exposure to waves and winds
- Highly susceptible to minor ecological changes
- Extinction rate much faster than in mainland
Major Conservation and Management Issues

- Protection
  - Remote/ scattered islands separated by vast sea and a very long coastline
  - Inadequate infrastructures for mobility and patrolling
  - Inadequate infrastructures for frontline staff in remote and inaccessible localities

- Management of Invasive Species

- Research, survey and monitoring

- Balance between conservation and development

- Capacity Development of officials and frontline staff at all levels in conservation and management of marine biodiversity
Andaman

- Mountainous volcanic islands
- Threats due to sea-level rise is NOT severe
- But there is threat to livelihood due to loss of key habitats

Nicobars

- Coral Islands: Mostly flat topography
- Rise in sea-level would mean higher tides/storm surges
- Extreme climates may affect the freshwater supply
- Threats to livelihood due to loss of land, key habitats
Consequences of climate change

- Increase in air temperature
- Increase in sea surface temperature (SST)
- Increase in sea-level
- Increase in CO₂ in atmosphere and water
- Changes in rainfall/ extreme rainfall events
- More extreme weather conditions - more number of cyclones, hurricanes and typhoons
Climate-induced changes in Island Ecosystem

**Physical**
- Temperature & Sea level
- Salinity, pH, Currents
- Nutrients
- Oxygen
- Ice cover
- Turbulence & mixing
- Wind - Speed & Direction
- Storm - Frequency/intensity
- Evaporation
- Precipitation & Runoff

**Ecological**
- Species distribution
- Reproduction & Recruitment
- migration, abundance
- Physiology & Behaviour
- Sex ratios
- Calcification rates
- Upwelling
- Coastal habitat loss
- Coral bleaching frequency & severity
- Disease Incidence
- Algal blooms

**Ecosystem/Livelihood**
- Productivity
- Distribution
- Species availability
- Days at sea
- Accidents
- Loss of harbour/ homes
- Damage to assets
- High insurance costs
- Livelihood diversification
- Difficulty in seasonal livelihood activities
Three Pillars of Island Economy

- Tourism
- Fisheries
- Agriculture

Coastal Habitats affecting Tourism and fisheries

- Coral reef
- Mangroves
- Sea grass

How climate change affects A & N Islands
Mangrove areas of A & N Islands

- Total mangrove area: 4827 sq. km. out of this 966 sq. km. in A & N islands, 929 sq. km. Andamans, 37 sq. km. - Nicobar

- Luxuriant mangroves can be seen in Shoal Bay (South Andaman), Yerrata (Middle Andaman), Austin Creek (Mayabunder), Kalighat Creek & Cadel Bay (Diglipur)

- Mangrove of Andaman and Nicobar Islands consists of 17% of total mangrove areas of mainland India.
True Mangroves

Avicennia marina

Xylocarpus granatum

Acanthus ebracteatus

Ceriops tagal

Bruguiera parviflora
Sonneratia ovata

Nypa fruticans

Bruguiera gymnorrhiza
Mangrove roots exposed during low tide
(\textit{Bruguiera sp})
Mangrove nursery at Durgapur in Diglipur
Mangrove associates

Crinum asiaticum

Thespisia populnea

Clerodendron inerme

Acrostrichum aureum
Responses of Mangroves to Climate Change

Changes in temperature

• Mangroves stop producing leaves below 15°C.
• Mangrove root structures and establishment of mangrove seedlings are affected above 35°C.
• Photosynthesis is arrested above 38°C.

Increase in sea-level

Mangroves can adapt (special aerial roots, support roots, and buttresses to live in muddy, shifting, and saline conditions) to sea-level rise if it occurs slowly.
Responses of Mangroves to Climate Change

Increase in CO₂ in atmosphere and water

- **Direct impact** - Increases photosynthesis and the average growth rates (*Rhizophora stylosa* and *R. apiculata*).

- **Indirect impact** - Damage to coral reefs may adversely impact mangroves that depend on the reefs to provide shelter from wave action.

Changes in **rainfall (precipitation)**

- **Decreased precipitation** – Decreases mangrove productivity, growth, seedling survival, mangrove area and diversity.

- **Increased precipitation** - Increases mangrove area, diversity, growth rates in some species and also allow mangroves to migrate and outcompete saltmarsh vegetation.
Effects of damage of mangroves to Islands

• All social and ecological value depending on Mangroves will be affected.
• Income of fishermen will be drastically affected.
• Commercial fisheries related to Mangrove ecosystem will be affected.
• Loss of habitat for a number of molluscs, birds, insects, crustaceans, monkeys, and reptiles.
• Mangrove destruction will affect coastal development and human safety.
Responses of Corals to Climate Change

● **Increase in sea surface temperature**

• High levels of photosynthesis and nitric oxide production by zooxanthellae

• Polyp expels the zooxanthellae and eventually dies due to starvation.

● **Increase in CO₂ in atmosphere and water**

• Increase in acidity and decrease in calcification

• Overall decrease in growth of reef
Responses of Corals to Climate Change

Unusual rainfall (precipitation)

- Extreme rainfall, low salinity and high sedimentation
- High content of microbes

Increase in sea-level

- Diminished light conditions.
- Corals that currently exist at shallow depths are expected to go extinct with rising sea levels.
- Reduced growth rates due to increasing SST or acidification, makes it difficult for reefs to cope up with a rising sea-level.
Effects of damage of Corals to Islands

• Coastlines are prone to harsh ocean storms and floods due to reefs damage.

• Commercial and artisanal fisheries will be affected.

• Tourism will be badly affected
Chowra is the most vulnerable island to climate-associated disasters.

**Agricultural Vulnerability map**
prepared based on multiple parameters showed that about 20% of the area in Car Nicobar has high vulnerability to climate change.
Effect of climate change on our neighbours

Bangladesh

Myanmar

Thailand
Myanmar (Burma)

- A Least Developed Country with an Unstable political environment
- Donors don’t trust govt and hence no funds flow
- Poor response from Govt. to deal with climate change
- Unprotected coasts
- Witnessing adverse climate changes (Frequent floods/Cyclones) almost every year during last three decades.
• 1% of the world’s tropical storms hit Bangladesh.

• More than 36% of the people live below poverty line.

• Per capita income is US $370, emphasizing the economic depression.

• Climate models estimate a constant increase of temperature in Bangladesh and vulnerability to water related diseases.
• Low level lands, occupying 80% of the country – they are disaster prone.

• About 10% of the country is hardly 1 m above the mean sea level.

• Higher population density (>1209 persons per km²; 133 million people) limits the migration within the country.
Potential impact of sea-level rise on Bangladesh

Today
Total population: 112 Million
Total land area: 134,000 km²

1.5 m - Impact
Total population affected: 17 Million (15%)
Total land area affected: 22,000 km² (16%)
Coastal regions of Thailand are extremely vulnerable to climate changes.

Coastal erosion, altered wetlands, frequent floods are some of the observed impacts of climate change.

Most of the population reside in proximity to the oceans.

Landslides pose a serious threat to these coastal villages.

Recent weather severities, due to climate change, like flooding and non-seasonal rainfalls have destructive effects on agriculture and rural livelihood. **Rice yields decline 10% with 1° C increase in temperature.**
How this will affect our security environment

• Displaced people may move to our islands. As the population is ethnically similar to our population it is difficult to identify them. These will be potential security risk

• Loss of livelihood of this huge population may lead to poaching in our seas.

• This can also lead to their taking up drug trafficking, gun running using our sea routes at the behest of bigger player antagonistic to our interests
Mangrove & Tsunami

• During the recent Tsunami, the Pitchavaram mangrove forest in Tamil Nadu in India, slowed down the waves, protecting around 1700 people living in the hamlets, built inland between 100-1000 metre from the mangroves.

• Similar observation has been made in case of South Andaman also.
During Tsunami (26.12.2004) at Marina Park
Damage of mangrove

✖ It has been observed that mangroves in many places have been degraded condition due to various factors, now aggravated by the recent Tsunami.

✖ In addition, in some places like south Andamans the coastal non-mangrove vegetables have been quite devastated.

✖ With reference to the above observations, it is suggested that mangrove restoration could be undertaken in degraded areas and bio-shields could be created in exposed coastal areas.
Acrosticum spp. affected by tsunami
Sedges affected by tsunami

True mangrove affected by tsunami
Tsunami impact on mangrove associates
Tsunami affected paddy field

Reverse water flow after Tsunami
High tide