CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU

COASTAL ECOSYSTEM

Capacity Building Programme

REPORT

MARCH 2024

Funded By
Department of Environment and Climate Change
Government of Tamil Nadu

Prepared By
Centre for Climate Change and Disaster Management
Department of Civil Engineering
Anna University, Chennai

TEAM – CLIMATE STUDIO

PRINCIPAL INVESTIGATORS	:	*Dr. Kurian Joseph,* *Professor & Director, CCCDM*
		Dr. A. Ramachandran *Emeritus Professor, CCCDM &* *Member, Chief Minister's Governing Council on Climate Change*
RESEARCH TEAM		
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ADMINISTRATION TEAM	:	*Mr. D. Murali, Superintendent* *Ms. H. Janani, Project Assistant* *Mr. S.T.Udhayachandran, Project Assistant*

ACKNOWLEDGEMENT

We sincerely acknowledge the support and encouragement by Tmt. Supriya Sahu IAS., Additional Chief Secretary to Government, Department of Environment, Climate Change and Forests, Government of Tamil Nadu, Thiru. A.R. Rahul Nadh IAS., Director, Department of Environment and Climate Change, Government of Tamil Nadu and Thiru. Deepak Bilgi IFS., Chief Mission Director, Tamil Nadu Coastal Restoration Mission, for the successful execution of the project "Operationalization of Climate Studio" and in completion of the Climate Vulnerability Assessment and Adaptation Plan for the key sectors of Tamil Nadu.

We extend our acknowledgement to the, Tamil Nadu Forest Department, Water Resources Department (WRD), Fisheries Department, and State Disaster Management Authority for their support in nominating participants for the capacity building program. Additionally, we would like to thank all the participants who attend the program.

We humbly acknowledge Prof. Dr. R. Velraj, the Honourable Vice Chancellor, Anna University, Dr. G. Jeyasekaran, Former Director of Research, Tamil Nadu Fisheries University, Er. G.R. Radha Krishna, Executive Engineer, Water Resource Organization (WDR), Government of Tamil Nadu, Dr. K. Palanivelu, Professor, Centre for Climate Change and Disaster Management (CCCDM) at Anna University, Dr. V. Selvam, Executive Director of Speed Trust, Dr. Tune Usha, Scientist-G, National Centre for Coastal Research, Ministry of Earth Sciences, Chennai, Dr. Pravakar Mishra, Scientist G, National Centre for Coastal Research, Ministry of Earth Sciences in Chennai, Dr. Deepak Samuel V, Scientist, National Centre for Sustainable Coastal Management (NCSCM), Ministry of Environment, Forest and Climate Change, Dr. M. Krishnaveni, Director, Institute for Ocean Management at Anna University.

We sincerely thank other project staff and administrative staff of CCCDM for their continuous support towards the successful execution of the project.

ABOUT THE PROGRAMME

The Capacity Building Program for Climate Vulnerability Assessment and Adaptation Planning in Tamil Nadu aims to improve stakeholders' abilities in evaluating and addressing climate-related risks to coastal ecosystems. The program was established in response to the growing acknowledgment of the substantial impacts of climate change on coastal ecosystems, which present significant challenges for coastal area management.

Climate Studio at CCCDM

Embracing its commitment to the Nationally Determined Contribution (NDC), Tamil Nadu has emerged as a pioneer in developing adaptation strategies across sectors. Utilizing the acclaimed IPCC framework on "Climate Change Risk Assessment," the Government of Tamil Nadu has established the 'Climate Studio' at the Centre for Climate Change and Disaster Management (CCCDM), Department of Civil Engineering, Anna University. This state-of-the-art facility, funded with Rs. 3.89 crores, is equipped with high-performance computational resources and digital learning tools (financially supported by GIZ, Germany) to analyse global climate data at the cadastral level. The climate studio project includes a capacity development programme that has been allotted a sum of Rs. 27,00,000 lakhs for all six sectors. Among these sectors, three programme have been performed specifically for the Coastal resources sector. The Climate Studio aims to provide updated high-resolution regional climate scenarios, assess climate change impacts on natural resources, develop multi-sectoral spatial information, and disseminate knowledge to stakeholders.

Program Components

Participants in the program attended interactive lectures covering topics such as climate science, Status of Tamil Nadu coastal areas and Blue Carbon, coastal vulnerability and risk, coastal inundation and shoreline assessment techniques, and adaptation strategies. Hands-on training sessions were conducted to familiarize participants with Digital Shoreline Analysis System (DSAS), and Simulator of Climate Change Risks and Adaptation Initiatives (SimCLIM) models to assess shoreline assessment and sea level projections and its impact on coastal areas induced coastal inundation, its applications for climate risk assessment and decision-making.

Participants in the program engaged in interactive lectures on various topics including climate science, the current status of coastal areas in Tamil Nadu, Blue Carbon, coastal vulnerability and risk, coastal inundation, shoreline assessment techniques, and adaptation strategies. Practical training sessions were also conducted to acquaint participants with the Digital Shoreline Analysis System (DSAS) and the Simulator of Climate Change Risks and Adaptation Initiatives (SimCLIM) models. These models were used to evaluate shoreline assessment and sea level projections, as well as their impact on coastal areas, including coastal inundation. The sessions also focused on the applications of these tools for climate risk assessment and decision-making. This program offered a platform for networking and peer-learning to facilitate collaboration and knowledge sharing among participants, experts, and practitioners in the field of coastal area management.

Training Module

The capacity-building programme “Training Manual” on the topic of Climate Vulnerability Assessment and Adaptation Plan of Tamil Nadu – Coastal Ecosystem has been released by Dr. V. Selvam, Executive Director of Speed Trust.

Dr. A. Ramachandran, Founder Director and Emeritus Professor of CCCDM; Dr. Kurian Joseph, Professor and Director of CCCDM; and Dr. K. Palanivelu, Professor of CCCDM, were present at the event. This manual equips government officials from various departments with the necessary skills to assess the impacts of climate change on coastal areas in Tamil Nadu. The training provides officers with the knowledge to utilize coastal inundation and shoreline change data for accurate evaluations and conduct effective coastal risk assessments.

Technical Sessions

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management, Anna University, Chennai delivered the lecture on “Climate Risk and Resilience” where the concept of climate risk factors such as hazard, vulnerability, exposure and response was derived. The IPCC AR6 and its shared socio-economic pathway scenarios on clear picture extrapolated for the coastal sector. In addition, the importance of future climate adaptation strategies was strongly recommended to face the climate change impacts.

Dr. A. Ramachandran, Emeritus Professor, Centre for Climate Change and Disaster Management at Anna University, delivered a lecture on "Coastal Biodiversity and Blue Carbon." He focused on the significance of mangrove forests in Tamil Nadu for climate change mitigation and the concept of blue carbon. He elaborated on the role of mangroves in sequestering carbon and reducing greenhouse gas emissions. Additionally, Dr. Ramachandran discussed methods for estimating blue carbon, highlighting the importance of preserving coastal biodiversity, particularly mangrove ecosystems, for their critical role in carbon sequestration and climate change mitigation efforts.

Er. G.R. Radha Krishna, Executive Engineer. Water Resource Organization of the Public Works Department, Government of Tamil Nadu, delivered a lecture on "State Initiative towards Coastal

Protection" In his presentation, he discussed various coastal protection strategies, including both hard and soft measures. Er. Radha Krishna explained the concept of living shorelines, emphasizing nature-based solutions for coastal protection. Furthermore, he provided insights into the ongoing projects related to coastal management in Tamil Nadu. By shedding light on these initiatives, the lecture aimed to highlight the state's proactive approach towards safeguarding coastal areas and enhancing resilience against coastal hazards.

Dr. G. Jeyasekaran, Former Director of Research at Tamil Nadu Fisheries University, delivered a lecture on “The impacts of climate change on fisheries and aquatic food safety” in his lecture. He highlighted challenges faced by coastal fishing communities, such as changing sea temperatures and extreme weather events affecting seafood quality and availability. Dr. Jeyasekaran stressed the importance of sustainable practices in the fishing industry and the need for ensuring the safety of aquatic food sources amidst ongoing climate change. His presentation aimed to raise awareness about these issues and emphasize the significance of addressing climate-related challenges in the fisheries and aquaculture sectors.

Dr. K. Palanivelu, Professor, Centre for Climate Change and Disaster Management (CCCDM) at Anna University, Chennai, delivered a lecture on "Impact of Extreme Climate Change on Coastal Rural Communities in Tamil Nadu." The focus of the lecture was to examine the effects of extreme climate events on vulnerable coastal rural communities in Tamil Nadu. Dr. Palanivelu discussed the challenges faced by these communities, such as rising sea levels, increased frequency of natural disasters, and their socio-economic implications. By highlighting these impacts, the lecture aimed to create awareness and promote strategies for enhancing the resilience of coastal rural communities to cope with extreme climate events.

Dr. V. Selvam, Executive Director of Speed Trust, delivered a lecture on "Enhancing Adaptive Capacity of Coastal Communities to Climate Change." The focus of the lecture was to highlight the importance of equipping coastal communities with the necessary tools, knowledge, and resources to effectively respond and adapt to the challenges posed by climate change. By discussing strategies for enhancing adaptive capacity, Dr. Selvam aimed to empower coastal communities to develop

resilience, implement sustainable practices, and mitigate the impacts of climate change on their livelihoods and well-being.

Dr. Tune Usha, Scientist-G, National Centre for Coastal Research, Ministry of Earth Sciences in Chennai, delivered a lecture on "Coastal Hazards and Vulnerability of Tamil Nadu." The presentation focused on highlighting the various coastal hazards faced by Tamil Nadu, including cyclones, tsunamis, erosion, and sea-level rise, and assessing the vulnerability of the coastal regions to these hazards. Dr. Tune Usha discussed the impacts of these hazards on communities, infrastructure, and ecosystems along the Tamil Nadu coast. The lecture aimed to raise awareness about the risks posed by coastal hazards and the importance of enhancing resilience in the face of such challenges.

Dr. Pravakar Mishra, Scientist G, National Centre for Coastal Research, Ministry of Earth Sciences in Chennai, delivered a lecture on "Marine Litter and Microplastics Pollution." The lecture focused on addressing the growing issue of marine litter and the pollution caused by microplastics in marine environments. Dr. Pravakar Mishra discussed the sources, impacts, and consequences of marine litter and microplastics pollution on marine ecosystems, wildlife, and human health. The presentation aimed to raise awareness about the pressing environmental challenges posed by marine pollution and emphasize the importance of taking collective action to mitigate these threats to coastal and marine environments.

Dr. Deepak Samuel V, Scientist E, National Centre for Sustainable Coastal Management (NCSCM), Ministry of Environment, Forest and Climate Change, delivered a lecture on "Strategies for Conservation of Coastal and Marine Resources." The presentation highlighted the importance of coastal and marine resources and provided a detailed explanation on their significance. He also discussed strategies aimed at conserving marine resources, including case studies such as a long-term monitoring, conservation, and management plan for the Bitarkanika Mangroves in Odisha. The lecture aimed to raise awareness about the critical need for conservation efforts to protect and sustainably manage coastal and marine resources for the benefit of ecosystems, communities, and future generations.

Dr. M. Krishnaveni, Director of the Institute for Ocean Management at Anna University delivered a lecture on "Coastal Morphodynamics and Environmental Variables of Ennore Creek: An Integrated Approach." During the lecture, It is highlighted that, the significance of addressing environmental issues concerning Ennore Creek by integrating coastal morphodynamics and environmental variables. The focus of the presentation was on conducting thorough water quality assessments to understand and manage the environmental challenges within the region.

Dr. R. Geetha, Project Scientist, and Mrs. Sathya Priya, Project Associate in Climate Modelling, Centre for Climate Change and Disaster Management at Anna University, Chennai, delivered a lecture on "Climate Modelling and Projections." During the lecture, they discussed different climate modelling scenarios, the process of model selection, and provided insights into the base period as well as future temperature and rainfall scenarios specific to Tamil Nadu.

Mr. S. N. Ahamed Ibrahim, Project Associate, Centre for Climate Change and Disaster Management (CCCDM) at Anna University, Chennai, discussed the web portal developed by CCCDM during an interactive session on Coastal Area Management. During the session, he highlighted the features of the web portal, which serves as a valuable tool for climate change and coastal area management. By offering a user-friendly interface and comprehensive information, the web portal aims to enhance the effectiveness of decision-making and planning processes related to coastal area management. Through this initiative, CCCDM aims to facilitate better preparedness and resilience to climate change and disasters in coastal areas.

Dr. Balaji, Project Scientist, and Dr. Malarvizhi, Project Associate, Water sector team, Centre for Climate Change and Disaster Management (CCCDM) at Anna University, Chennai, delivered a lecture on "Climate Change Risk Assessment on Water Resources." The presentation focused on the impacts of climate change on water resources in Tamil Nadu, particularly highlighted vulnerability of coastal districts to future floods and droughts. The discussion covered the potential impacts of changing climate patterns on water availability, emphasizing the urgent need to assess and address these risks.

Dr. Madavi Venkatesh, Project Scientist, and Ms. S. Nivetha, Project Associate Coastal team at Anna University's Centre for Climate Change and Disaster Management in Chennai, delivered a lecture on "Assessing Coastal Risks from Climate Change." Their presentation focused on assessing Tamil Nadu's vulnerability, shoreline changes, sea level elevation, coastal inundation, cyclone impacts, and adaptation approaches. By addressing these aspects, the speakers aimed to enhance understanding of coastal risks associated with climate change and stress the importance of implementing effective strategies to mitigate these risks and improve resilience in coastal areas.

Practical Training at Climate Studio

During the technical sessions, hands-on training was conducted on the 2nd day of each program, providing participants with an overview of the SimCLIM Model and DSAS Tool for assessing shoreline change. Dr. Madavi Venkatesh, Project Scientist, and Ms. S. Nivetha, Project Associate Coastal team at Anna University's Centre for Climate Change and Disaster Management in Chennai, facilitated the training. Participants were trained in calculating Coastal Inundation due to Sea Level Rise using ArcGIS and Shoreline change Assessment in the DSAS tool of ArcGIS. A training worksheet was shared with the participants to engage in practical exercises using ArcGIS and the DSAS tool. This hands-on experience aimed to enhance the participants' skills in utilizing these tools to analyze and evaluate coastal data, preparing them to address the challenges posed by climate change and shoreline dynamics effectively.

Outcomes and Impacts

Knowledge dissemination is a primary outcome of this project, with the training manual released and distributed through the programme. Three capacity-building programs were conducted, engaging a total of 37 government officials from all 14 coastal districts of Tamil Nadu. These officials participated in sessions held on 30th November and 1st December 2023, 20-21 December 2023, 13-14 March 2024, divided into three batches, gaining insights into coastal risk.

The Key Outcomes of the Capacity Building Programme are

- Understanding the fundamentals of climate change and climate change impact.

- Conceptualizing vulnerability, hazard, exposure and risk.

- Interactive exercise on shoreline assessment and coastal inundation.

By participating in this training program, officers gained essential expertise in managing the coastal ecosystem in response to evolving climatic conditions, ensuring resilience and sustainability in Tamil Nadu's coastal region.

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Report on the 1st Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu

30th November & 1st December 2023

The Centre for Climate Change and Disaster Management, Anna University with financial support by the Department of Environment and Climate Change, Government of Tamil Nadu has conducted two days Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu" on 30th November & 1st December 2023 to government officials of coastal districts, at Climate Studio, Conference Hall. The Assistant Engineers from Water Resources Engineers (WRD), Foresters and Forest Range Officers from Forest Department, Tehsildars, and Special Deputy Collectors from Disaster Management and Assistant Engineers from Fisheries Department, totaling approximately 13 officers from coastal districts of Tamil Nadu.

Training Programme Proceedings

The two-day training program featured nine technical sessions of 60 minutes duration, with presentations from renowned experts, academics, and coastal sector officials. Participants also engaged in practical training at the Climate Studio laboratory at Anna University in Chennai.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the participants to the first two-day training program in inaugural session.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the guests and participants to the valedictory session of a two-day capacity-building program.

Dr. V. Selvam, Executive Director of Speed Trust, delivered the valedictory address, highlighted the significant impacts of climate change on coastal areas. He underlined the fundamental connection between climate change science and effective coastal area management.

Dr. A. Ramachandran, Emeritus Professor, Centre for Climate Change and Disaster Management, praised the program for its value to officers in coastal districts and acknowledged the

collaboration between the CCCDM and the Department of Environment and Climate Change in organizing the training.

Dr. K. Palanivelu, Professor, Centre for Climate Change and Disaster Management, thanked the members on the dais, the organisers, and the participants and wished the programme great success.

Report on the 2nd Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu

December 20 & 21 2023

The Centre for Climate Change and Disaster Management, Anna University with financial support by the Department of Environment and Climate Change, Government of Tamil Nadu has conducted two days Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu" on 20th and 21st December 2023 to government officials of coastal districts, at Climate Studio, Conference Hall.

Training Programme Proceedings

The two-day training program featured nine technical sessions of 60 minutes duration, with presentations from renowned experts, academics, and coastal sector officials. Participants also engaged in practical training at the Climate Studio laboratory at Anna University in Chennai.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the participants to the second two-day training program in inaugural session.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the guests and participants to the valedictory session of a two-day capacity-building program.

Dr. Pravakar Mishra, Scientist G, National Centre for Coastal Research, Ministry of Earth Sciences in Chennai, delivered the valedictory address, highlighted the problem of marine pollution particularly marine liiter and microplastic. He aslo climate ralated hazards and its impact on coastal areas.

Dr. A. Ramachandran, Emeritus Professor, Centre for Climate Change and Disaster Management, praised the program for its value to officers in coastal districts and acknowledged the collaboration between the CCCDM and the Department of Environment and Climate Change in organizing the training.

Dr. K. Palanivelu, Professor, Centre for Climate Change and Disaster Management, thanked the members on the dais, the organisers, and the participants and wished the programme great success.

Report on the 3rd Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu

March 13 & 14, 2024

The Centre for Climate Change and Disaster Management, Anna University with financial support by the Department of Environment and Climate Change, Government of Tamil Nadu has conducted two days Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu" on 13th and 14th March, 2024 to government officials of coastal districts, at Climate Studio, Conference Hall.

The primary objective of the training program is to assist the Tamil Nadu coastal region in achieving its climate change response goals through adaptation measures. Specifically, the program focuses on understanding coastal hazards, vulnerabilities, and risks to effectively address these challenges. The program aims to provide knowledge and scientific methodologies to assess and manage the changes in coastal areas under climate risks.

Training Programme Proceedings

The two-day training program featured nine technical sessions of 60 minutes duration, with presentations from renowned experts, academics, and coastal sector officials. Participants also engaged in practical training at the Climate Studio laboratory at Anna University in Chennai.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the participants to the third two-day training program in inaugural session.

Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management at Anna University, warmly welcomed the guests and participants to the valedictory session of a two-day capacity-building program.

Dr. P. Palani, a Professor, Department of Centre for Advanced Study in Botany at the University of Madras, delivered the valedictory address, focusing on the coastal ecosystem and its

significance. He also discussed the future threats that climate change poses to these fragile ecosystems.

Dr. A. Ramachandran, Emeritus Professor, Centre for Climate Change and Disaster Management, praised the program for its value to officers in coastal districts and acknowledged the collaboration between the CCCDM and the Department of Environment and Climate Change in organizing the training.

Dr. Madavi Venkatesh, Project Scientist, Centre for Climate Change and Disaster Management, thanked the members on the dais, the organisers, and the participants and wished the programme great success.

CAPACITY BUILDING PROGRAMME

Climate Change Risk Assessment and Adaptation Plan of Tamilnadu

under OPERATIONALIZATION OF CLIMATE STUDIO

13-14 March 2024

4. Summary of the Capacity Building Programme (CBP)

1. Based on the feedback received from the participants, their response to the observed coastal hazards as follows

- The Coastal erosion is observed along the coast of Chengalpattu district, Villupuram district - Kottakuppam to Alagan Kuppam village, Cuddalore – Killai, Pichavaram, Samiyar Pettai, Parangipettai, Tuticorin, Tirunelveli, Kanniyakumari.
- Accretion at Manapadu, erosion at Kellavaippar and Amali Nagar – Thoothukudi district.
- Erosion and accretion found in Vedaranyam, Nagapatinam district.
- Erosion near Nagore fishermen villages, accretion at Vellapallam, Pushpavanam, Vedaranyam at Nagapattinam district.
- Sea level rise affecting forest plantation in Cuddalore, inundation in Thalangudi, Subuppalavadi.
- Increase in SST in Nagapattinam district.
- The periodic inundation of downstream of Cauvery river at Cuddalore district.
- River pollution.
- Sea water intrusion and ground water salinity.
- Coral bleaching at Keelavaippar, Threspuram at Tuticorin district.

2. The existing on going policies and actions such as

- Green Tamil Nadu mission – plantations along coast, shelter belt plantation in coastal areas.
- Tamil Nadu climate change mission.
- In Gulf of Mannar – livelihood Programme.
- Preparation of coastal and marine pollution action plan for Tamil Nadu.
- Free supply of tree seedlings.
- Thanjavur mangrove plantation under GTM and TBGPCCR
- Project dolphin, dugong, turtle to save marine animals.
- Mangrove plantation under MISTHI programme..

- Installation of artificial reefs at Manapadu, Sinkithurai, Kombu Thuraiand Punnayakayal at Thoothukudi district.
- Punnakayal - Thoothukudi district, mangrove plantation district.
- Mangrove plantation, shelter belt.
- TN wetland mission.
- Mangroves in Siruthalaikadu coastal areas of Nagapattinam.

3. Recommended Adaptation actions

- Promoting climate science at school education.
- Creating more public awareness and campaign related to climate change.
- Promote Ecosystem based adaptation strategies.
- Sea weed cultivation.
- Island conservation.
- Salt tolerant plants.
- Planting Casurina , cashew, mangrove species & buffer zone.
- Palmyra plantations.
- Construction of sub surface dykes in river mouths to prevent sea water intrusion.
- Hybrid model coastal protection structures.
- Construction of cascade of check dams reducing the ground water pollution.
- Construction Training wall near by river mouth.
- Promote inland fishing.
- Strict regulations to stop dumping of wastes in water bodies.
- Community participation for alternated livelihood.
- Wetland identification and conservation.
- Early warning system.
- Community involvement.
- Sea grass restoration and coral restoration.
- Building cyclone relief structure.
- Planting, conservation and restoration of coastal ecosystems.

- Bio shield.

4. The key gaps needs to addressed such as

- Lack of Scientific based approach for plantations actions.
- Integration of the line departments to work under climate change mitigation actions in order to achieve sustainable development.
- Lack of Community engagement.
- Project execution under plantations was not up to the mark, requires MRV techniques.
- Detailed scientific study required before implementing project.
- Identifying and planting the zone specific plants to get to better results.
- Coastal Pollution awareness.
- Lack of Cooperation between people and government while executing project.
- Community involvement in schemes.
- Community awareness regarding the schemes.
- Requirement of Zone specific schemes and policies.
- Make data availability on land use map, geological map, in public domain.
- Increase nursery for planting more trees.

5. Others

- Increase the training duration.

ANNEXURE - I

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organised by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: November 30, 2023	***Venue: CCCDM Conference Hall***
9:30 – 10:00 A.M	REGISTRATION & WELCOME
SESSION – I: Climate Risk and Resilience: An Overview	
10:00 - 11:00 A.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University
11:00 – 11:15 A.M	TEA BREAK
SESSION – II: Coastal Biodiversity and Blue carbon	
11:15 – 12:15 P.M	**Prof. Dr. A. Ramachandran D.Sc.,** Emeritus Professor, CCCDM, Anna University
SESSION – III: Climate Modelling and Projection	
12.15 – 1.15 P.M	**Dr. R. Geetha & Mrs. K. Sathyapriya** Climate Modelling Team, CCCDM, Anna University
1:15 – 2:15 P.M	LUNCH
SESSION – IV: Coastal Morphodynamics and Environmental Variables of Ennore Creek: An Integrated Approach	
2:15 – 3:00 P.M	**Prof. Dr. M. Krishnaveni** Director, Institute for Ocean Management, Anna University
SESSION – V: Assessing the Coastal Risk to Climate Change	
3:00 – 4:00 P.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
4:00 – 4:15 P.M	**TEA BREAK**
SESSION – VI: Impact of Climate Change on Fisheries Particularly on Aquatic Food Safety	
4:15 – 5:00 P.M	**Dr. G. Jayasekaran, Ph.D. FNAAS** Former Director of Research Tamil Nadu Fisheries University

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organised by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: December 1, 2023	***Venue: CCCDM Conference Hall***
SESSION – VII: Demonstration and Hands-on exercise - DSAS Model & Coastal Inundation Mapping	
9:30 – 10:30 A.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
SESSION – VIII: Interactive session - Coastal Area Management	
10:30 - 11:15 A.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
11:15 – 11:30 A.M	**TEA BREAK**
SESSION – IX: State Initiative towards Coastal Protection	
11:30 - 12.30 P.M	**Er. G.R. Radha Krishna** Executive Engineer Water Resource Organization, PWD, Govt. Tamil Nadu
SESSION – X: Impact of Extreme Climate Change on Coastal Rural Communities in TN	
12:30 - 1:30 P.M	**Dr. K. Palanivelu, Professor** CCCDM, Anna University
1:30 - 2:30 P.M	**LUNCH**
SESSION – XI: Enhancing Adaptive capacity of coastal communities to climate change	
2:30 – 3:30 P.M	**Dr. V. Selvam** Executive Director, Speed Trust
3:30 – 4:00 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.00 - 5.00 P.M	

தொலைபேசி: 04146 – 290744

தமிழ்நாடு வனத்துறை

அனுப்புநர்
திரு. சுமேஷ் சோமன், இ.வ.ப.,
மாவட்ட வன அலுவலர்,
விழுப்புரம் வனக்கோட்டம்,
விழுப்புரம்.

பெறுநர்
இயக்குநர்–CCCDM,
அண்ணா பல்கலைக்கழகம்,
சென்னை–25.

Dr. Venkatesh Mathan/
Ms. Minal
Sir

ந.க.எண்.4312/ 2021/ப1, நாள்.29.11.2023

அய்யா,

பொருள் : பயிற்சி –CCDM- காலநிலை ஸ்டுடியோ – திறன் மேம்பாட்டு திட்டம் – கடலோர – நவம்பர் 30 மற்றும் டிசம்பர் 1–2 நாள் பயிற்சியில் கலந்து கொள்ளும் பணியாளரின் விவரம் தெரிவித்தல் – தொடர்பாக.

பார்வை : 1. முதன்மை தலைமை வனப்பாதுகாவலர்(வனத்துறைத்தலைவர்), மே.கு. எண்.A2/14239/2023, நாள்.28.11.2023.

2 .வனப்பாதுகாவலர், விழுப்புரம் மண்டலம், விழுப்புரம் ந.க..எண். 4299 /2023/ப2, நாள். 29.11.2023.

மேற்காணும் பொருள் தொடர்பாக, பார்வை 1 மற்றும் 2–ல் காணும் கடிதங்களில் ஒதுக்கீடு செய்தவாறு, சென்னை அண்ணா பல்கலைக்கழகம், பருவநிலை மாற்றம் மற்றும் பேரிடர் மேலாண்மை மையத்தில் நவம்பர்–30 மற்றும் டிசம்பர்–01 ஆகிய இரண்டு நாட்கள் தமிழக கடலோர மாவட்டங்களுக்கான பருவநிலை மாற்ற பாதிப்பு மற்றும் இடர் மதிப்பீடு குறித்த பயிற்சியில் கீழ்காணும் பணியாளர் கலந்துகொள்ள பணிக்கப்பட்டுள்ளார் என்பதை பணிவுடன் தெரிவித்துக்கொள்கிறேன்.

வ. எண்	பயிற்சியின் பெயர்	பெயர்	கைப்பேசி எண்
1	Climate change Vulnerability and Risk Asessment for Coastal Districts of Tamil Nadu.	திரு.S.பாலசுந்தரம், வனவர், திண்டிவனம் வனச்சரகம், திண்டிவனம்.	8072078591

தங்கள் உண்மையுள்ள,
ஒம்/– சுமேஷ் சோமன்,
மாவட்ட வன அலுவலர்,
விழுப்புரம் வனக்கோட்டம்,
விழுப்பும்.

நகல் – முதன்மை தலைமை வனப்பாதுகாவலர் (வனத்துறைத் தலைவர்) , சென்னை அவர்களுக்கு பணிந்து அனுப்பப்படுகிறது.

(கு.பி.பா)

நகல் – வனப்பாதுகாவலர், விழுப்புரம் மண்டலம், விழுப்புரம், அவர்களுக்கு பணிந்து சமர்ப்பிக்கப்படுகிறது.

நகல்– திரு. S.பாலசுந்தரம், வனவர், (வனச்சரக அலுவலர், திண்டிவனம் வனச்சரகம், திண்டிவனம் மூலமாக). மேற்காண் பயிற்சியில் தவறாமல் கலந்து கொள்ளவும்.

நகல்–வனச்சரக அலுவலர், திண்டிவனம் வனச்சரகம், திண்டிவனம்.
(மேற்காணும் பயிற்சியில் பணியாளர் கலந்து கொள்வதனை வனச்சரக அலுவலர் உறுதி செய்ய வேண்டியது.)

//உண்மை நகல்/உத்தரவுப்படி//

கண்காணிப்பாளர்.

DEPARTMENT OF FISHERIES AND FISHERMEN WELFARE

From
The Commissioner
Fisheries and Fishermen Welfare,
Integrated Office Complex for Animal Husbandry and Fisheries Department,
Nandanam, Chennai-35.

To
Dr.Kurian Joseph,
Professor of Environmental Engineering & Director,
CCCDM, Anna University,
Chennai - 25.

Rc.No.18520/P7/2023 Dated:28.11.2023

Sir,

Sub : Fisheries and Fishermen Welfare - CCCDM - Climate Studio - Capacity Building Progarmme - Climate Change Vulnerability & Risk Assessment for Coastal Districts of Tamil Nadu Scheduled on 30.11.2023 & 01.12.2023 - Participation Requested - Intimated - Regarding

Ref : Your Office Lr.No. CCCDM/CS/Capacity Building/ Coastal/2023, Dated: 22.11.2023

****

With reference to the letter cited, it is informed that the following officials are nominated to participate in the capacity building progarmme on "Climate Change Vulnerability & Risk Assessment for Coastal Districts of Tamil Nadu" Scheduled on 30.11.2023 & 01.12.2023 at Anna University, Chennai - 25.

- ✓ Tmt N.Chandra,
  Joint Director of Fisheries & Fishermen Welfare (R) Chennai
- ✓ Thiru E.P Vigneswaran, Assistant Executive Engineer,
  Fishing Harbour Project Division, Nandanam, Chennai - 35.
- ✓ Thiru N.Sridhar, Assistant Engineer,
- ✓ Fishing Harbour Project Division, Nandanam, Chennai - 35.

K.S.Palanisamy
Commissioner
Fisheries & Fishermen Welfare

25/11/23

For Commissioner
Fisheries & Fishermen Welfare

Office of the Engineer-in-Chief,
and Chief Engineer (GI), WRD, Chepauk, Chennai – 600 005.

Present:

Er. A. Muthalya, B.E.,
Engineer-in-Chief, and Chief Engineer (General), WRD
Chepauk, Chennai – 600 005.

Proceeding No. AEE / T1 / AE- 2 / 48930 / 2014, dated. 28.11.2023

Sir,

Sub : Training – Department of Environment and Climate Change – "Operationalization of Climate Studio" – Capacity Building Programme – Coastal Sector – Nominations – regarding.

Ref :
1. The Director, Centre for Climate Change and Disaster Management, Anna University, Chennai letter no: CCCDM/CS/Capacity Building/Coastal /2023, dated:22.11.2023.
2. The Director, Department of Environment and Climate Change, Chennai letter no: P4 / 1829 / 2019 / DoE&CC / 2023, dated: 23.11.2023.

****

With reference to the letter cited, the following Engineers are nominated to attend the Two-day Capacity Building Training Programme on 30th November & 01st December 2023 at Conference Hall, Centre for Climate Change and Disaster Management, Anna University, Chennai- 25.

S. No	Name and Designation	Office address	Phone number & email id
1.	**Er. D. Sai Charan,** Assistant Engineer, WRD	O/o the Assistant Executive Engineer, WRD, Anti Sea Erosion Sub Division, Chennai.	9840394347 saicharanraju3366@gmail.com
2.	**Er. P. Subhathra,** Assistant Engineer, WRD	O/o the Assistant Executive Engineer, WRD, Krishna Water Supply Project Sub Division-2, Chennai.	7373518587 subhathra.gce@gmai.com

The period of absence during the above said period shall be treated as on official duty as per FR 9(6) b (i) and the participating officials are eligible to draw Travelling Allowance and Dearness Allowance in connection with the said training at the rate admissible as per rules in force.

28/11/23
for **Engineer-in-Chief, &**
Chief Engineer (General), WRD,
Chepauk, Chennai- 5.

28/11/23

To:

1. The Director, Centre for Climate Change and Disaster Management, Anna University, CEG Campus, Guindy, Chennai – 25.
2. The Director, Department of Environment and Climate Change, Ground Floor, Panagal Building, Saidapet, Chennai – 15.

Copy to:

1. The Individuals listed in the above table (through e mail).
2. **The Chief Engineer, WRD,** Chennai Region, Chepauk, Chennai – 05.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by Department of Environment and Climate Change, Government of Tamil Nadu

CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

30th November and 1st December 2023

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
1.	Mr. Sai Charan. D	Assistant Engineer	O/o Anti Sea Erosion Chepauk, WRD.	9840394347	saicharanraju3366@gmail.com	
2.	Ms. Subhathra. P	Assistant Engineer	O/o The Krishna Water Supply Project Sub-Division III, Chep, WRD	7373518587	subhathra.gce@gmail.com	
3.	Ms. Chandra. N	Joint Directorate of Fisheries & Fishermen Welfare	O/o Joint Director of Fisheries, DMS, Teynampet	9486715356	jdfchennai28@gmail.com	
4.	Mr. Vigneshwaran. E.P	Assistant Executive Engineer	O/o, Executive Engineer, FHPD, Chennai	8754911155	engg.fisheries.chennai@gmail.com	
5.	Mr. Sridhar. N	Assistant Engineer	O/o, Executive Engineer, FHPD, Chennai	9360598996	sridharfd3@gmail.com	
6.	Mr. Krishnan. V	Forester	Chengalpattu Range Office	6380784008	dfokpm@gmail.com	
~~7.~~	~~Mr. Saravanan. V~~	~~Forest Range Officer~~		8903201222	tamilnadudoe@gmail.com	
8.	Mr. Balasundaram. S	Forester	Forest Range office Tindivanam	8072078591	balasundar729@gmail.com	30/11/2023
9.	Mr. Sivaperuman. G	Forest Range Officer	Forest Range Office Thiruvallur	9843296634	tvrdfo@gmail.com	30/11/23
10.	Mr. Vikram N.A	Forester	Office of District Forest Officer Chennai	8667439085	dfoufd@yahoo.in	30/11/2023

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30th November and 1st December 2023

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
11.	~~Mr. Raghavan. R~~	~~Forest Range Officer~~				
12.	~~Mr. Ponnusamy. N~~	~~Forest Range Officer~~				
13.	Mr. Ponnusamy N ~~Dr. Muthukumar. K~~	~~Programme Officer~~ Forest Range officer	Forest Range office Kumbakonam	8883198472	ponnuforest@gmail.com	
14.	Mr. Saravanan. V.K	Forest Range Officer	D.D.E & CC chennai	8903201222	Saravanan1401@gmail	
15.	Mr. Premkumar. M	Information and Technology Officer	Dept. Environment Panagal Maligai, Saidapet - 15.	6380008632	Premkumargeo1986@gmail	
16.	Dr. K. Muthukumar	Programme officer ENVIS, DOE & CC	Department of Environment & CC	9941719100	muthukumar bdt1976@gmail.	
17.						
18.						
19.						
20.						

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

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30th November and 1st December 2023

ATTENDANCE SHEET

S.NO.	Name	Designation	30/11/2023		01/12/2023	
			FN	AN	FN	AN
1.	S. Balasundaram	Forester				
2.	V. Krishnan	Forester				
3.	N. CHANDRA	JD, Fisheries				
4.	N. SRIDHAR	AE, Fisheries				
5.	Dr. K. Mathiekeeran	PO, DOEACC				
6.	V. K. Saravanan	Forest Range Offr. D.O.E				
7.	M. Premkumar	ITO, DOEACC				
8.	P. Subbathra	AE, WRD				
9.	N. Ponnusamy	Forest Ranger				
10.	EP. VIGNESHWARAN	AEE, FISHERIES				

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30th November and 1st December 2023

ATTENDANCE SHEET

S.NO.	Name	Designation	30/11/2023		01/12/2023	
			FN	AN	FN	AN
11.	Er. D. Sai Charan	AE, WRD				
12.	G. Sivaperuman	Forest Range officer				
13.	N. A. Vikram	Forester				
14.	N. Ponnudurai	Forest Range officer				
15.						
16.						
17.						
18.						
19.						
20.						

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

Training Evaluation

Please tick according to the performance: (✓)

Training Relevance	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Content	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Method	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Trainers	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Presentations	1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

A Need of the hour training for all the line departments. Had the opportunity to know about Marine Eco-System & need to promote nature based Solutions for Sustainable Coastal Protection.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

Training Evaluation

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Training Relevance	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Content	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
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Trainers	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Presentations	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Very usefull programme. Epcially all the deprat. officers crere pasticipated the same Training Bogramme.

1/12/2023

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

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Presentations	1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

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30th November and 1st December 2023

Training Evaluation

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Trainers	✓ 1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Presentations	✓ 1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	✓ 1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Good.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

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Presentations	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Arrangements, trainers, Hospitalities all very good. We got some know things which will be useful for discharge of duties in our dept.

N. Pannusamy 01/12/23

N. PANNUSAMY
FRO, Forest Dept.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

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Presentations	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Fine Congrats.

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30th November and 1st December 2023

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Presentations	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Excellent training of the two days of Coastal Sector. I have knowledge gained about the climate change factors involving the coastal sector. Almost all trainers delivers a wonderful lecture on climate scenario in current environmental conditions.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

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Presentations	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

It was a very useful and it has opened a new perspective.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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Presentations	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

climate change Risk Assessment & Adaptation plan of TN coastal Ecosystem useful training. The training also Subject to filed visit area further the training

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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30th November and 1st December 2023

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Presentations	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

In all aspects, the training was good. The lectures were more useful and we learnt a lot of new things. Looking forward for more training like this.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
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30th November and 1st December 2023

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Trainers	✓ 1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)
Presentations	1 (Excellent)	✓ 2 (Good)	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	✓ 1 (Excellent)	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Please provide a proper Hands-on session. The hands-on session itself should be continued for a day in my opinion. And the repetition of same concepts can be avoided as it feels like boredom.

Apart from that, the trainers really threw light on the topics of mitigation/consequences/Adaptations of climate change.

A hands-on session in open source software for simple modelling can be given.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - COASTAL ECOSYSTEM

30th November and 1st December 2023

Training Evaluation

Please tick according to the performance: (✓)

Training Relevance	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Content	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Method	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Trainers	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Presentations	1 (Excellent)	2 (Good) ✓	3 (Fair)	4 (Not Satisfactory)
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

overall good.

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organised by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: December 20, 2023	***Venue: CCCDM Conference Hall***
9:30 – 10:00 A.M	REGISTRATION & WELCOME
SESSION – I: Climate Risk and Resilience: An Overview	
10:00 - 11:00 A.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University
11:00 – 11:15 A.M	TEA BREAK
SESSION – II: Coastal Biodiversity and Blue carbon	
11:15 – 12:15 P.M	**Prof. Dr. A. Ramachandran D.Sc.,** Emeritus Professor, CCCDM, Anna University
SESSION – III: Climate Modelling and Projection	
12.15 – 1.15 P.M	**Dr. R. Geetha & Mrs. K. Sathyapriya** Climate Modelling Team, CCCDM, Anna University
1:15 – 2:15 P.M	LUNCH
SESSION – IV: Enhancing Adaptive capacity of coastal communities to climate change	
2:15 – 3:00 P.M	**Dr. V. Selvam** Executive Director, Speed Trust, Member of SEAC, Former Director MSSRF
SESSION – V: Impact of Extreme Climate Change on Coastal Rural Communities in TN	
3:00 – 4:00 P.M	**Dr. K. Palanivelu, Professor** CCCDM, Anna University
4:00 – 4:15 P.M	**TEA BREAK**
SESSION – VI: Assessing the Coastal Risk to Climate Change	
4:15 – 5:00 P.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organised by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: December 21, 2023	***Venue: CCCDM Conference Hall***
SESSION – VII: Interactive session - Coastal Area Management	
9:30 – 10:30 A.M	**Dr. Madavi Venkatesh, Ahmed Ibrahim & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
SESSION – VIII: Demonstration and Hands-on exercise - DSAS Model & Coastal Inundation Mapping	
10:30 - 11:15 A.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
11:15 – 11:30 A.M	**TEA BREAK**
SESSION – IX: Impact of Climate Change on Fisheries Particularly on Aquatic Food Safety	
11:30 - 12.30 P.M	**Dr. G. Jeyasekaran, Ph.D. FNAAS** Former Director of Research Tamil Nadu Fisheries University
SESSION – X: Coastal Hazards and Vulnerability of Tamil Nadu	
12:30 - 1:30 P.M	**Dr. Tune Usha** Scientist-G, National Centre for Coastal Research, MoES, Chennai
1:30 - 2:30 P.M	**LUNCH**
SESSION – XI: Marine Litter and Microplastics pollution	
2:30 – 3:30 P.M	**Dr. Pravakar Mishra** Scientist G, National Centre for Coastal Research, MoES, Chennai
3:30 – 4:00 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.00 - 5.00 P.M	

By E.Mail / Tappal

Tamil Nadu Forest Department

From
Tmt. R.Padmawathe, I.F.S.,
Conservator of Forests& Field Director,
Srivilliputtur Megamalai Tiger Reserve,
Madurai-2.

To
The Director,
Centre for Climate Change and Disaster Management,
Department of Civil Engineering,
Anna University, Chennai – 600 025.

Ref.No: 23304 /2023/A2, Dated: 19.12.2023

Sir,

Sub: CCCDM – Climate Studio – Capacity Building Programme – Coastal – Tamil Nadu – 20th December and 21st December, 2023 – List of Participants – requested – regarding.

Ref:
1) The Principal Chief Conservator of Forests, Chennai Endt.Ref.No.A2/36349/2023, dt: 18.12.2023.
2) The Wildlife Warden, Ramanathapuram, C.No.E1/8382/2023, dt: 19.12.2023.

*****

With reference to the above subject, I submit that Thiru.E.Balamurugan, Forest Range Officer, (Mobile No.9047567276 and E.Mail ID balaforestry@gmail.Com) Wildlife Division, Ramanathapuram is nominated and deputed for attending the 2 day training program on ***"Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu"*** to be held from 20th December and 21st December, 2023 at the Centre for Climate Change and Disaster Management, Anna University, Chennai.

This is submitted for favour of kind information.

Yours Sincerely,
Sd/- R.Padmawathe
Chief Conservator of Forests and Field Director,
Srivilliputhur Megamalai Tiger Reserve,
Madurai.

Copy submitted to the Principal Chief Conservator of Forests(HOFF) Chennai-32 for favour of kind information.

/t.c.b.o/

19/12/2023
Superintendent.

19.12.2023

TAMIL NADU FOREST DEPARTMENT

Dr. Mr. Satheesh/
Ms. Mr. Mahesh
26/12/23

From

Thiru.N.Satheesh, I.F.S.,
Chief Conservator of Forests,
Tiruchirappalli Circle,
Tiruchirappalli .620 023.
e. mail :
ccftrichycircle@gmail.com

To

The Director,
Centre for Climate Change and
Disater Management,
Department of Civil Engineering,
Anna University,
Chennai – 600 025.

C.No.E2/8989/2022, Dated.19.12.2023.

Sir,

Sub :- CCCDM – Climate Studio – Capacity Building Programme – Coastal – Tamil Nadu – 20th and 21st December, 2023 – List of Participants submission - Regarding

Ref. :- 1. The Director, Centre for Climate Change and Disaster Mangement, Anna University, Chennai Lr.No.CCCDM/CS/Capacity Building/Coastal/2023, Dated.11.12.2023

2. The Principal Chief Conservator of Forests (HoFF), Chennai Ref.No.A2/36349/2023 Dt.18.12.2023

With reference to the above, I submit that the following field officials have been nominated for 2 days training program on "Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu" from 20.12.2023 to 21.12.2023, at the Centre for Climate Change and Disaster Management, Anna University, Chennai.

S. No	Name of the Individual (Tvl)	Designation	Division	Contact No
1	D.Mani Venkatesh	Forest Range Officer	Pudukkottai	8883380727
2	A.Sivasankar	Forester	Thanjavur	9629961658
3	K.Srinivasan	Forester	Thiruvarur	7092570329

Yours faithfully
Sd/-N.Satheesh
Chief Conservator of Forests,
Tiruchirappalli Circle.

//t.c.b.o//

S.G.Superintendent

19/12/23

GOVERNMENT OF TAMILNADU
WATER RESOURCES DEPARTMENT

From
Er. K.ASOKAN, M.Tech.,
Chief Engineer, WRD,
Chennai Region,
Chepauk, Chennai-05.
Email: cecrwropwd@yahoo.co.in

To
The Engineer-in-Chief &
Chief Engineer (General),
Water Resources Department,
Chepauk, Chennai – 5.

Lr.No. OT- II / AE5 / Climate Studio-Training / 2023, Dated: 15.12.2023

Sir,

Sub: Chennai Region – Water Resources Department – CCCDM - Climate Studio - Capacity Building Programme – Coastal - Tamil Nadu – 20th December and 21st December 2023 - Request to nominate participants – Reg.

Ref: 1. Director, Centre for Climate Change and Disaster Management, (CCCDM) Department of Civil Engineering, Kalanjiyam Building, CEG Campus Anna University, Chennai -25 Lr. No. CCCDM/CS/Capacity Building / Coastal / 2023 dated 11.12.2023.
2. Email Received from Engineer-in-Chief & Chief Engineer (GI), WRD, T1 Section on 12.12.2023.

****

With the reference to the letter and email cited above, I herewith nominate the following Engineers for the training on "Climate Change Vulnerability and Risk Assessment for Coastal District of TamilNadu" scheduled to be held on 20th December and 21st December 2023 at Conference Hall, Centre for Climate Change and Disaster Management, (CCCDM) Anna University, Chennai.

Sl. No.	Name & Designation	Office Address	Phone No.	Email ID
1.	Er. C. Senthilkumar, Assistant Engineer	Paravanaru Irrigation Section-I, Paravanaru Basin Sub Division, Kurinjipadi.	9787590074	senthilkumar047@gmail.com
2.	Er. K. Ravichandran, Section Officer, Srimushnam	Irrigation Section, Srimushnam, Vellar Basin Division, Virdhachalam.	9486389333	eepwdwrovellarvri@yahoo.co.in

15/12/23
for Chief Engineer, WRD,
Chennai Region, Chennai

Copy to the Special Chief Engineer, WRD, Vellar Basin Circle, Cuddalore for information.
Copy to the Executive Engineer, WRD, Coleroon Basin Division, Chidambaram for information.
Copy to the Executive Engineer, WRD, Vellar Basin Division, Virudhachalam for information.
Copy to the Director, Centre for Climate Change and Disaster Management, (CCCDM) Department of Civil Engineering, Kalanjiyam Building, CEG Campus Anna University, Chennai -25 for information.

Phone: 04146 220806
e-mail: cfvillupuram@gmail.com

TAMIL NADU FOREST DEPARTMENT

From

Thiru. N. Satheesh, I.F.S.,
Chief Conservator of Forests &
Conservator of Forests (FAC),
Viluppuram Circle,
Viluppuram - 605 602.

To

The Principal Chief Conservator of Forests
(Head of Forest Force),
Forest Head Quarters,
Guindy – Velachery Main Road,
Near Kannigapuram Check Post,
Guindy, Chennai – 600 032.

The Director, Centre for Climate Change
and Disaster Management,
Department of Civil Engineering,
Anna University, Chennai – 600 025.

Ref.No.4299/2023/E2, Dated: 19.12.2023.

Sir,

Sub: Training – CCCDM – Climate Studio – Capacity Building Programme – Coastal – Tamilnadu – 20th December and 21st December 2023 – Nomination details submission – Reg.

Ref: 1. Principal Chief Conservator of Forests, Cheanni. Endt.No: A2/36349/2023 dated .12.2023.

2. The Director, Centre for Climate Change and Disaster Management, Department of Civil Engineering, Anna University, Chennai. Lr.No:CCCDM/CS/Capacity Building/Coastal/2023 dated:11.12.2023.

With reference to the above cited, I submit to inform that the following field officials are deputed in respect of Viluppuram circle for a two days training program on " Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu"

to be held on 20th December and 21st December 2023 at the Centre for Climate Change and Disaster Management, Anna University, Chennai.

Sl.No.	Topic	Venue	Training dates	Details of the Field Officials deputed (Thiruvalargal)
1.	Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu	Centre for Climate Change and Disaster Management, Anna University, Chennai.	20.12.2023 to 21.12.2023 (02 days)	J. Ramesh, FRO Cuddalore Division. Mobile No: 9442744587 E-mail ID: ramfor88@gmail.com

Yours faithfully,
Sd/-N. Satheesh,
Chief Conservator of Forests
and Conservator of Forests (FAC),
Viluppuram Circle,
Viluppuram.

// True copy/By order//

Superintendent.

19/12/2023

Office of the Engineer-in-Chief,
and Chief Engineer (GI), WRD, Chepauk, Chennai – 600 005.

Present:

Er. A. Muthaiya, B.E.,
Engineer-in-Chief, and Chief Engineer (General), WRD
Chepauk, Chennai – 600 005.

Proceeding No. AEE / T1 / AE- 2 / 48930 / 2014, dated. 18.12.2023

Sir,

Sub : Training – Department of Environment and Climate Change – "Operationalization of Climate Studio" – Capacity Building Programme – Coastal Sector – Nominations – regarding.

Ref :
1. The Director, Centre for Climate Change and Disaster Management, Anna University, Chennai letter no: CCCDM/CS/Capacity Building/Coastal /2023, dated:11.12.2023.
2. The Director, Department of Environment and Climate Change, Chennai letter no: P4 / 1829 / 2019 / DoE&CC / 2023, dated: 18.12.2023.

****

With reference to the letter cited, the following Engineers are nominated to attend the Two-day Capacity Building Training Programme on 20th December & 21st December 2023 at Conference Hall, Centre for Climate Change and Disaster Management, Anna University, Chennai- 25.

S. No	Name and Designation	Office address	Phone number & email id
1.	**Er. C. Senthilkumar,** Assistant Engineer, WRD	O/o the Assistant Executive Engineer, WRD, Paravanaru Basin Sub Division, Kurinjipadi.	9787590074 senthilkumar047@gmail.com
2.	**Er. K. Ravichanran,** Section Officer, WRD	Irrigation Section, Srimushnam, Vellar Basin Division, Virdhachalam.	9486389333 eepwdwrovellarvri@yahoo.co.in

The period of absence during the above said period shall be treated as on official duty as per FR 9(6) b (i) and the participating officials are eligible to draw Travelling Allowance and Dearness Allowance in connection with the said training at the rate admissible as per rules in force.

18/12/23

for Engineer-in-Chief, &
Chief Engineer (General), WRD,
Chepauk, Chennai- 5.

18/12/23

To:

1. The Director, Centre for Climate Change and Disaster Management, Anna University, CEG Campus, Guindy, Chennai – 25.
2. The Director, Department of Environment and Climate Change, Ground Floor, Panagal Building, Saidapet, Chennai – 15.

Copy to:

1. The Individuals listed in the above table (through e mail).
2. **The Chief Engineer, WRD,** Chennai Region, Chepauk, Chennai – 05.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by Department of Environment and Climate Change, Government of Tamil Nadu

CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

20th December and 21st December, 2023

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
1.	Mr. Senthilkumar. C	Assistant Engineer	Ponnaiyanallur Dist Soc. WRD. Kurinjipadi.	9787590074	senthilkumar047@gmail.com	
2.	Mr. Ravichandran. K	Section Officer	Irrigation Section WRD. Srimushnam Vridhachalam	9486389333	eepwdwrovellarrvi@yahoo.co.in	
3.	Mr. Ramesh. J	Forest Range Officer	Forest Range Office Cuddalore.	9442744587	ramjor88@gmail.com	
4.	Mr. Sivasankar. A	Forester	Forest range office Pattukottai Thanjore dist	9629961658	Siva149sankar@gmail.com	
5.	Mr. Balamurugan. E	Forest Range Officer	Forest Range office M.E.F, Ramanathapuram	9047567276	balaforestry@gmail.com	
6.	Mr. Mani Venkatesh. D	Forest Range Officer	Forest Rang office Aranthangi Pudukkottai	8883380727	mani031196@gmail.com	
7.	Mr. Srinivasan. K	Forester	Forest Range office Muthupet, Thiruvarur Division	7092570329	seenuwildman@gmail.com	
8.	Mr. Sathasivam. R	Special Deputy Collector	may Cuddalore	9942464206	Salkakannaki@gmail.com	
9.	R. Gaiba.	Deputy Collector	o/o the District Collector, Thiruvarur.	9865479909	gaibari69@gmail.com	
10.	Dr. P. Thiruvengadam			9940809649	wetlandsengg@tngcl@gmail.com	

wetland engg

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by Department of Environment and Climate Change, Government of Tamil Nadu

CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

20th December and 21st December 2023

ATTENDANCE SHEET

S.NO.	Name	Designation	20/12/2023		21/12/2023	
			FN	AN	FN	AN
1.	SIVASANKAR A	Forester				
2.	Ravichandran.k	section officer Irrigation				
3.	SENTHILKUMAR C.	ASST. ENGR-/WRD				
4.	R. SADASIVAM.	SDC Deputy Collector				
5.	R. Geetha.	Deputy Collector				
6.	J. Ramesh.	Forest Range officer				
7.	K. SRINIVASAN	Forester				
8.	D. MANIVENKATESH	Forest Range offic				
9.	E. Balamurugan.	Forest Range offic				
10.	Dr. P. Thirumurugan	Wetland Expert				

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent)	**2** (Good)	**3** (Fair) ✓	**4** (Not Satisfactory)
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Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

The training methodology may change for government officers because our experience totally different from your content. You may explain and train about how to apply in to the field. Thank you.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

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Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

அனைத்து வகுப்புகளும் நன்று.

இந்த பயிற்சி வகுப்பு தொடர்ந்து நடைபெறவேண்டும்.

21/12/2023

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

please. provide the PPT copy (pendrive) in tamil. for Creating programmes. awareness to people in our areas. and try to provide free accomodation for ~~the~~ trainees.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

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20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

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Training Relevance	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

Totally very useful training.

பயிற்சி பயனுள்ளதாக இருந்தது. சுற்றுச்சூழல் மற்றும் தொடர்பான, முக்கியமான விஷயங்கள் அனைத்து அனைத்து விதமான விஷயங்கள். இந்த மாதிரி பயிற்சிகளை அடிக்கடி நடத்த வேண்டும்.

நன்றி
21/12/23

நன்றி
சுற்றுச்சூழல் ஆர்வலர்,
திருவாரூர்.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

I stay place is very nice, and food arrangement well
so thankyou all of you sir.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent)	**2** (Good)	**3** (Fair) ✓	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
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Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

very useful and try to insist to minimise the polluted particles.

D. Manivenkatesh,
Forest Range officer,
Pethukkottai.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

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CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

NA

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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Department of Environment and Climate Change, Government of Tamil Nadu

20th and 21st December 2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

This training provided basics knowledge about climate change & DM.

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organized by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: March 13, 2024	***Venue: CCCDM Conference Hall***
9:30 – 10:00 A.M	REGISTRATION & WELCOME
SESSION – I: Climate Risk and Resilience: An Overview	
10:00 - 11:00 A.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University
11:00 – 11:15 A.M	***TEA BREAK***
SESSION – II: Coastal Biodiversity and Blue carbon	
11:15 – 12:15 P.M	**Prof. Dr. A. Ramachandran, D.Sc.,** Emeritus Professor, CCCDM, Anna University
SESSION – III: Climate Modelling and Projection	
12.15 – 1.15 P.M	**Dr. R. Geetha & Mrs. K. Sathyapriya** Climate Modeling Team, CCCDM, Anna University
1:15 – 2:15 P.M	***LUNCH***
SESSION – IV: Strategies for Conservation of Coastal and Marine Resources	
2:15 – 3:00 P.M	**Dr. Deepak Samuel V** Scientist – E, NCSCM
SESSION – V: Climate Change Risk Assessment on Water Resources	
3:00 – 4:00 P.M	**Dr. Balaji Lakshminarayanan & Dr. R. Malarvizhi** Water Resource Team, CCCDM, Anna University
4:00 – 4:15 P.M	***TEA BREAK***
SESSION – VI: Assessing the Coastal Risk to Climate Change	
4:15 – 5:00 P.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMIL NADU

Organised by Centre for Climate Change and Disaster Management, Anna University
funded by the Department of Environment and Climate Change,
Government of Tamil Nadu

Agenda

Date: March 14, 2024	***Venue: CCCDM Conference Hall***
SESSION – VII: Demonstration and Hands-on exercise - Coastal Inundation Mapping and DSAS Model	
9:30 – 10:30 A.M	**Dr. Madavi Venkatesh & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
SESSION – VIII: Interactive session - Coastal Area Management	
10:30 - 11:15 A.M	**Dr. Madavi Venkatesh, Ahmed Ibrahim & Ms. S. Nivetha** Coastal Team, CCCDM, Anna University
11:15 – 11:30 A.M	***TEA BREAK***
SESSION – IX: State Initiative towards Coastal Protection	
11:30 - 12.30 P.M	**G.R. Radha Krishna** Executive Engineer, Irrigation & Water Resource Engineer
SESSION – X: Impact of Climate Change on Fisheries Particularly on Aquatic Food Safety	
12:30 - 1:30 P.M	**Dr. G. Jeyasekaran, Ph.D. FNAAS** Former Director of Research Tamil Nadu Fisheries University
1:30 - 2:30 P.M	***LUNCH***
SESSION – XI: Enhancing Adaptive capacity of coastal communities to climate change	
2:30 – 3:30 P.M	**Dr. V. Selvam** Executive Director - Speed Trust, Member of SEAC, Former Director - MSSRF
3:30 – 4:00 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.00 - 5.00 P.M	

From:	To:
Thiru.Johny Tom Varghese. I.A.S., District Collector Nagapattinam.	The Director - CCCDM Anna University Chennai - 25

RC NO.7087/2022/J1 Date- 08.03.2024

Sir,

Sub: Disaster Management – CCCDM – Climate Studio – Capacity Building Programme – Coastal – Tamilnadu – 13th and 14th March 2024 – Nomination Details Send - Regarding.

Ref: Director ,Disaster Management Tamilnadu Disaster Risk Reduction Agency, Chepauk, Chennai-5 Lr.No. NC III (1) / 62/2023 Dated:01.03.2024.

I send herewith the details about the Participant in the above said Training Programme from the Nagapattinam District.

S.no	Officer Name	Designation	Contact no	Email-id
1	K.Karthikeyan	DM Tahsildar	8778276531 & 9486310835	deocngt@gmail.com karthiksumathi29@gmail.com

Yours Faithfully

For District Collector
Nagapattinam

Copy Submitted to,
The Director,
Disaster Management,
Tamilnadu Disaster Risk

Phone: 04146 220806
e-mail: cfvillupuram@gmail.com

TAMIL NADU FOREST DEPARTMENT

From

Thiru. A. Periyasamy, I.F.S.,
Chief Conservator of Forests,
Viluppuram Circle,
Viluppuram - 605 602.

To

The Principal Chief Conservator of Forests (Head of Forest Force),
Forest Head Quarters,
Guindy – Velachery Main Road,
Near Kannigapuram Check Post,
Guindy, Chennai – 600 032.

The Director, Department of Environment and Climate Change ,
Ground Floor, Panagal Building,
Saidapet, Chennai – 600 015.

Ref.No.4299/2023/E2, Dated: 04.03.2024.

Sir,

Sub: Training – Department of Environment and Climate Change – " Operationalization of Climate Studio" Capacity Building Programme – Coastal Sector– Tamilnadu – 13th March and 14th March 2024 – Nomination details submission – Reg.

Ref: The Director, Department of Environment and Climate Change, Chennai. Lr.No:P4/1829/2019/DoE&CC/2023, dated:26.02.2024.

With reference to the above cited, I submit to inform that the following field officials are deputed in respect of Viluppuram circle for a two days training program on " Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu"

to be held on 13th March and 14th March 2024 at the Centre for Climate Change and Disaster Management, Anna University, Chennai.

Sl.No.	Topic	Venue	Training dates	Details of the Field Officials deputed (Thiruvalargal)
1.	Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu	Centre for Climate Change and Disaster Management, Anna University, Chennai.	13.03.2024 to 14.03.2024 (02 days)	S. Sanjeevi, Forester, Forestry Extension centre Neyveli@Cuddalore Division. Mobile No: 8148155416 E-mail ID: sanjusparkz95@gmail.com

Yours faithfully,
Sd/-A. Periyasamy,
Chief Conservator of Forests,
Viluppuram Circle,
Viluppuram.

// True copy/By order//

5/3/24

Superintendent.

05/03/2024

TAMIL NADU FOREST DEPARTMENT

From

Thiru.N.Satheesh, I.F.S.,
Chief Conservator of Forests,
Tiruchirappalli Circle,
Tiruchirappalli -620 023.
e. mail : ccftrichycircle@gmail.com

To

The Director,
Centre for Climate Change and Disaster Management, Anna University,
Chennai-25

C.No.1001/2024/E2 Dated. 11.03.2024

Sir,

Sub :- CCCDM – Climate Studio – Capacity Building Programme – Coastal – Tamil Nadu – 13th Matche and 14th March 2024 – participants submission of - Regarding.

Ref. :- Principal Chief Conservator of Forests (HoFF), Chennai, Ref.No.AB3/5611/2024, Dated:07.03.2024.

With reference to the above, I submit that Thiru.R.Ramadas, Forester working in Wildlife Division, Nagapattinam has been nominated for the capacity building programme on "Climate Change Vulnerability and Risk Assesment for Coastal Districts of Tamil Nadu" to be scheduled on 13th and 14th of March 2024 at Anna University, Chennai in respect of this circle.

His contact details are furnished below.

S. No	Name & Designation	DOB	Place of Working	Contact Number	E-mail id
1	Thiru.R.Ramadas, Forester	07.06.1987	Nagapattinam	6382215362	ramadas.ece@gmail.com

This is for favour of kind information.

Yours faithfully
Sd/- N.Satheesh,
Chief Conservator of Forests,
Tiruchirappalli Circle.

//t.c.b.o//

S.G.Superintendent

Office of the Engineer-in-Chief,
and Chief Engineer (GI), WRD, Chepauk, Chennai – 600 005.

Present:

Er. A. Muthaiya, B.E.,
Engineer-in-Chief, and Chief Engineer (General), WRD
Chepauk, Chennai – 600 005.

Proceeding No. AEE / T1 / AE- 2 / 48930 / 2014, dated. 07.03.2024

Sir,

Sub : Training – Department of Environment and Climate Change – "Operationalization of Climate Studio" – Capacity Building Programme – Coastal Sector – Nominations – regarding.

Ref : The Director, Department of Environment and Climate Change, Chennai letter no: P4 / 1829 / 2019 / DoE&CC / 2023, dated: 26.02.2024.

****

With reference to the letter cited, the following Engineers are nominated to attend the Two-day hands on training on **"Climate Change Vulnerability and Risk Assessment for Coastal district of Tamil Nadu"** is scheduled to be held on 13th & 14th March 2024 at Conference Hall, Centre for Climate Change and Disaster Management, Anna University, Chennai- 25.

S. No	Name and Designation	Office address	Phone number & email id
1.	**Er. P. Rajasekaran,** Assistant Engineer, WRD	O/o the Assistant Executive Engineer, WRD, Anti Sea Erosion Sub Division, Chennai	9487227237
2.	**Er. S. Sozharaja,** Assistant Engineer, WRD	O/o the Assistant Executive Engineer, WRD, Anti Sea Erosion Sub Division, Chennai	7010099244

The period of absence during the above said period shall be treated as on official duty as per FR 9(6) b (i) and the participating officials are eligible to draw Travelling Allowance and Dearness Allowance in connection with the said training at the rate admissible as per rules in force.

7/3/24.

for **Engineer-in-Chief, &**
Chief Engineer (General), WRD,
Chepauk, Chennai- 5.

07/03/24

To:

1. The Director, Centre for Climate Change and Disaster Management, Anna University, CEG Campus, Guindy, Chennai – 25.
2. The Director, Department of Environment and Climate Change, Ground Floor, Panagal Building, Saidapet, Chennai – 15.

Copy to:

1. The Individuals listed in the above table (through e mail).
2. **The Chief Engineer, WRD,** Chennai Region, Chepauk, Chennai – 05.

Dr. Nachiappan / Ms. Nivedha / Sridhivya

DEPARTMENT OF FISHERIES AND FISHERMEN WELFARE

18/3/2024

From
The Principal Secretary/Commissioner
Fisheries and Fishermen Welfare,
Integrated Office Complex for Animal Husbandry and Fisheries Department,
Nandanam, Chennai - 35.

To
The Director,
Centre for Climate Change and Disaster Management (CCCDM),
Anna University,
Chennai - 25.

Rc.No.15529/P7/2023 Dated: 07.03.2024

Sub : Fisheries and Fishermen Welfare - Centre for Climate Change and Disaster Management - Training programme on Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu - Scheduled on 13.03.2024 and 14.03.2024 at Centre for Climate Change and Disaster Management, Anna University, Chennai - Participation Requested - - Intimated - Regarding

Ref : The Director, CCCDM, Anna University, Chennai Letter No. CCCDM/CS/Capacity Building/ Coastal/2024, Dated: 21.02.2024.

****

With reference to the letter cited, it is informed that the following officials are nominated to participate in the training programme on "Climate Change Vulnerability and Risk Assessment for Coastal Districts of Tamil Nadu" scheduled on 13.03.2024 and 14.03.2024 at Centre for Climate Change and Disaster Management, Anna University, Chennai.

S.No	Name of the Official (Thiru/Tmt)	Designation	Office
1.	K.Selvaraj Mob No.9994695911 vpkselva@gmail.com	Assistant Executive Engineer	O/o the Fishing Harbour Project Sub Division, Cuddalore
2.	N.S. Mohan Kumar Mob No.7845521268 sankaratgate2013@gmail.com	Assistant Engineer	O/o the Fishing Harbour Project Sub Division, Bhavanisagar
3.	D.Valli Mob No.9840882034 vallifisheries@gmail.com	Assistant Engineer	O/o the Fishing Harbour Project Sub Division, Thoothukudi
4.	L.Aravinth Kumar Mob No.9488256677 ari.accet@gmail.com	Assistant Engineer	O/o the Fishing Harbour Project Sub Division, Colachel

07/03/24

For Principal Secretary/Commissioner

Fisheries & Fishermen Welfare

07/03/24

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by Department of Environment and Climate Change, Government of Tamil Nadu

CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

13th and 14th March 2024

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
1.	K. Karthikeyan	Tahsildar	TAHSILDAR, DISASTER MANAGEMENT COLLECTORATE NAGAPATTINAM - 611001	8778276531	karthiksumathi29@gmail.com	13/3/2024
2.	Santhi	Tahsildar	District collector office Mayiladuthurai	8248113430	deocmyl@gmail.com	S. Santhi
3.	A. Haridoss	Special Tahsildar	District collector office Cuddalore	9597474948	EOCcud@gmail.com	A. Haridoss 13/3/24
~~4.~~	~~P. Rajasekaran~~	~~Assistant Engineer~~		~~9487227237~~		
5.	S. Sozharaja	Assistant Engineer	O/o Anti Sea Erosion Sub Divn, WRD, Chepauk, Chennai-05	7010099244	sozha3@gmail.com	13/3/24.
6.	S. Sanjeevi	Forester	Cuddalore Forest Division.	8148155416	sanjusparkz95@gmail.com	S. Sanjeevi
7.	~~Iyachamy~~ B. AYYASAMY	Forester	Gulf of Mannar Biosphere Reserve Trust, Erwadi-Ramanathapuram Division. Mannar	9894842803		
8.	G. Ramakrishnan	Forester	Divisional Forest Officer, SF Division, Chengalpattu	8124839256	grantki92@gmail.com	G. Ramakrishnan
9.	R. Ramadas	Forester	Nagapattinam Wildlife division	6382215362	ramadas.ece@gmail.com	R. Ramadas
10.	K. Selvaraj	Assistant Executive Engineer	Fishing harbour project Sub Div. Cuddalore.	9994695911	vpkselva@gmail.com	

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

13th and 14th March 2024

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
11.	N.S. Mohan Kumar	Assistant Engineer	Fishing Harbour project section Bhavanisagar - 638451	7845521268	sankaratgate2013@gmail.com	N Mohan AE/FHPS/Bhavanisagar
12.	D. Valli	Assistant Engineer	Fishing Harbour project sub Division, Tuticorin-2.	9840882034	vallifisheries@gmail.com	D. valli AE/FHPSD/TUT
13.	L. Aravinth Kumar	Assistant Engineer	O/o The Assistant Executive Engineer, Fishing harbour Project sub division Colachel.	9488256677	~~ar.aceet@gmail.com~~ ar1.aceet@gmail.com	AE-II Colachel.
14.	~~Bharadhidasan~~ A.BHARATHIDASAN	Forest Range Officer	District Forest Officer, manjakuppam cuddalore.	9566729808.		
15.						
16.						
17.						
18.						
19.						
20.						

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

13th and 14th March 2024

ATTENDANCE SHEET

S.NO.	Name	Designation	13/03/2024		14/03/2024	
			FN	AN	FN	AN
1.	N.S. Mohan Kumar	Assistant Engineer				
2.	K. Selvaraju	Assistant Geo. Engineer				
3.	S. Santhi	D.M. Tahsildar				
4.	R. RAMADAS	FORESTER				
5.	L. Aravinth Kumar	Assistant Engineer				
6.	S. Sanjeevi	Forester				
7.	B. Ayyasamy.	Forester.				
8.	A. Bhoopathidasan.	FRO				
9.	A. AARUDOSS	TAHSILDAR	13/3/24		14/3/24	
10.	S. SOZHARAJA	Assistant Engineer	13/3/24	13/03/24	14/03/24	14/03/24

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by Department of Environment and Climate Change, Government of Tamil Nadu

CAPACITY BUILDING PROGRAMME on

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU COASTAL ECOSYSTEM

13th and 14th March 2024

ATTENDANCE SHEET

S.NO.	Name	Designation	13/03/2024		14/03/2024	
			FN	AN	FN	AN
11	G. RAMAKRISHNAN	FORESTER				
12	D. VALLI	Fisheries Department Assistant Engineer	D. valli	D. valli	D. valli	D. valli
13	Karthikeyan	TAHSILDAR D.M. sec. collectorate Nagai.			14/3/24	14/3/2024
14.						
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16.						
17.						
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19.						
20.						

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

CAPACITY BUILDING PROGRAMME III
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

organizing was absolutely Great
Content was Threats advanced
we need to adopt them for the
well being

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

CAPACITY BUILDING PROGRAMME III
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Method	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Trainers	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

CAPACITY BUILDING PROGRAMME III
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Training Venue and Hospitality	1 (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

14/3/2024

C. KARTHICEYAN

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

CAPACITY BUILDING PROGRAMME III
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent)	✓ **2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	✓ **1** (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Trainers	**1** (Excellent)	✓ **2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Presentations	**1** (Excellent)	✓ **2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Venue and Hospitality	✓ 1 (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

Organizing was absolutely Great.
Content was Throughly advanced, we need to adopt these for the well being.

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Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

CAPACITY BUILDING PROGRAMME III
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU – COASTAL ECOSYSTEM

TRAINING EVALUATION

Please tick according to the performance: (✓)

Training Relevance	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
Training Content	**1** (Excellent) ✓	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)
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Other Comments
Please write your comments regarding this training:

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

13th and 14th March 2024

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Other Comments
Please write your comments regarding this training:

Trining was good but one regret for me kindly. arrange accomodation because we are coming different distrct other than Chennai. we are facing difficult situation. without ~~attend~~ staying place. we paid our own money.

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Other Comments
Please write your comments regarding this training:

Practical may more.

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Other Comments
Please write your comments regarding this training:

It is very use full for field excursion like shore line protection and avoid the shore line erosion in future.

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Training Venue and Hospitality	1 (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

Kindly Focus Training also on Water pollution (Inland Water Bodies), Air pollution, and Soil Pollution.

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Training Venue and Hospitality	1 (Excellent)	**2** (Good) ✓	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

1. Need free Accomodation for future Training.
2. Food & Morning & Evening (night) Compulsarily Need.

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Training Venue and Hospitality	✓ 1 (Excellent)	**2** (Good)	**3** (Fair)	**4** (Not Satisfactory)

Other Comments
Please write your comments regarding this training:

Most of the Engineers who attended the training, are very busy with financial year closing in march. Hence it is requested to conduct the training in Jan - Feb or April onwards is comfortable like us. Thanking you.

ANNEXURE - II

CLIMATE CHANGE AND COASTAL MARINE ECOSYSTEM RESILIENCE

Dr.KURIAN JOSEPH

Professor of Environmental Engineering

Director, Centre for Climate Change and Disaster Management

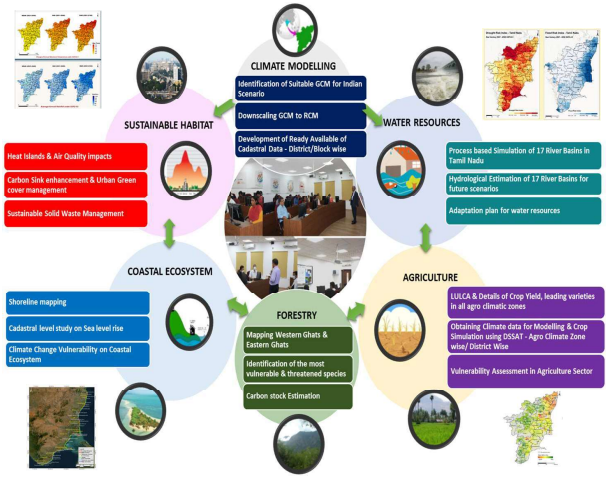
Dept. of Civil Engg, Anna University, Chennai- 600 025

E Mail: kuttiani@gmail.com

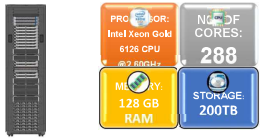
Centre for Climate Change and Disaster Management (CCCDM)

GIZ Support (HPC) – Rs. 2.5 Cr & Operationalised by DoECC, GoTN - Rs. 3.89 Cr

Climate Studio



High Performance Computing System



- **PROJECTION OF REGIONAL CLIMATE SCENARIO**
- **SECTORAL VULNERABILITY ASSESSMENT**
- **CADASTRAL LEVEL RISK INFORMATION**
- **KNOWLEDGE DISSIMINATION**
- **CAPACITY BUILDING**

Supporting Climate Resilient Sustainable Development Planning

MULTIDISCIPLINARY TEAM OF CCCDM

FACULTY

Prof. Dr. Kurian Joseph, Director, h-Index - 31

Prof. Dr. K Palanivelu, Professor, h-Index - 44

Prof. Dr. A. Ramachandran, Emeritus Professor, h-Index - 23

Prof. Dr. S. Rajarathnam, Honorary Professor, h-Index -11

PROJECT STAFF

Climate Modeling
- Dr. Geetha R, Project Scientist
- Mrs. Sathyapriya K, Project

Water Resources
- Dr. L. Balaji, Project Scientist
- Dr. R. Malarvizhi, Project

Sustainable Agriculture
- Dr S. Pavithrapriya, Project Scientist
- Mr. P. Praveenkumar, Project

Forest Ecosystem
- Dr. Hariharan S, Project Scientist
- Dr. Mithilasri M, Project

Geospatial Information
- Dr. Mathan M, Project Scientist
- Dr. Thirunavukkarasu P, Project Associate

Coastal Area Management
- Dr Madavi Venkatesh,Project Scientist
- Mrs. S. Nivetha, Project Associate

Sustainable Habitat
- Dr. Divya Subashkumar, Project Scientist
- Mr. Ahamed Ibrahim S N, Project Associate

Seismic Microzonation
- Mr. G. Sundhar, Project Associate
- Mr. M. G. Santhoshnath, Technical Assistant
- Mr. S Ahamed Kabeer Rahmathullah, Technical Assistant

Carbon Enrichment Programme
- Dr. Yasar Arafath K A, Project Scientist
- Mr. V. Vijaya Kumar, Project Associate

Web Portal
- Mr. Asan Basheer K, Project Associate

ADJUNCT FACULTY

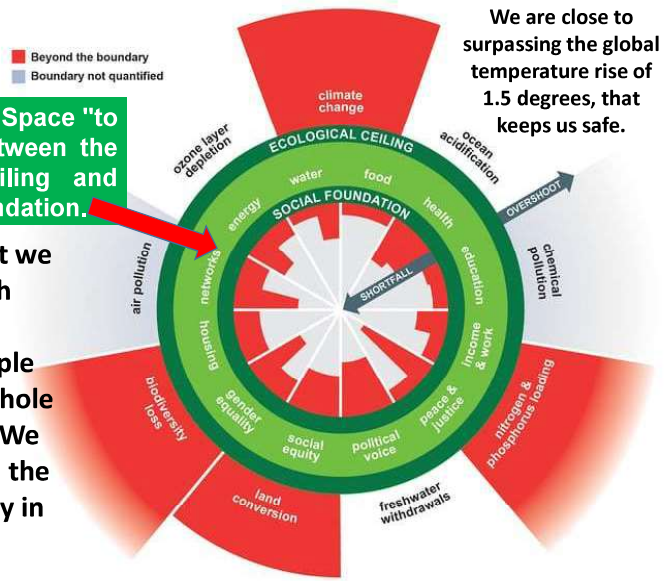
- Dr. R. Saravanan, Professor, (Centre for Water Resources)
- Dr. K. Premalatha, Professor, (Division of Soil Mechanics and Foundation Engineering)
- Dr. A. Merline Sheela, Associate Professor (Centre for Environmental Studies)
- Dr. R. Saravanan, Professor (Department of Mechanical Engineering)
- Dr. R. Vidya, Professor (Institute of Remote Sensing)
- Dr. K. Gunasekaran, Associate Professor (Transportation Engineering)
- Dr. J. Indumathi, Associate Professor (Information Technology)
- Dr. L. Jones Tarcius Doss - Professor (Dept. of Mathematics)
- Dr. J. Velmurugan, Associate Professor (Medical Physics)
- Dr. G.J. Bhagavathiammal, Assistant Professor (Dept. of Medical Physics)
- Dr. S. Anbuchelian, Assistant Professor (Ramanujan Computing Centre)
- Dr. P. Balachander, Assistant Professor (Refrigeration and Air Conditioning Engg.)
- Dr. P. Hemalatha, Assistant Professor (Dept. of Chemistry)
- Dr. Surya Vanilla, Assistant Professor (Centre for Water Resources)

Research Scholars
- Punya Murthy Khristodas
- Easwari B R
- Ms. A Whelinta Sherin

Administrative Staffs
- Mr. D Murali Superintendent
- Ms. H. Janani, Project Assistant
- Mr. Venkatesh G, Peon

"Safe and Just Space "to live well is between the Ecological Ceiling and the Social Foundation.

At the moment we transgress both lines. While Billions of people still live in the hole in the middle, We have breached the outer boundary in several places.



We are close to surpassing the global temperature rise of 1.5 degrees, that keeps us safe.

Source: **9 dimensions of planetary boundaries** according to Rockström et al. 2009, **12 dimensions of social boundaries** according to Raworth 2017, based on government priorities at Rio+20 and later UN Conferences.

SDGs -A blueprint for a better world by 2030

UNITED NATIONS SUSTAINABLE DEVELOPMENT SUMMIT 2015
25-27 SEPTEMBER

People every where to have a decent life in Peace and Partnership. Prosperity is shared and our Planet is protected.

SDG-13-Climate Action- Targets

13.1: Strengthen Resilience and Adaptive Capacity to Climate Related disasters

13.2: Integrate Climate Change Measures into Policies and Planning

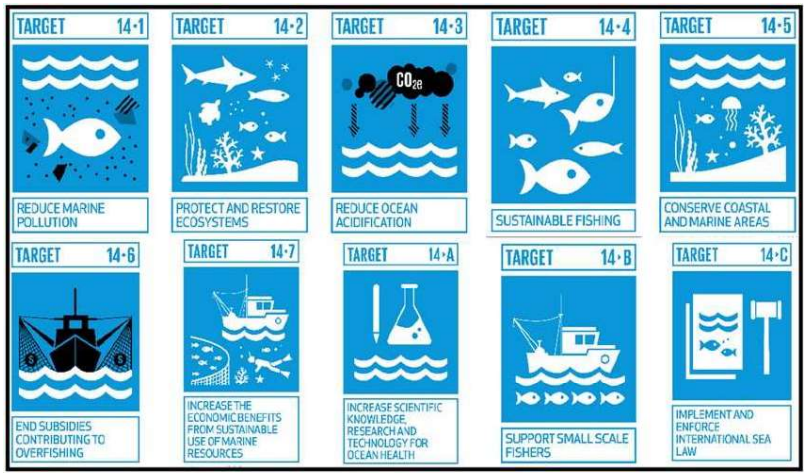
13.3: Build Knowledge and Capacity to meet Climate Change

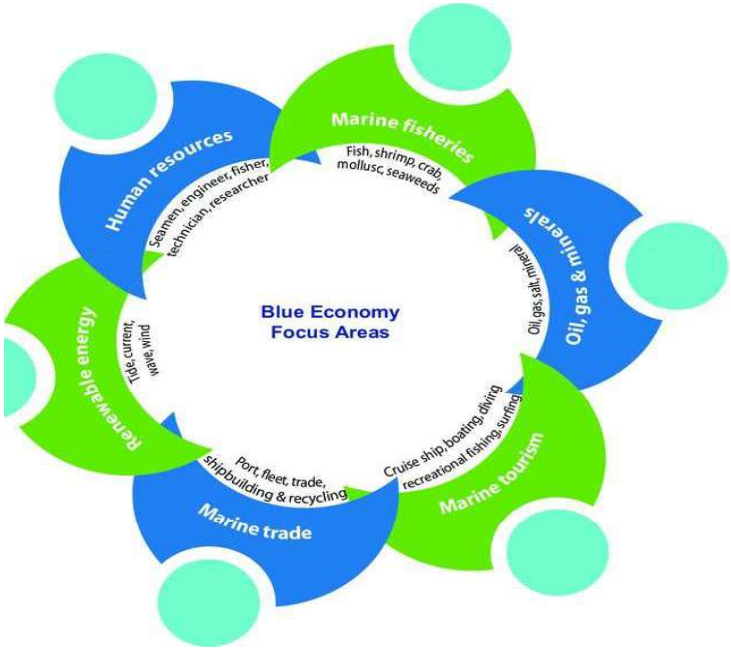
13.A: Implement the UN Framework Convention on Climate Change (UNFCC)

13.B: Promote Mechanisms to raise Capacity for Climate Planning and management

Goal 14: Life Below Water

Conserve and sustainably use the oceans, seas and marine resources for sustainable development





Direct Impacts of marine litter

Economic

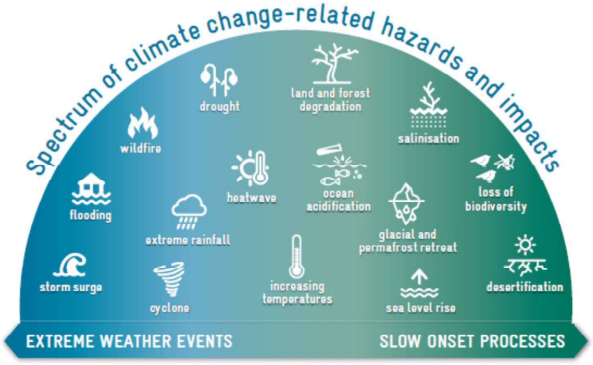
- Loss of employment in fisheries due to reduced catch resulting from ghost fishing and fish mortality
- Less income and reduced employment in coastal communities due to decreased tourism related to dirty and less attractive beaches
- High costs for coastal and beach clean-ups
- Reduced opportunities for recreational activities
- Increased risk of flooding due to blockage of stormwater systems and drainage
- Higher cost of drinking water due to the increased amount of plastic pollution in the water

Biota and ecosystems

- Pressure on aquatic species due to plastic debris ingestion or entanglement
- Loss of biodiversity in aquatic ecosystems
- Spread of invasive species
- Risk of microplastics consumption through the food-chain
- Smothering of organisms, reduced light penetration, and dragging along the sea floor causing physical damage

Climate Change Impacts

Rising Temperature	• More frequent and severe heat waves, wildfires, extreme weather events
Extreme Weather events	• Intense and frequent Cyclones, Floods and Droughts causing losees and damages
Glacier Melting	• Sea level Rise, coastal Inundation and displacement of people
Ocean Acidification	• Harming Coral Reefs and other marine life, livelihoods of millions who rely on the oceans for food and income
Biodiversity Loss	• Species extinction, Food productivity loss, Impact on overall ecosystem health
Health Impacts	• Spread of diseases, poor air quality, heat related illness, leathal humidity
Social Injustice	• Disproportional impact on vulnerable communities with least resources to adapt or recover



Anticipatory capacity	Absorptive capacity	Adaptive capacity	Transformative capacity
• Options that enable people to foresee risks and prepare for hazards, therefore reducing the impacts	• Options that prepare people to absorb/respond to shocks with minimum impact on their lives and livelihoods	• Options that build people's capacity to adjust to changing conditions and evolving risks	• Options that promote systemic changes to create an enabling environment for community adaptation and resilience building

Climate Risk

= PROBABILITY OF A HARMFUL CLIMATE EVENT OR TREND x IMPACT

Hazard (likelihood x magnitude) x Exposure x Vulnerability

Vulnerability = Sensitivity - Adaptive capacity

Hazard: the threatening event, including its probability and geographical extent
Exposure: the elements present in affected areas, such as citizens, flora & fauna, buildings or infrastructure
Vulnerability: the resistance or lack of resistance of these exposed elements to the hazard

ECOLOGICAL RESILIENCE TO CLIMATE CHANGE

Resistance to increasingly frequent and severe disturbances

- Capacity for recovery and self-organization
- Ability to adapt to new conditions.

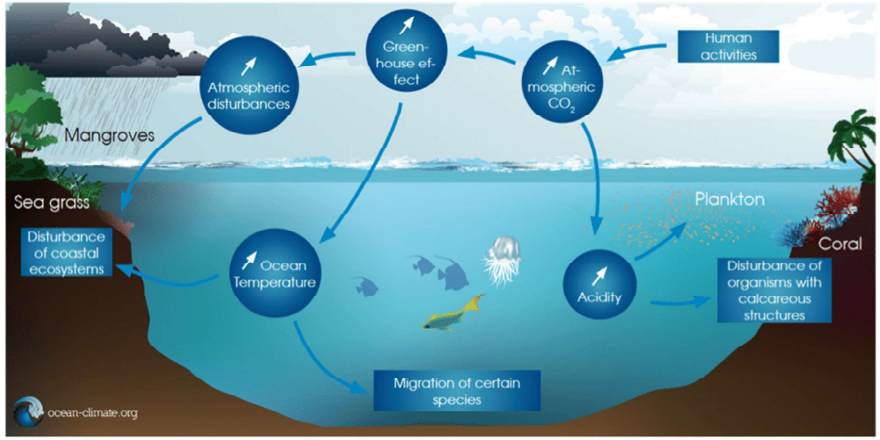
Ecological properties that underlie resilience:

- Diversity increases the variety of responses to disturbance and the likelihood that species can compensate for one another.
- Connectivity among species, populations, and ecosystems enhances capacity for recovery.

CLIMATE CHANGE INDUCED COASTAL MARINE HAZRDS

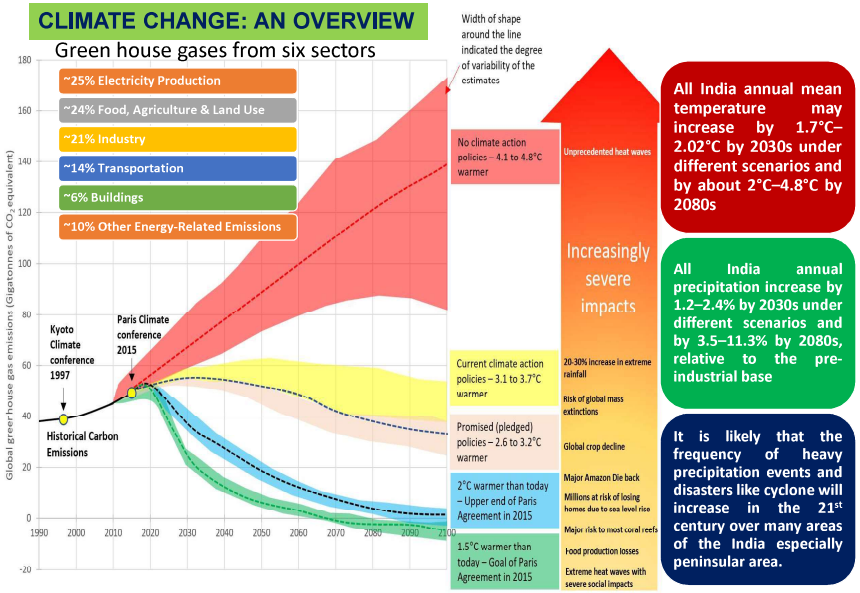
- Coastal Erosion
- Sea Level Rise
- Sea water Intrusion
- Ecosystem Shifts
- Increased Storm frequency/Cyclones
- Coastal Inundation and Flooding

Ocean Acidification



Coral reefs represent only 0.2% of the ocean surface and are home to 30% of its known marine species. However, estimates show that **20% of the world's coral reefs have been lost and another 20% degraded.**

Ecological benefits of coral reefs represent US$ 30 billion yearly, and directly support 500 million people for fishing.

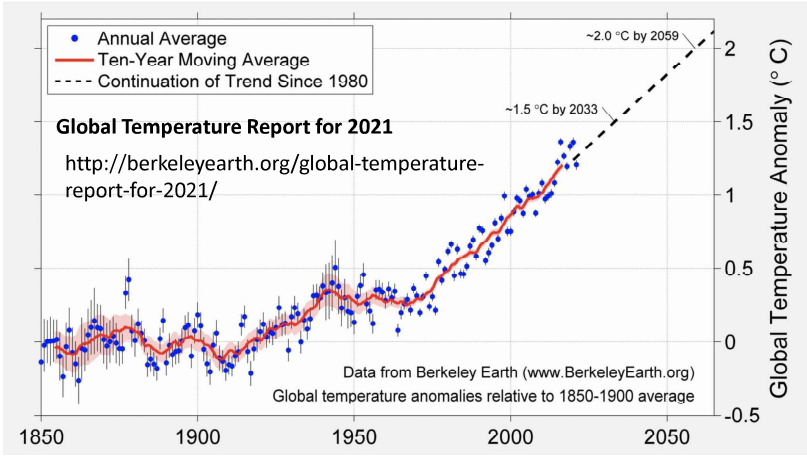


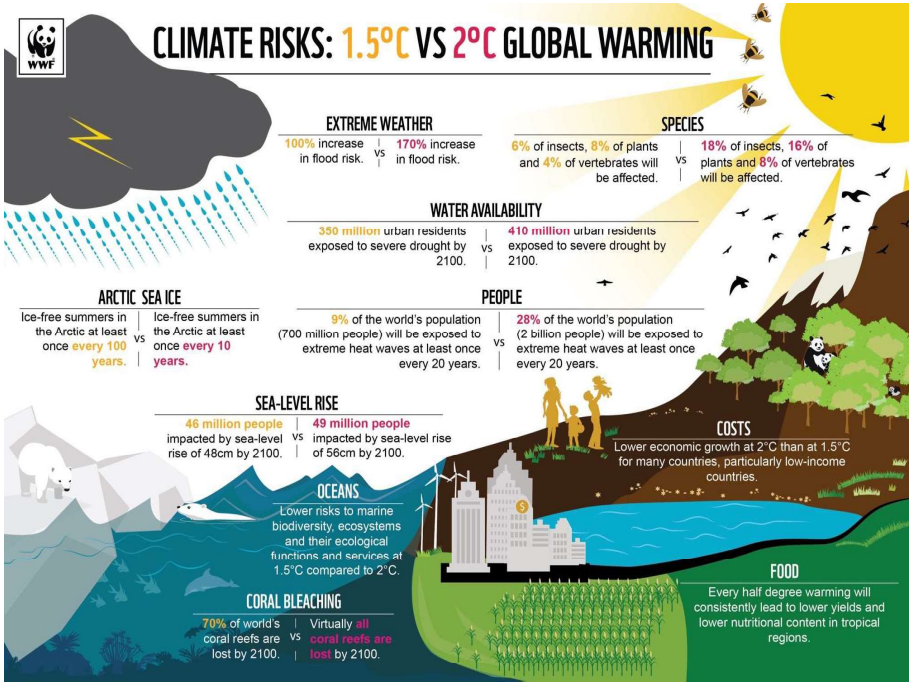
All India annual mean temperature may increase by 1.7°C–2.02°C by 2030s under different scenarios and by about 2°C–4.8°C by 2080s

All India annual precipitation increase by 1.2–2.4% by 2030s under different scenarios and by 3.5–11.3% by 2080s, relative to the pre-industrial base

It is likely that the frequency of heavy precipitation events and disasters like cyclone will increase in the 21st century over many areas of the India especially peninsular area.

At 1.15°C of global warming now, with current pace, we will hit 1.5°C in 2033 and 2°C by 2060.





"*Panchamrit*" - Nationally Determined Contributions (NDC) – India

Increase non-fossil fuel energy capacity to 500 GW by the year 2030

Meet 50% of energy requirements from "Renewable Energy" by the year 2030

Reduce projected carbon emissions by one billion tonnes from till the year 2030

Reduce Carbon intensity of Economy by more than 45% by the year 2030

Achieve the target of "Net Zero" (no net carbon dioxide emitted from energy sources) by the year 2070.

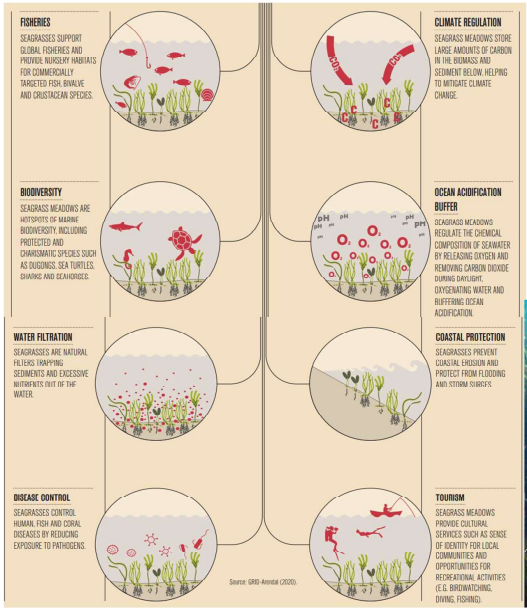
Nature (Ecosystem)Based approaches

- Protecting and restoring coastal ecosystems such as coral reefs, mangroves, and salt marshes can provide natural buffers against storm surges and erosion.
- **These ecosystems also sequester carbon and help mitigate climate change.**

BLUE CARBON INITIATIVE

Mitigate climate change by restoration and sustainable use of coastal and marine ecosystems (mangroves, tidal marshes, seagrasses).

Mangroves for Nature Based Disaster Risk Reduction



Seagrasses are one of the most widespread coastal habitats on the planet that provide a range of environmental, economic and social benefits

Carbon is sequestered and stored as seagrass biomass and through the trapping of organic particles derived from adjacent ecosystems

Opportunities from Mangrove protection, restoration projects

purchase of carbon credits from forest conservation (REDD+) or reforestation (AR – Afforestation/Reforestation) are internationally recognized solutions to neutralize emissions that are harder to subtract. About $1.3 trillion in capital would be deployed in the Net Zero 2050 scenario, mostly for afforestation.

THANK YOU

WAY FORWARD…..

Enhanced resilience of coastal and marine ecosystems

- Vulnerability assessment of the coast to inform planning of ecosystem and community-based adaptation interventions
- Community-based conservation and restoration of coastal ecosystems for increasing ecosystem resilience

Climate-adaptive livelihoods for enhanced resilience of vulnerable coastal communities

Integrating ecosystem-centric approaches to climate change adaptation into public and private sector policies, plans and budgets.

Coastal Biodiversity and Blue Carbon

by
Prof. Dr. A . Ramachandran D.Sc.,
Emeritus Professor
Centre for Climate Change and Disaster Management (CCCDM),
Department Of Civil Engineering, Anna University Chennai

Coastal Biodiversity and Blue Carbon Ecosystem of Tamil Nadu

Second longest coastline in India – 1076 kms, covering 14 Coastal districts

Tamil Nadu fishermen population – 10.48 lakhs

Marine fish production - 547615.387 tonnes

Blue Carbon Ecosystems

- ❑ Mangroves – Pichavaram, Muthupet
- ❑ Seagrasses – Palk Bay
- ❑ Coral reefs – Gulf of Mannar

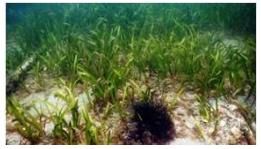
Ecologically Important Areas in Tamil Nadu

- Pulicat Birds Sanctuary, Tiruvallur District - 153.67 sq.km
- Pichavaram Mangrove Forest, Cuddalore District – 13.58 sq.km
- Point Calimere Wildlife Sanctuary, Nagapattinam District - 141.36 sq. km
- Gulf of Mannar biosphere reserve & national park - 526.02 sq. km

Blue Carbon Ecosystems in Tamil Nadu

Mangroves

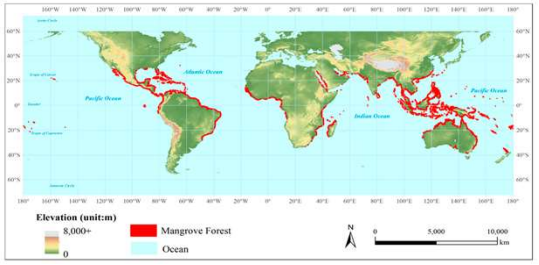
Coral Reefs



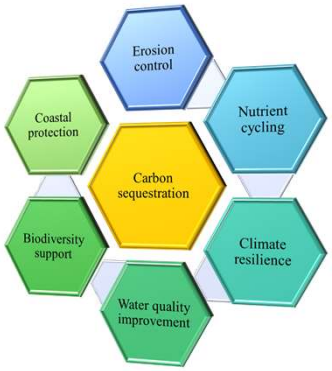
Sea Grasses

Introduction

- Mangroves are tropical plants that are adapted to loose, wet soils, salt water and being periodically submerged by tides.
- Mangroves are flowering plants which can tolerate salinity and show peculiar ecological adaptations.



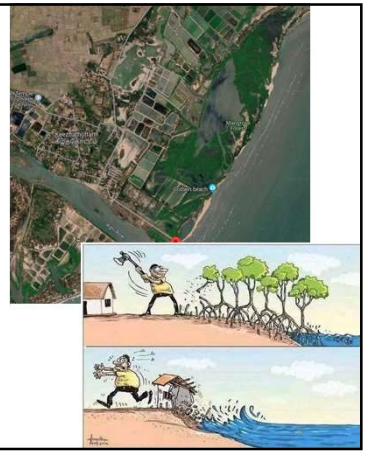
Key benefits of mangroves



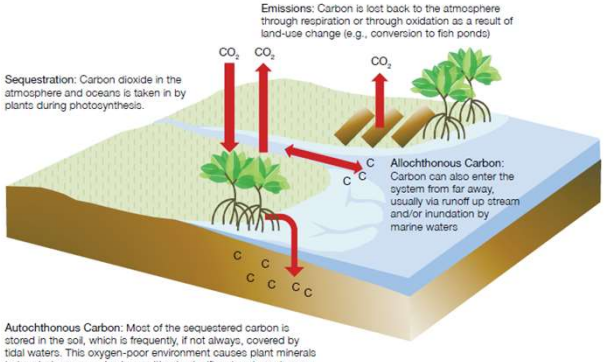
Mangroves cover only about 0.1 per cent of the planet's surface. They can potentially store up to 10 times more carbon per hectare than terrestrial forests.

Threats to Mangroves

- Coastal Development
- Fisheries, Aquaculture and Coastal Agriculture
- Climate Change & Extremities



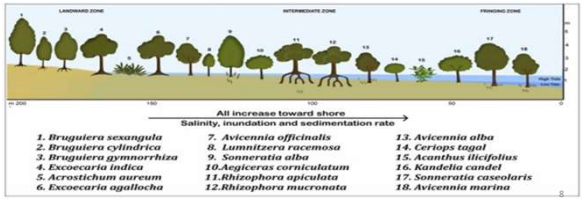
Mechanism of carbon move into and out of Mangrove ecosystem



Source : Mathur et al., 2020

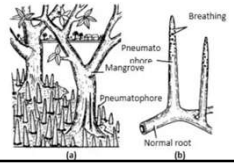
Adaptations of Mangroves

- Aerial Roots
- Vivipary dispersal
- Halophytic in Nature



Pneumatophores

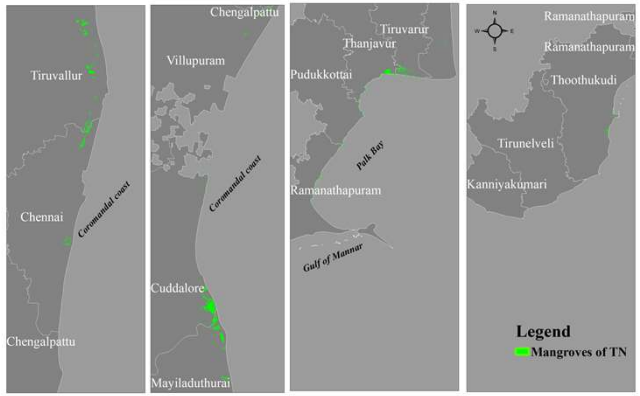
- In certain species, shallow horizontal roots radiate outwards.
- Vertical structures known as Pneumatophores emerge as lateral branches – from horizontal roots.
- Eg. *Avicennia* and *Sonneratia*



Stilt Roots

- Roots diverge from the tree.
- On reaching the soil - becomes vertical. Provide main physical support of the trunk.
- Eg: Rhizophora

Distribution of mangroves in Tamil Nadu



Source: CCCDM

Distribution of mangroves in Tamil Nadu

S.No	District	Mangrove Area (ha)
1	Tanjavur	1949
2	Thiruvarur	1759
3	Cuddalore	1165
4	Mayiladuthurai	689
5	Ramanathapuram	689
6	Thoothukudi	613
7	Pudukottai	397
8	Thiruvallur	364
9	Nagapattinam	236
10	Chennai	167
11	Villupuram	142
12	Chengalpattu	11
	TOTAL	**8181**

Source: CCCDM

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Mangrove species of Tamil Nadu

No	Species	Family	Local Name
1	*Acanthus ilicifolius*	Acanthaceae	ஆற்றுமுள்ளி Arru-mulli
2	*Avicennia alba*	Avicenniaceae	-
3	*Avicennia marina*	Avicenniaceae	கண்ணா Kanna
4	*Avicennia officinalis*	Avicenniaceae	வெண்கண்டல் Venkantal
5	*Lumnitzera racemosa*	Combretaceae	தீப்பரத்தை Tipparathai)
6	*Excoecaria agallocha*	Euphorbiaceae	தில்லை Tillai
7	*Xylocarpus granatum*	Meliaceae	சொன்முந்திரி Conmuntiri
8	*Aegiceras corniculatum*	Mrysinaceae	நரிக்கண்டல் Narikandal
9	*Bruguiera cylindrica*	Rhizophoraceae	காக்கண் Kaakandal
10	*Bruguiera gymnorrhiza*	Rhizophoraceae	சிகப்பு காகந்தன் Sigappu kaakandan
11	*Ceriops decandra*	Rhizophoraceae	-
12	*Ceriops tagal*	Rhizophoraceae	பன்றிக்குத்தி Panri-k-kutti
13	*Kandelia candel*	Rhizophoraceae	பூக்கண்டல் Pu-k-kantal
14	*Rhizophora annamalayana*	Rhizophoraceae	-
15	*Rhizophora apiculata*	Rhizophoraceae	சிறுகண்டல் Cirugandal
16	*Rhizophora mucronata*	Rhizophoraceae	கண்டல் Kantal
17	*Sonneratia apetala*	Sonneratiaceae	மரம மரம் Marama maram
18	*Heritiera littoralis*	Sterculiaceae	சொன்முந்திரி Conmuntiri

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Dominant mangrove species of Tamil Nadu

- ✓ *Avicennia Marina*
- ✓ *Rhizophora* spp.
- ✓ *Bruguiera Cylindrical*
- ✓ *Avicennia Officianalis*
- ✓ *Exocaria Agallocha,*
- ✓ *Lumnitzera Racemosa,*
- ✓ *Ceriops Decandra*
- ✓ *Aegiceras Corniculatum*

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Carbon Stocks estimation of Mangrove forest

$$Total\ carbon\ stock\ (t/ha) = C_{treeAGB} + C_{treeBGB} + C_{soil}$$

➢ **Aboveground Biomass (AGB)**

$$B\ (kg) = 0.0509 * \rho * (DBH)^2 * H$$

B = Biomass, ρ= Wood density (g/cm^3), DBH = Diameter at breast height, H = Height (m).

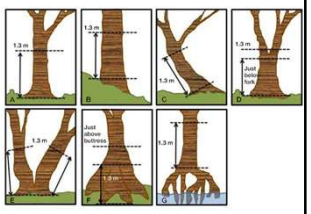
$$Wood\ Density\ (g/cm^3) = \frac{Dry\ weight\ (g)}{Volume\ of\ fresh\ wood\ (cm^3)}$$

➢ **Soil carbon**

$$SCS\ (kg\ t\ C\ ha^{-1}) = C * T * BD$$

C = organic carbon concentration (%), T = layer thickness (cm), and BD = bulk density (g/cm^3).

$$Bulk\ Density = \frac{Weight\ of\ Soil\ (g)}{Volume\ of\ Core(Cylinder)\ in\ cm^3}$$



Estimating diameter at breast height for irregular mangrove trees

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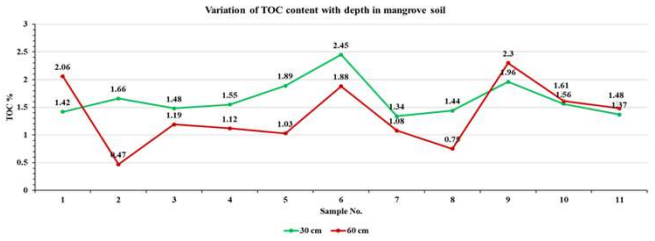
Soil Organic Carbon of Pichavaram Mangroves – Cuddalore District



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Aboveground Biomass (AGB)

Species	DBH (cm)	Height (m)	wood density (g cm-3)	Biomass Tons
Avicennia marina	32	6	0.64	20.0
Avicennia officinalis	9	4	0.63	1.0
Bruguiera cylindrica	3	4	0.73	0.1
Ceriops decandra	8	5	0.73	1.2
Excoecaria agallocha	18	4	0.43	2.8
Lumnitzera racemosa	10	3	0.83	1.3
Rhizophora annamalayana	25	15	0.85	40.6
Rhizophora apiculata	15	10	0.88	10.1
Rhizophora mucronata	15	10	0.85	9.7
			Average =	**9.7**

$$B\ (kg) = 0.0509 * \rho * (DBH)^2 * H$$

B = Biomass, ρ= Wood density (g/cm³), DBH = Diameter at breast height, H = Height (cm).

Biomass (t C/ha)	Soil Carbon (t C/ha)	Ratio (Biomass : SOC)
107.2	114	1 : 1.06

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Mangrove Carbon Stock Estimation Pichavaram Mangroves

Samples of 30 cm Depth

Sample ID	SOC (%)	BD (g/cm³)	Carbon Stock (tC / ha)
S1-30	1.42	1.30	55
S2-30	1.66	1.27	63
S3-30	1.48	1.24	55
S4-30	1.55	1.33	62
S4-30	1.89	1.34	76
S5-30	2.45	1.22	90
S6-30	1.34	1.29	52
S7-30	1.44	1.30	56
S8-30	1.96	1.17	69
S9-30	1.56	1.25	59
S10-30	1.37	1.24	51
Mean	**1.65**	**1.27**	**63**
Min	**1.34**	**1.17**	**51**
Max	**2.45**	**1.34**	**90**

Samples of 60 cm Depth

Sample ID	SOC (%)	BD (g/cm³)	Carbon Stock (tC / ha)
S1-60	2.06	1.26	78
S2-60	0.47	1.24	17
S3-60	1.19	1.18	42
S4-60	1.12	1.32	44
S4-60	1.03	1.36	42
S5-60	1.88	1.25	71
S6-60	1.08	1.30	42
S7-60	0.75	1.38	31
S8-60	2.30	1.22	84
S9-60	1.61	1.23	59
S10-60	1.48	1.29	57
Mean	**1.36**	**1.28**	**52**
Min	**0.47**	**1.18**	**17**
Max	**2.30**	**1.38**	**84**

Soil carbon stocks (SCS) in each layer was determined as:

SCS (tC /ha) = C *T* BD

C = Organic carbon (%),

T = Layer thickness (cm), and

BD = Bulk density (g/cm³).

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Conclusion

- Change in climate, Sea Level Rise, and climate extremities are all virtual threats to the existing Mangrove Ecosystem
- In-situ conservation and restoration of degraded mangroves are highly warranted


Thank you…
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Water Resources Department

Tamilnadu State Initiative towards Coastal Protection

Capacity Building Programme
Climate change vulnerability and risk assessment for coastal districts of Tamil Nadu
organised by
Centre for climate change and disaster management, Anna University

Er. G.R. Radhakrishna, B.E, M.Sc. (UNSCO-IHE)
Executive Engineer, Water Resource Organization,
Govt. Tamil Nadu

Causes for shoreline erosion and need for protection

Why ? The Shoreline is affected by waves actions, winds, Tides, nearshore currents, storms, sea level variations, climate, ecosystems and anthropogenic causes.

How? Waves : Stirs up and moves sediments deposited on the sea bed and churns the moving sediment along the coast.
Winds : Aeoline erosion, movement of dunes
Tides : High tides releases higher energy to break waves on the shoreline
Nearshore currents : Currents generated by tides, winds, wave breaking at an oblique angle with shore, and the backwash of waves on foreshore contributes to shoreline changes.
Storms : Generating storm surges and high energy waves leading to shoreline changes and severe damages to coastal infrastructures.
Sea level raise : Sea level raise of 1mm per year leads to inundation of about 0.50m per year(IPCC), 40cm raise in the past century.
Anthropogenic : Harbours & Ports, dredging, damming and river flow regulation, seawalls, Groynes, mining, beach nourishment, degradation of natural protection from mangroves and natural buffers.

Costal Protection work

Rip-raps : Rubble Mount Seawall Parallel to shoreline
Groynes : Rubble Mount Seawall oblique to shoreline (Curved/Straight/ short/ long)
Break water : Rubble Mount Seawall for harbours and ports
Curved training wall : Sustainable river mouth opening

Projection of Climate change-induced sea-level rise for Chennai coast
Source : Dhanalakshmi and Kankara (2020)

Artificial structures along Tamilnadu coast

Major/ Minor Ports along Tamilnadu and Puducherry coast

Sl.No	District Name	Major/Minor Ports
1	Chennai	Chennai port
2	Thiruvallur	Ennore port
3	Thiruvallur	Kattupalli Port
4	Thoothukudi	Thoothukudi Port
5	Puducherry	Puducherry Port
6	Puducherry	Karaikal Port

Fishing Harbours along Tamilnadu and Puducherry coast

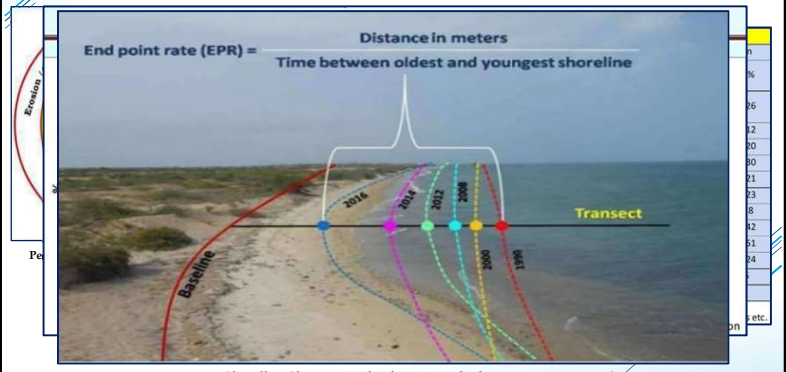
Sl No	District name	Fishing Harbours
1	Kanyakumari	Thengapattanam Colachel Muttom ChinnaMuttom
2	Thoothukudi	Thoothukudi
3	Ramanathapuram	Mookaiyur Rameshwaram
4	Thanjavur	Mallipattinam
5	Nagapattinam	Nagapattinam Pazhayar Poompuhar Vellapallam Tharangambadi Nambiar Nagar
6	Cuddalore	Cuddalore
7	Thiruvallur	Royapuram Thiruvottiyur
8	Karaikal	Karaikal

Coastal length covered with artificial structures along Tamilnadu coast

Sl. No	District	Coastal Length	Coastal length with artificial structures (Seawall/Groins/ Jetty)	Coastal length with artificial structures (Ports/Fishing Harbour/FLC)	Coastal length with artificial structures
		(In km)	(In km)	(In km)	(In %)
1	Kanyakumari	69	29	4	48
2	Tirunelveli	52	7	1	15
3	Thoothukudi	121	5	17	18
4	Ramanathapuram	272	14	1	6
5	Pudukottai	47	1	-	3
6	Thanjavur	52	0.5	0.5	2
7	Nagapattinam	126	10	4	11
8	Cuddalore	43	5	1	10
9	Villupuram	35	4	-	11
10	Kancheepuram	84	7	-	9
11	Chennai	25	0.5	4.5	20
12	Thiruvallur	41	11	7	44
13	Thiruvarur	24	-	-	-
	Total	991	94	40	13.5%

Source : NCCR (2022)

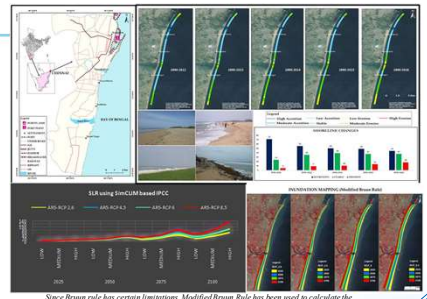
Shoreline changes : National and State Perspective



Shoreline Changes : End point rate method (between 1990 and 2016)
Source : National assessment of shoreline changes along Indian Coast (2018)

Impact of Sea Level Rise along Chennai Coast

- The total length of Chennai coast is 21.48km in which 6 km of the coast is covered with Chennai Port and Royapuram fishing harbor including protective structures to about 2.3km long.
- Using different time frames and scenarios for projected SLR gives a source information for coastal policy planning and decision makers to take SLR adaption.
- Since Bruun rule is not a full pledged rule, the modified Bruun rule has compared to demarcate the coastal disaster. But it acts as a pre-alarm for the future crisis.
- 36.7% of the coast was seen with eroding condition. Overall long term analysis trend suggest that more than 60% of the region falls in stable to low accretion.
- Projected SLR for Chennai, range from 7.1cm to 36.87cm for RCP 2.6; 7.37 cm to 49.84cm for RCP 4.5; 7.16 cm to 51.75 cm for RCP 6; 7.38 cm to 77.88 cm for RCP 8.5.
- The area of horizontal inundation is estimated as ~1.6km (Bruun rule) and ~1.1 km (Modified Bruun rule). So this makes a solid state of evidence for calculation of inundation of seawater. Hence the resultant gives a brief admittance to prevent from the future disaster aimed in the coast.



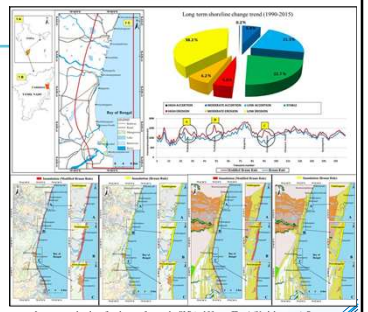
Since Bruun rule has certain limitations, Modified Bruun Rule has been used to calculate the inundation of Chennai coast with different RCPs (2.6, 4.5, 6, and 8.5) of IPCC AR5 on different time scale (2025, 2050, 2075, and 2100).

"Assessment on Shoreline Retreat in Response To Sea Level Rise – Chennai Coast"-
Dhanalakshmi Silamban*, R. S. Kankara- *Special Issue 689 of the Journal of Coastal Research.*

Impact of Sea Level Rise along Cuddalore Coast

- Response of Shoreline retreat with respect to sea level rise. **Bruun Rule** and **Modified Bruun Rule** were used in the study to assess the inundation factor.
  Parameters used for inundation calculation (Modified Bruun rule):
  - Prediction of future shoreline retreat rate
  - Historic Shoreline retreat rate
  - Historic and Future sea level rise (IPCC - AR5 scenario)
  - length of active cross-shore profile
  - Depth of closure, Elevation
  - Proportion of sediment that remains within the active profile.
- The area of horizontal inundation was estimated using both Bruun Rule and Modified Bruun Rule. The horizontal inundation is estimated as ~1.1 km (Bruun Rule) and ~1.35 km (Modified Bruun Rule) by considering the sea level height from 0.59 m to 1.22 m.
- The horizontal inundation was overlaid on geomorphic landforms, and land use/land cover features to assess the impact. About 16.08 sq.km of geomorphic landform are affected by inundation. Whereas, 17.5 sq.km of land use/land cover area are affected by horizontal inundation.

➢ The study provides an interactive means to identify the vulnerable zone, and the output maps can be used to visualize the affected areas spatially.



Impact over land use/land cover feature by SLR in 100 yrs. The A (Nadukuppam), B (Talanguda), C (Periyakuppam) are the locations which indicate more inundation rate.

"Impact assessment of sea level rise over coastal landforms: a case study of Cuddalore coast, south-east coast of India"-
Dhanalakshmi Silamban*, R. S. Kankara, S. Chenthamil Selvan at *Environmental Earth Sciences.*
DOI: 10.1007/s12665-019-8463-1

COMPLETED WORKS

BY

WATER RESOURCES DEPARTMENT

GOVERNMENT OF TAMIL NADU

Construction of Series of 10 Nos. of Groynes from Ennore to Ernavoor Kuppam LS.19/000 to 15/200KM along the Coastal Area in Madhavaram Taluk of Thiruvallur District

Estimate Amount = Rs.31.82 Crore
G.O. (Ms.) No. 27 / PW(W1) Dept. / Dated: 19.03.2013

Construction of Series of 10 Nos. of Groynes from Ennore to Ernavoor Kuppam LS.19/000 to 15/200KM along the Coastal Area in Madhavaram Taluk of Thiruvallur District

- **Scope of Work:**

  To prevent Shore erosion and protect the Fishermen Villages of Ennorekuppam, Nettukkuppam and Thalankuppam.

- **Benefits Attained:**

  The Fishermen Villages of Ennorekuppam, Nettukkuppam and Thalankuppam for a length of 1.50 Km was affected by severe shore erosion, by construction of 10 numbers of groynes the erosion was prevented and lives and livelihood of the local Fishermen was safeguarded.

Construction of Series of 9 Nos. of Groynes from Ennore to Ernavoor Kuppam LS.19/000 to 15/200KM (Reach-II) along the Coastal Area in Madhavaram Taluk of Thiruvallur District
Estimate Amount = Rs.38.39 Crore
G.O. (Ms.) No. 285 / PW(W1) Dept. / Dated: 30.08.2018 – NABARD Assistance

Construction of Series of 9 Nos. of Groynes from Ennore to Ernavoor Kuppam LS.19/000 to 15/200KM along the Coastal Area in Madhavaram Taluk of Thiruvallur District
Estimate Amount = Rs.38.38 Crore

- **Scope of Work:**

  To prevent the Fishermen Villages of Ennore Periyakuppam, Ennore Chinnakuppam and Ernavoorkuppam from Sea Erosion.

- **Benefits Attained:**

  The Fishermen Villages of Ennore Periyakuppam, Ennore Chinnakuppam and Ernavoorkuppam for a length of 1.45 Km had been protected from Severe Sea Erosion, which protects the lives and livelihood of the local Fishermen people.

ONGOING WORKS

BY

WATER RESOURCES DEPARTMENT

GOVERNMENT OF TAMIL NADU

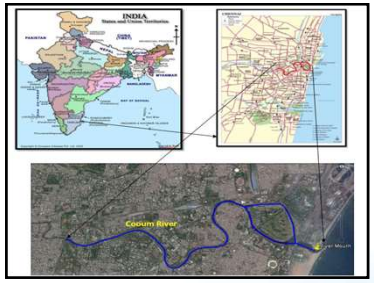
2023

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works .

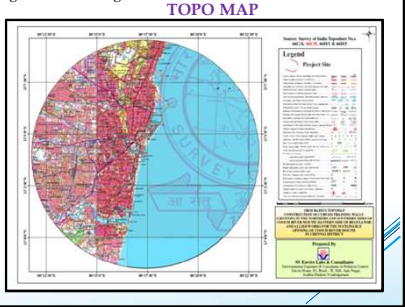
Estimate Amount : Rs.70.00 Crore

Scope of Work: To ensure the tidal exchange between the Sea and the River so that to enable the sustainable opening of Cooum River mouth and mitigate the flooding.

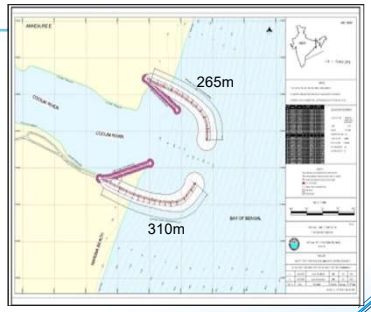
LOCATION MAP



TOPO MAP



PROPOSED CONSTRUCTION OF TRAINING WALLS



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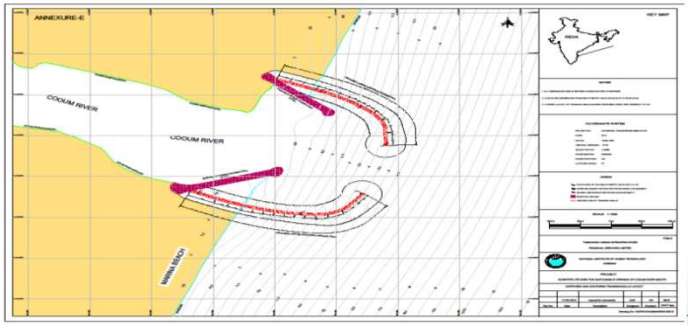
Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works

TRAINING WALL LAYOUT



ACTIVITIES PROPOSED

1. Construction of Curved Training Walls

- The proposed Northern Training wall has a total length of 265m, in which 155m extends into sea from 0.00m CD to (-)3.50m CD.
- The proposed Southern Training wall has a total length of 310m, in which 165m extends into sea from 0.00m CD to (-)3.50m CD.
- The Northern and Southern Training Wall layouts were made such that they intersect each other at 140° and clear Toe-Toe spacing of 63m at the bottom and 122m at the top to facilitate flushing and high

Contd…

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ACTIVITIES PROPOSED.,

2. Dredging and Disposal

- The Cooum River Mouth, North side and South side of Curved Training Walls are to be dredged to (-)2.00m with respect to CD.
- The Capital dredging is estimated to be 305000m^3 based on field surveys conducted. The dredged material of about 305000m^3 will be disposed off in following locations:

a) Near Cooum River Mouth, Triplicane Village in Mylapore Taluk of Chennai District

b) Srinivasapuram area in Triplicane Village of Mylapore Taluk in Chennai District

c) Northern side of Royapuram Fishing Harbour area in Thiruvottiyur Taluk of Chennai District

d) Akkarai Village in Sholinganallur Taluk of Chennai District

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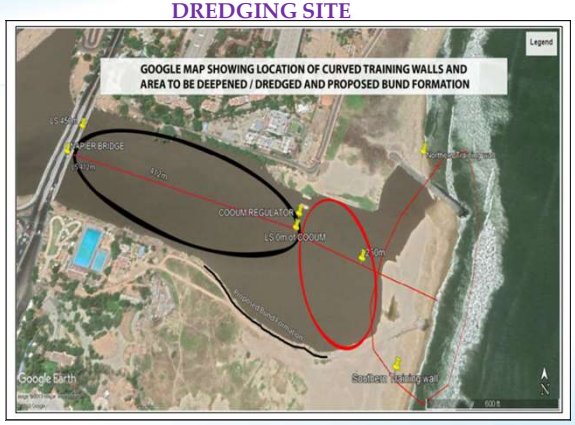
DREDGING SITE



18

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works

Tetrapod's Casting Yard

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works

Aerial View of Tetrapod's Casting Yard

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works

Southern Training Wall in Progress

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works .

Northern Training Wall in Progress

Pre Project Situation

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works .

During progress of training wall : With sandbar

Construction of Curved Training Walls (Groynes) in the Northern and Southern sides of the Cooum River Mouth and its allied Works

After Completion of main work : With out sandbar

25

IMPACTS DUE TO PROJECT IMPLEMENTATION

- Sand deposition at the Cooum River Mouth would be **reduced from 1,75,000m³ to 8,000m³ annually** (i.e., will be only about 4.57%).
- **Improved tidal exchange / flushing** would enhance the aquatic eco-system inside the Cooum river which traverses through '***Heart of Chennai City***'.
- It would help in establishment of **Flora and Fauna** by way of natural cycle.
- This would help in effective discharge of Flood waters into sea during peak floods **without inundating the inhabited areas of Chennai City** adjacent to Cooum River.

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BENEFITS OF THE PROJECT

- The proposed project is envisaged to reduce the quantity of maintenance dredging/siltation and will ensure fresh water flushing during North-East monsoon.
- The Sustainable Opening of River mouth will ensure proper tidal exchange between Sea and River which will subsequently enhance high fish production thereby ensuring large number of fishes to fishing community, resulting in increased income generation.
- Will have the potential to enhance the Tourist Attraction.
- Reduction in water borne diseases by River Restoration.
- The project will provide direct and indirect employment to the local communities.
- The project thus will certainly aid in providing clean and healthy environment to the local citizens and thus will fulfill the **Article 48A of Indian Constitution** wherein it was envisaged that '***The State shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country***'

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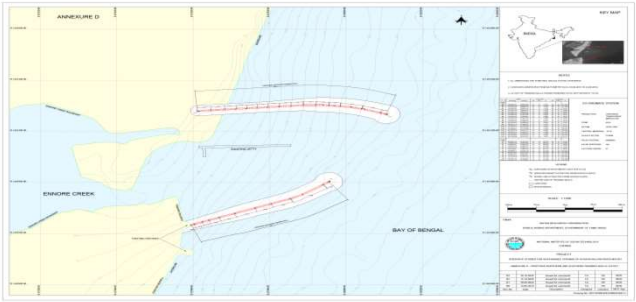
Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District

Estimate Amount : Rs.154.00 Crore

Scope of Work: To ensure the tidal exchange between the Sea and the River so that to enable the sustainable opening of Kosasthalaiyar River mouth.



Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District

Southern Training Wall – In Progress

Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District
Estimate Amount = Rs.106.07 Crore

Southern Training Wall in Progress & Tetrapod's Stock Yard near Site

Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District
Estimate Amount = Rs.106.07 Crore

Pre-Casting of Tetrapod's and Stock Yard near Site

Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District

Tetrapod's Stock Yard near Site

Construction of Training Walls (Groynes) in the Northern and Southern sides of Ennore Creek / Inlet (South side of M/s.KPL) in Thiruvottiyur Taluk of Thiruvallur District

Pre-Casting of Tetrapod's in Casting Yard and Stock Yard

Proposals Formulated and awaiting Approval

1. Construction of Series of 8nos. Groynes using Geo Synthetic Material and Sand Nourishment along the shore line to the Northern side of shore Temple in Mamallapuram in Thirukalukundram Taluk of Chengalpattu District – Estimate Cost Rs.95.95 crore.
2. Comprehensive Master Plan and DPR for the Eco-Restoration of Kovalam Creek (Muttukadu) for CRRT. The Project Cost is Rs.171.03 Crores. vide CRRT Lr.No.Nil dated 06-02-2023.

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THANK YOU

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Climate Change and Coastal Cities

Coastal Sector

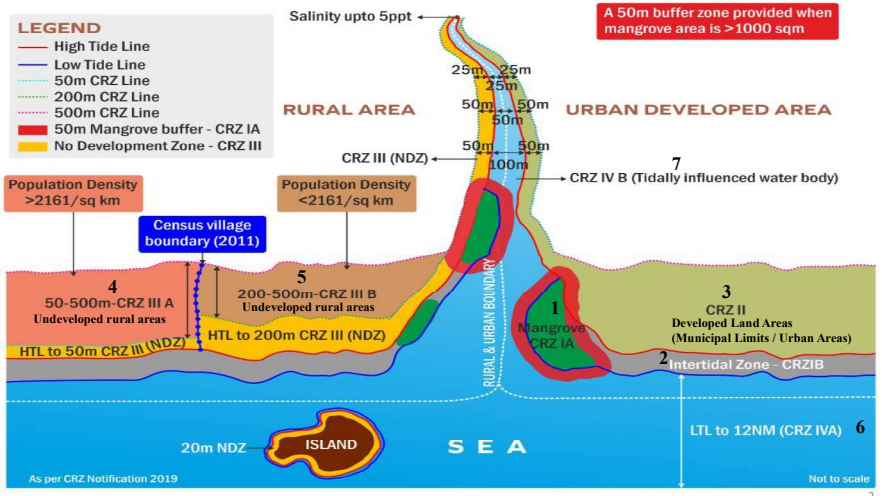
OPERATIONALIZATION OF CLIMATE STUDIO

Funded by

Department of Environment and Climate Change, Government of Tamil Nadu

Centre for Climate Change and Disaster Management (CCCDM),
Anna University
Chennai - 600025

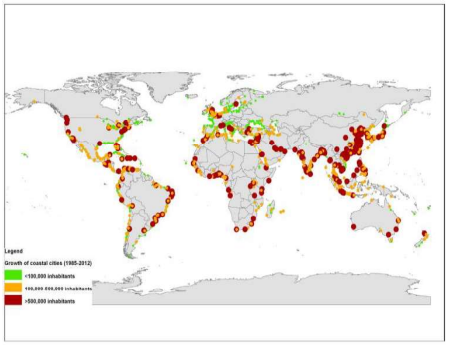
Conceptual Diagram of Coastal Regulation Zone



Source: CRZ notification 2019, NCSCM

Why Focus on Coastal Areas?

- Nearly half of the global population resides in coastal areas.
- 2/3rd of the world's cities are in coastal areas.
- Goods and services provided by marine coastal ecosystems are worth US $ 13 trillion per annum, which equals to half of the annual global GDP. (Source: UNEP)



Coastal cities

Coastal cities have experienced tremendous growth in recent decades, especially in Africa and Asia.

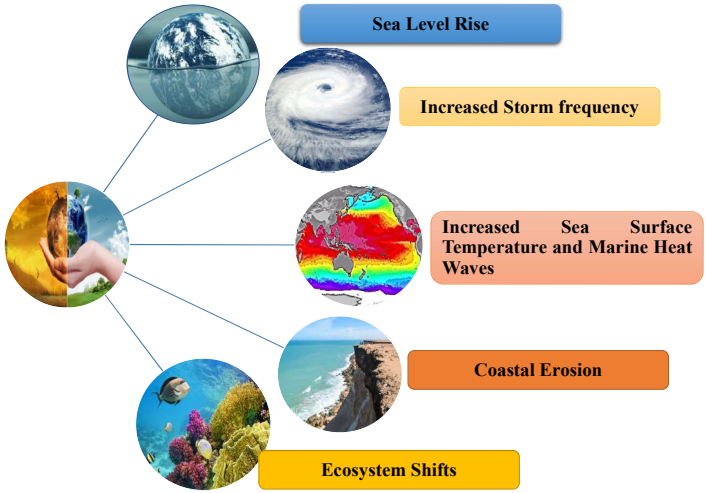
In 2016, 44 % of the Global Population Living in Coastal Cities.

The population of low-lying coastal cities increased from about 360 million to about 500 million from 1990 to 2015.

A studies shows that in 2020, 197–347 million people living in coastal areas less than 2 m above sea level, of which 59% in tropical Asia and 10% in tropical Africa (Hooijer and Vernimmen, 2021) .

By 2050, two-thirds of the world's population is expected to live in cities and by then an estimated 800 million people will live in more than 570 coastal cities that are vulnerable to a 0.5 meter rise in sea level (WEF, 2019).

Climate Change Impacts on Coastal (IPCC AR6)



COASTAL PROFILE OF TAMIL NADU

Source: CCCDM, 2023

Blue Economy of TN

1. Fisheries and Aqua Culture

Marine fish production
Quantity (in Tonnes) - 5,47,615.387
Value (Rs. in Lakhs) – 14,76,696.86

2. Ports and Shipping

Major/Minor ports – 4
Fishing Harbours – 17

Total Cargo handled (2020-2023) – 12,615,635 metric tonnes

3. Offshore wind energy

India's first offshore Wind Energy in TN
Palk Bay – Arichamunai
Gulf of Mannar - Thoothukudi

4. Coastal Tourism

Number of tourists arrival in No's
2019 - 501731166
2020* - 1153.93
Tourism spots – Chennai, Mahabalipuram, Kanyakumari

* Reduced due to covid restriction

5. Coastal Blue Carbon Ecosystems

Mangroves – pichavaram, Muthupet.
Coral reefs & Seagrasses – Gulf of Mannar.
Salt marshes.

6. Sea weed Cultivation

Macroscopic algae grows in shallow coastal waters
Locations in TN- Ramanathapuram District
434 Species – Red, Brown, Green Algaeas

Coastal Vulnerability and Risk Assessment

OBJECTIVES

1. Shoreline Change Assessment for Coastal Tamil Nadu (1992-2022)

a) Digitization of shoreline (1992, 2000, 2005, 2010, 2015 and 2022).

b) Assessment of shoreline change rate with multi-decadal data using DSAS model.

c) Land loss and Land gain assessment.

d) Shoreline change trend analysis at Block and District level of TN.

e) Identification of Eroding and Accreting hotspots.

2. Sea Level Rise Projection Using SimCLIM for Coastal Tamil Nadu SSP 2- 4.5 – AR6.

a) Projection of SLR for SSP 2 - 4.5 (Near century - 2050).

b) District-level assessment of SLR.

c) District-level assessment of Coastal Inundation due to SLR.

d) Preparation of Land Use Land Cover.

e) Analyzing Impact of SLR on Coastal Land Use.

3. Cyclone frequency analysis of Tamil Nadu.

a) Overall cyclone frequency analysis

b) Severe cyclonic storm frequency analysis

c) Cyclone proximity analysis for coastal Tamil Nadu

4. Climate Change Vulnerability and Risk Assessment for Coastal Tamil Nadu.

a) District-wise risk assessment and mapping.

Adaptation Strategies

Digital Shoreline Analysis System (DSAS)

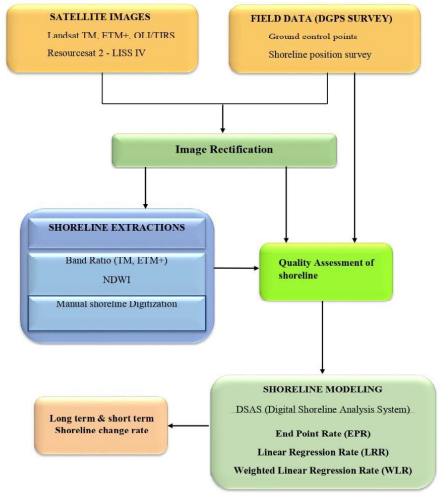
LIST OF IMAGE	PIXEL SIZE (M)	YEAR	SOURCE
Landsat 5 TM	30	1992	USGS
Landsat 7 ETM+	30	2000	USGS
Landsat 5 TM	30	2005	USGS
Landsat 7 ETM+	30	2010	USGS
Landsat 8 OLI / TIRS	30	2015	USGS
Resourcesat 2 - (LISS-IV)	5.8	2022	NRSC - INDIAN

NDWI (Normalized Difference Water Index)

$$NDWI = \frac{(Green - NIR)}{(Green + NIR)}$$

BAND RATIO IMAGE ENHANCEMENT

$$\text{Band Ratio} = \frac{Band\ Red}{Band\ Near\ Infra\ Red}$$



Shoreline Proxies used for shoreline Extraction

A. High Water Line
B. Rip rap structures in case there is no sandy shore
C. Debris brought by the waves
D. Vegetative line
E. Cliff base or top

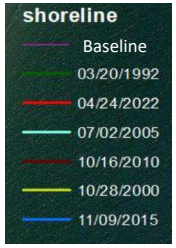
Uncertainty in shoreline Measurement

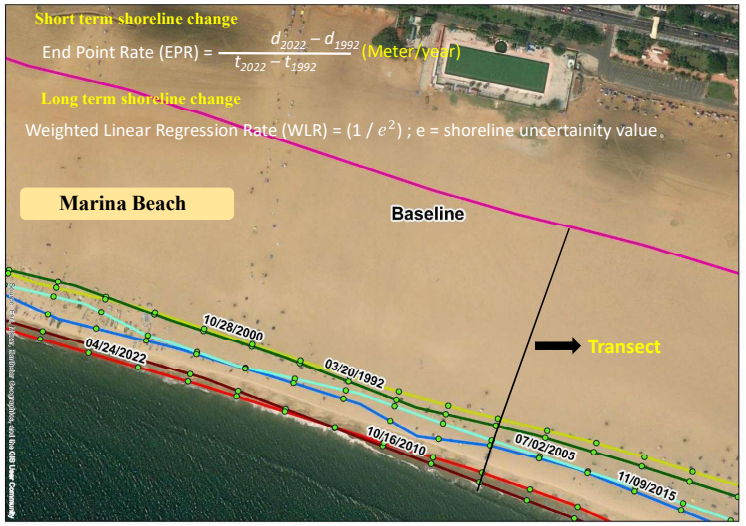
1) Positional Uncertainties
   Seasonal Error $\mathbf{E_s}$
   Tidal Fluctuation $\mathbf{E_{td}}$

2) Measurement Uncertainties
   Digitizing error $\mathbf{E_d}$
   Pixel error $\mathbf{E_p}$
   Rectification error $\mathbf{E_r}$

$$Et = \pm\sqrt{E_s^2 + E_{td}^2 + E_d^2 + E_P^2 + E_r^2}$$

d = Distance in meter
t = time in year



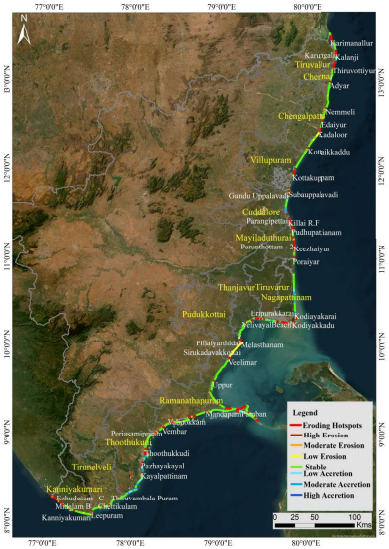


Erosion – Stable - Accretion Status of Tamil Nadu Coast (1992 – 2022)

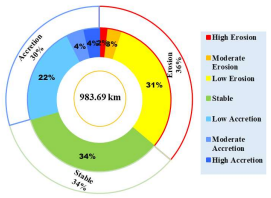
Sl.No	Districts	Coast Length in Km	Coast Length in Km						
			High Erosion	Moderate Erosion	Low Erosion	Stable	Low Accretion	Moderate Accretion	High Accretion
1	**Tiruvallur**	34.52	**6.87**	2.16	8.25	7.79	3.74	0.67	5.04
2	Chennai	39.51	0.00	2.12	9.71	19.46	7.72	0.41	0.09
3	Chengalpattu	74.58	0.00	1.64	42.21	20.02	9.69	1.02	0.00
4	Villupuram	33.69	0.00	0.46	12.87	15.56	4.79	0.00	0.00
5	**Cuddalore**	41.50	**1.82**	4.69	5.80	5.42	16.21	6.30	1.26
6	**Mayiladuthurai**	49.77	**3.69**	5.49	19.90	11.07	8.73	0.89	0.00
7	**Nagapattinam**	81.90	**1.75**	4.26	19.97	11.38	32.31	7.79	4.43
8	Tiruvarur	22.44	0.00	0.45	2.18	7.19	7.41	2.27	2.94
9	Tanjavur	43.27	0.00	0.85	7.26	15.56	17.22	1.40	0.98
10	Pudukkottai	43.55	0.28	0.05	14.55	21.38	7.13	0.16	0.00
11	**Ramanathapuram**	275.71	**2.28**	4.34	96.18	131.06	32.37	3.26	6.22
12	**Thuthookudi**	118.88	**1.98**	4.48	21.63	28.70	41.52	12.02	8.54
13	Tirunelveli	53.10	0.00	0.00	6.04	21.88	19.63	1.97	3.58
14	Kanyakumari	71.28	0.04	0.44	38.48	22.41	7.58	0.96	1.37
	Total	**983.69**	**18.72**	**31.44**	**305.02**	**338.89**	**216.05**	**39.11**	**34.45**

Category	Vulnerable Districts
High Erosion	Tiruvallur, Mayiladuthurai, Ramanathapuram, Thuthookudi, Cuddalore and Nagapattinam
Moderate Erosion	Mayiladuthurai, Cuddalore, Thuthookudi, Ramanathapuram and Nagapattinam

Field verification of shoreline assessment- Tiruvallur District



Shoreline Change Assessment

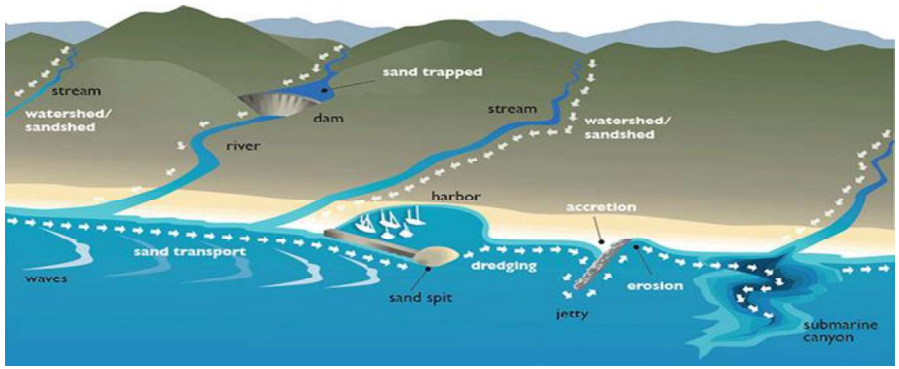


Classification	Rate (m/year)	Colour schemes
High Erosion	< -5.0	
Moderate Erosion	-5.0 to -3	
Low Erosion	-3.0 to -0.5	
Stable	-0.5 to 0.5	
Low Accretion	0.5 to 3.0	
Moderate Accretion	3.0 to 5.0	
High Accretion	>5.0	

S.No	District Name	Average Erosion rate (m/yr)	Average Accretion rate (m/yr)
1	Tiruvallur	**3.66**	**6.6**
2	Chennai	1.25	0.89
3	Chengalpattu	0.93	0.95
4	Villupuram	0.79	0.62
5	Cuddalore	**2.86**	2.3
6	Mayiladuthurai	**2.71**	1.13
7	Nagapattinam	**2.03**	2.72
8	Tiruvarur	1.33	2.51
9	Tanjavur	0.83	1.23
10	Pudukkottai	0.7	0.82
11	Ramanathapuram	1.2	1.9
12	Thuthookudi	**2.01**	3.02
13	Tirunelveli	0.51	1.68
14	Kanyakumari	1.03	1.59

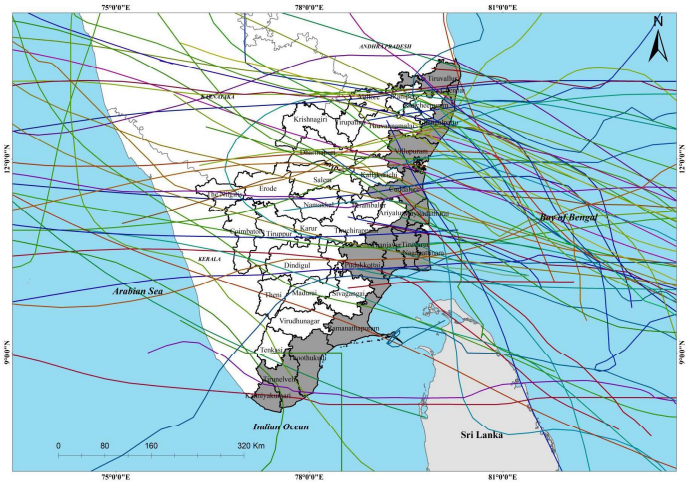
Erosion – Stable - Accretion Status of Tamil Nadu Coast (1992 – 2022)

Complexity of Sediment transport pathways



Reality: 1. Sand blocked by dams and mining leading to coastal erosion.
2. man-made interventions in coastal zone

Cyclone Tracks hit Tamil Nadu – 1891 - 2022



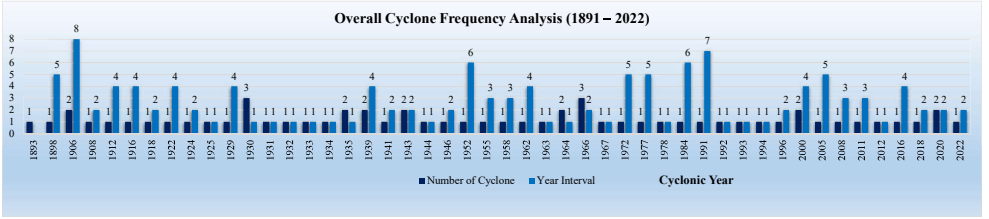
Tracks of Cyclones made Landfall in Tamil Nadu

Period : 1891-2022

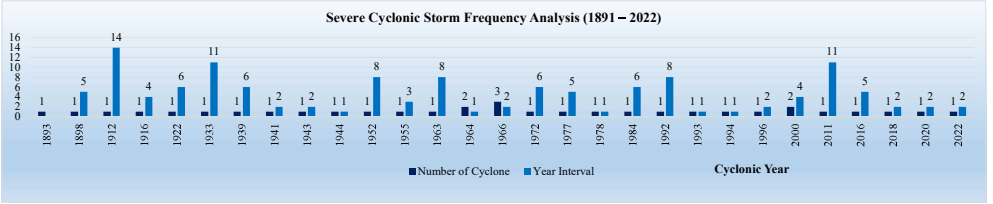
Source: IMD, IBTrACS

Total number of cyclones: 59

Cyclone category: Cyclonic Storm ≥ 63 km/h.

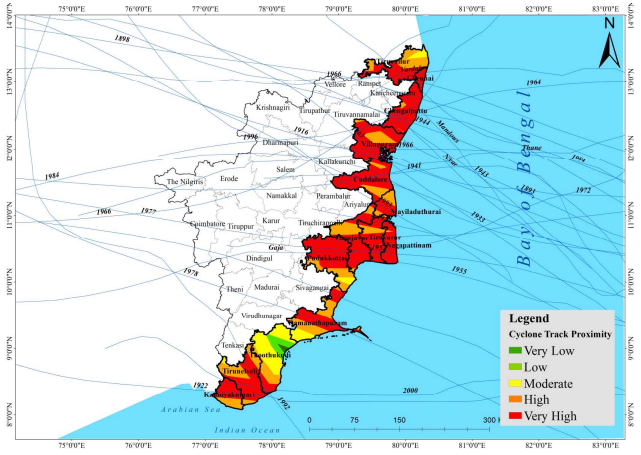


- A total of 59 Cyclones whose wind speed ≥ 63 km/h made landfall in Tamil Nadu.
- After 2016 the event is occurring at the frequency of two-year intervals.



- A total of 33 Severe Cyclonic Storms whose wind speed ≥ 94 km/h made landfall in Tamil Nadu.
- After 2016 the event is occurring at the frequency of two-year intervals.

SEVERE CYCLONIC STROM TRACK PROXIMITY ANALYSIS FOR COASTAL TAMIL NADU



S. No	Districts	Number of SCS
1	**Chengalpattu**	**8**
2	**Cuddalore**	**6**
3	**Nagapattinam**	**5**
4	**Villupuram**	**4**
5	Chennai	3
6	Ramanathapuram	2
7	Tirunelveli	2
8	Mayiladuthurai	1
9	Tuticorin	1

	Very Low	Low	Moderate	High	Very High
Distance to the track in Km	>70	70	50	25	10

Table: Categorization of Vulnerability to the SCS track.

Contributors to Sea Level Rise

The contributions from the components at the global, regional, and local scales.

ΔRSL = ΔSLG + ΔSLRM + ΔSLRG + ΔSLVLM

Where,

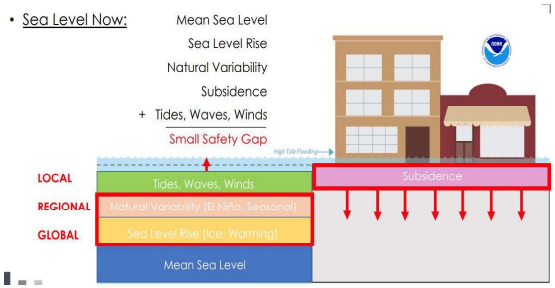
ΔRSL = Relative sea-level change,

ΔSLG = Global mean sea-level change,

ΔSLRM = Regional variation in sea level from the global mean due to metero-oceanographic factors,

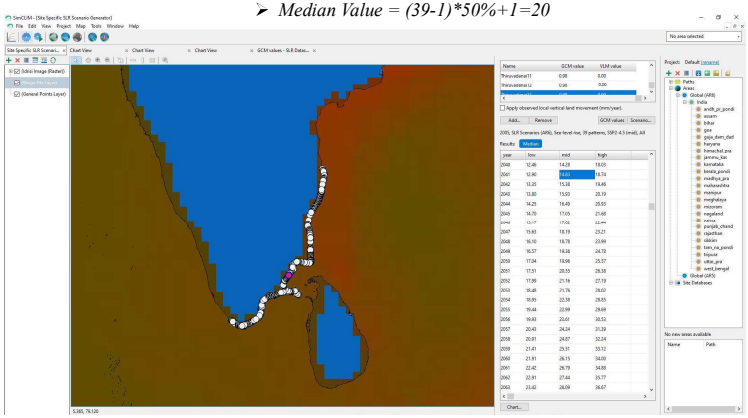
ΔSLRG = Regional variation in sea level due to changes in the earth's gravitational field, and

ΔSLVLM = Change in sea level due to vertical land movement.

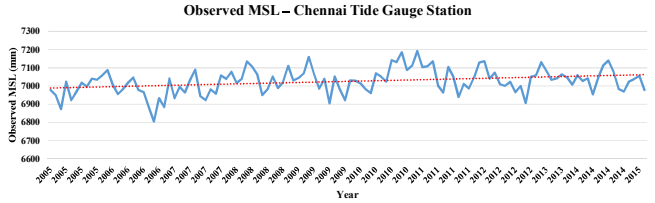


Generation of SLR Using SimCLIM

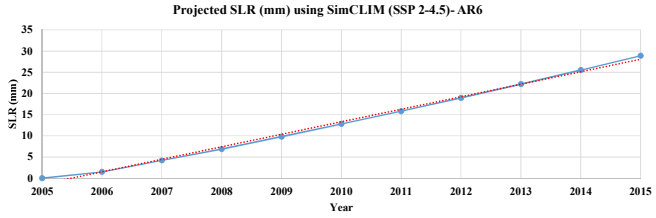
- The method used to determine the measure of central tendency is as follows:
  - *Median Value = (n-1)*50%+1*
  - *Median Value = (39-1)*50%+1=20*



Model Validation (2005-2015) – Chennai Tide Gauge Station

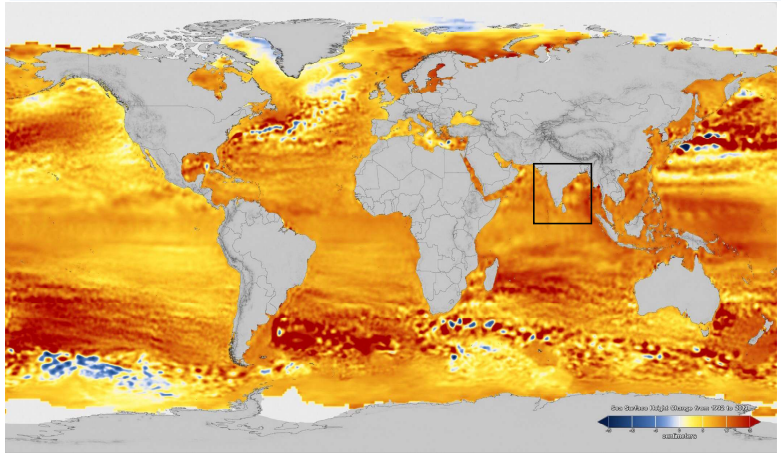


Year	Observed MSL (mm)
2005	6996
2015	7024
SLR (mm)	28



Year	Projected SLR (mm)
2005	0
2015	29
SLR (mm)	29

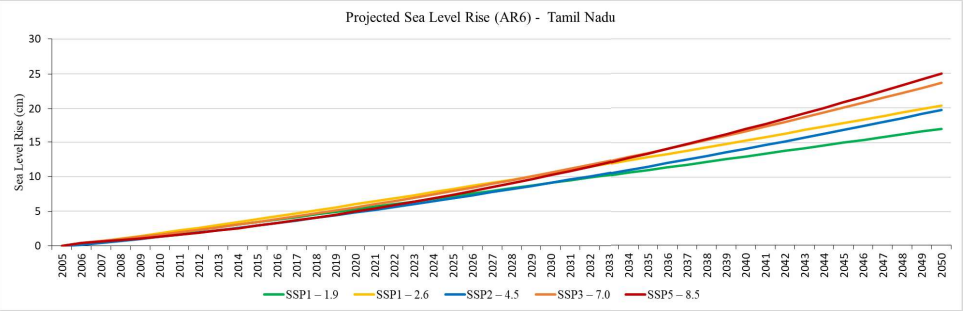
OBSERVED REGIONAL SLR – (1992 -2019)



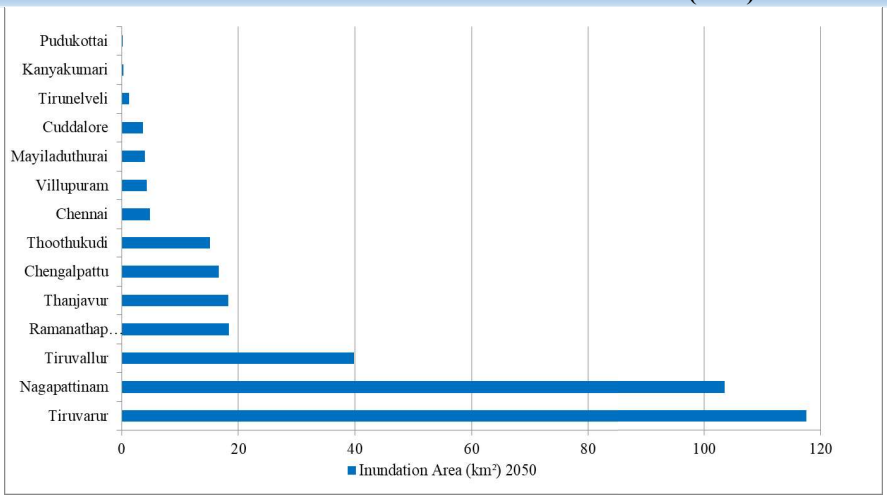
Since 1993, seas around the world have risen an average rate of **3.3 millimeters per year.**

Source: Regional sea-level change between 1992 and 2019, based on data collected from the TOPEX/Poseidon, Jason-1, Jason-2, and Jason-3 satellite altimeters. Credit: NASA

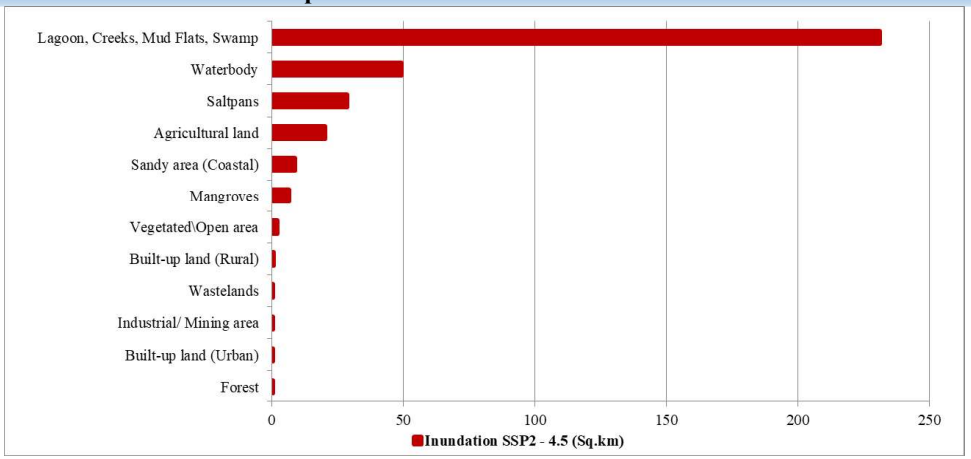
Sea Level Rise Projection –AR6 –Tamil Nadu

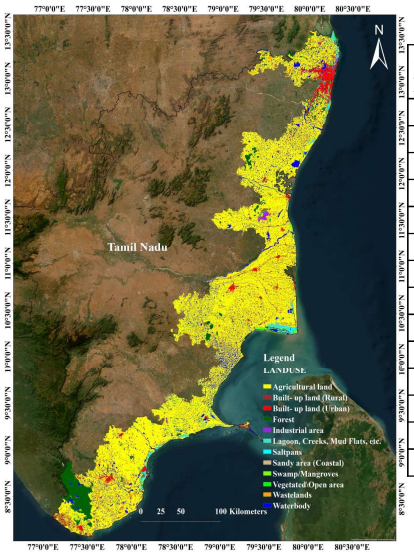


Inundation of Coastal Districts due to Sea Level Rise (2050)



Impact of Inundation on coastal Land use

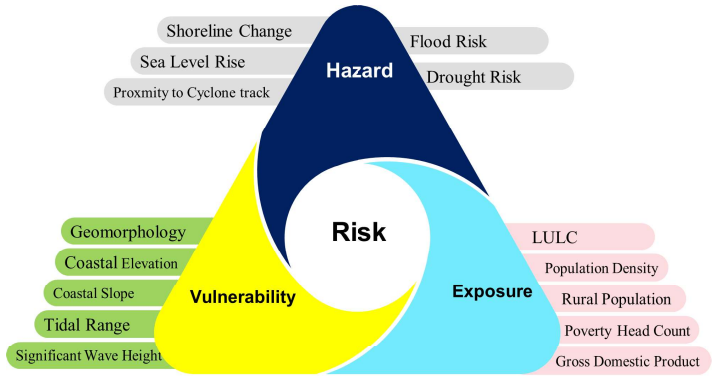




LANDUSE CLASSIFICATION

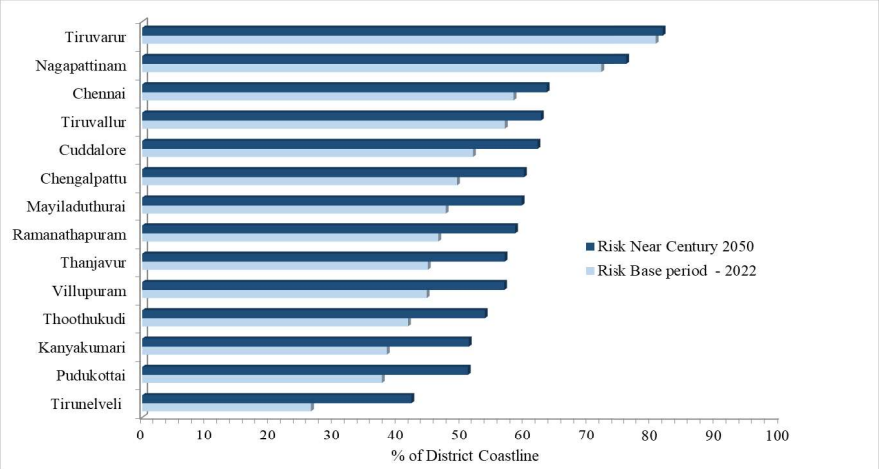
S. No.	LANDUSE	Area Km²	Area %
1	Agricultural land	29211	70.5
2	Waterbody	3773	9.1
3	Built-up land (Rural)	2373	5.7
4	Forest	1990	4.8
5	Wastelands	1018	2.5
6	Built-up land (Urban)	970	2.3
7	Vegetated/Open area	815	2.0
8	Lagoon, Creeks, Mud Flats, Swamp	619	1.5
9	Industrial/ Mining area	283	0.7
10	Saltpans	192	0.5
11	Sandy area (Coastal)	112	0.3
12	Mangroves	83	0.2
13	Breakwaters	0.9	0.0
	TOTAL	**41440**	**100**

Coastal Risk Frame work



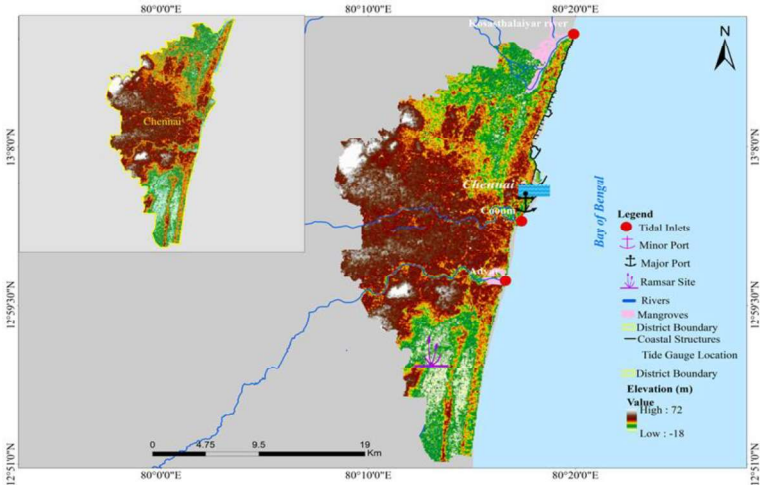
Coastal Risk Index = Hazard*Vulnerability*Exposure

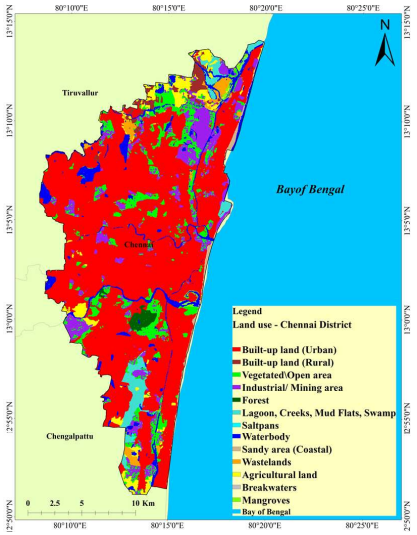
Coastal Risk Assessment of Tamil Nadu under SSP 2-4.5 Scenario - 2050



% of Coastline under High to Very High Risk

Chennai District

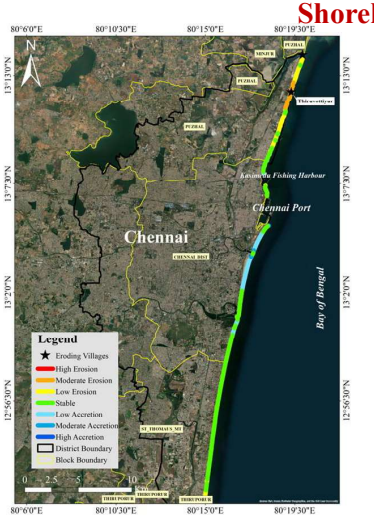




Chennai District

S. No.	Land use Land Cover	Area (ha)	% of Total Area
1	Built-up land (Urban)	28330	**64.6**
2	Built-up land (Rural)	721	1.6
3	Vegetated/Open area	4112	9.4
4	Industrial/Mining area	3673	8.4
5	Forest	368	0.8
6	Lagoons, Creeks, Mud Flats, Swamp	1293	2.9
7	Saltpans	15	0.0
8	Waterbody	2641	**6.0**
9	Sandy Beaches	313	0.7
10	Wastelands	628	1.4
11	Agricultural land	1566	3.6
12	Coastal structures	34	0.1
13	Mangroves	174	0.4
	Total	43868	100.0

Shoreline Change - Chennai District



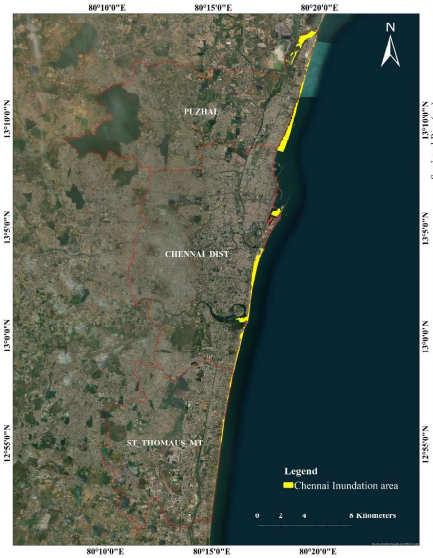
Block Name	Coast Length (km)	HE	ME	LE	Stable	LA	MA	HA
Puzhal	10.62	-	2.12	7.07	1.08	0.34	-	-
Chennai_Dist	15.68	-	-	0.47	7.46	7.26	0.41	0.09
ST.Thomas_MT	13.21	-	-	2.17	10.92	0.12	-	-
Total	39.51	-	2.12	9.71	19.46	7.72	0.41	0.09

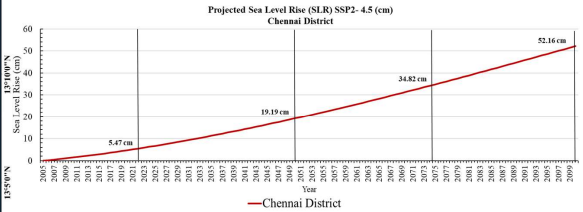
Note : HE - High Erosion, ME - Moderate Erosion, LE - Low Erosion, LA - Low Accretion, MA - Moderate Accretion, HA - High Accretion

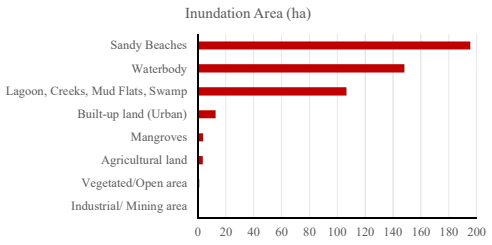
District Name	Block Name	Village Name	Length in Km
Chennai	Puzhal	Thiruvottiyur (Firka)	7.59

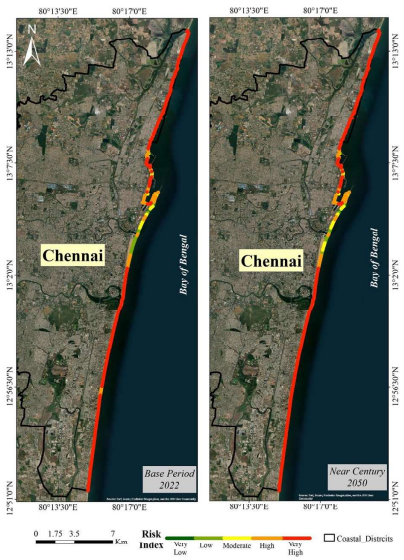
District Name	Average Erosion rate (m/year)	Average Accretion rate (m/year)	Land loss (ha)	Land gain (ha)
Chennai	1.3	0.9	58	55

Sea Level Rise and Coastal Inundation - Chennai

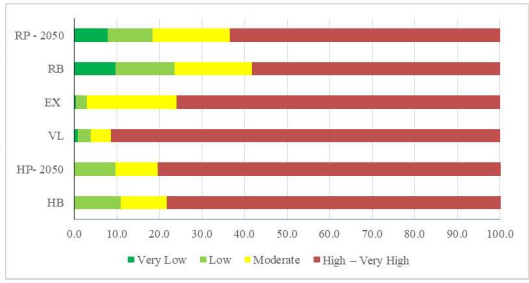




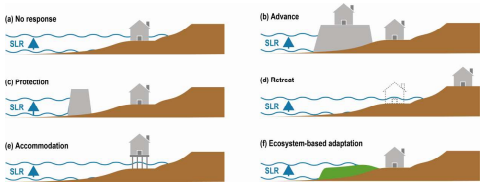




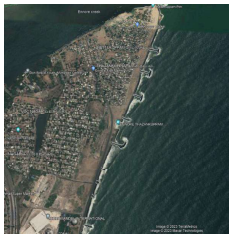
Coastal Risk Assessment - Chennai

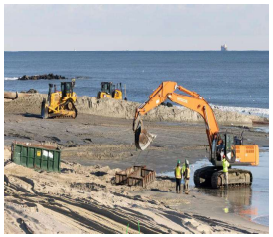


ADAPTATION AND MITIGATION STRATEGIES

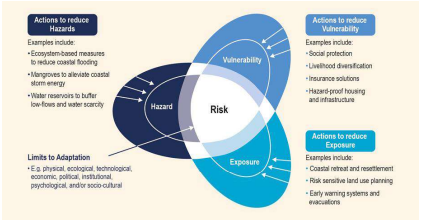


ADAPTATION TO SEA LEVEL RISE





HARD STRUCTURES BEACH NOURISHMENT



ADAPTATION TO CLIMATE CHANGE INDUCED IMPACTS

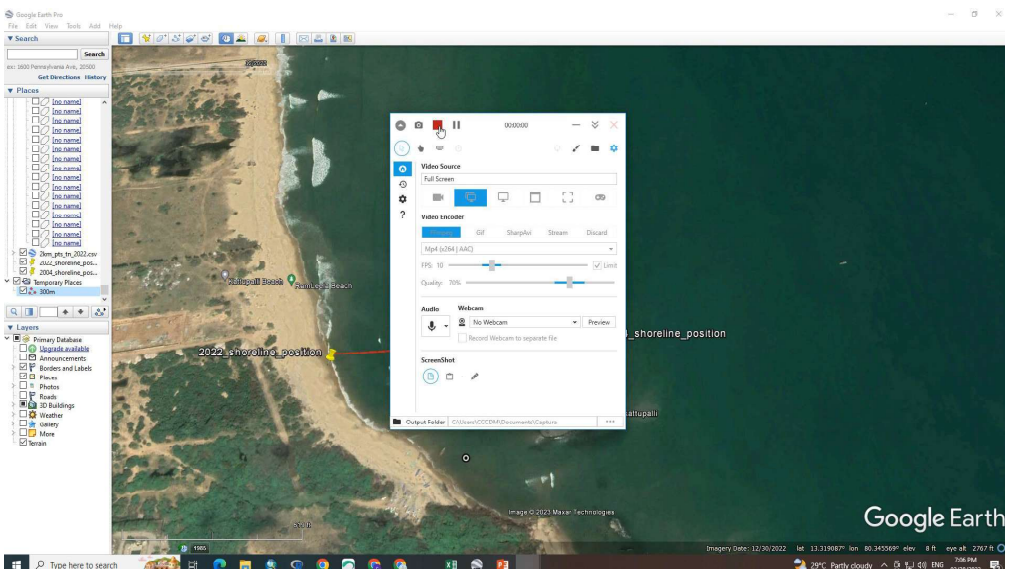
Source: IPCC AR6

COASTAL BUFFER VEGETATION – ECO-FRIENDLY SOLUTION

LIVING SHORELINES

Protection of Shoreline by promoting the growth of Marine Eco-system

Thank you…


Google Earth Pro
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Search
Places
Layers
Video Source
Full Screen
Video encoder
Audio
Webcam
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Kaliupaili Beach
Image © 2023 Maxar Technologies
Google Earth

Impact of Extreme Climate Change on Coastal rural communities in Tamil Nadu

1-12-2023

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Introduction

- Warming of climate system is undeniable and recent anthropogenic emissions of green-house gases are highest in the history
- Multi-model averages show that the temperature increase may range from 1.1 to 6.4°C and sea level rise up to 1 m by end of this century
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans
- Coupled with low socio-economic conditions of the area, the impacts of climatic events like cyclones, storm surges, and tidal flooding eventually negatively affect coastal rural communities with regard to their livelihood, income opportunities, education, and food security
- Rural areas will be particularly affected as it impacts on water resources, agriculture, overall biodiversity and ecosystems like forests and coastal zones, as well as human health

IPCC- AR5

- **Coastal systems are particularly sensitive to three key drivers related to climate change: sea level, ocean temperature, and ocean acidity**
- **Coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion due to relative sea level rise (RSLR; *very high confidence*)**
- **It is very likely that global mean sea level rose at a mean rate of 1.7 [1.5 to 1.9] mm yr–1 between 1900 and 2010 and at a rate 3.2 [2.8 to 3.6] mm yr–1 from 1993 to 2010**
- **Acidification and warming of coastal waters will continue with significant negative consequences for coastal ecosystems**

Climate change could affect different parts of the world in different ways.

- Temperature
- Sea level
- Drought
- Storms
- Flooding

. Some of them are already dealing with the effects of climate change on health and livelihoods in the poorest communities on Earth today.

Scientists have identified some of the likely effects of climate change.

Climate Change and Coastal Resources

Coastal resources will be affected by a number of consequences of climate change, including:

- Higher sea levels
- Higher sea temperatures, sea-surface temperature(SST),
- El Niño/La Niña-Southern Oscillation (ENSO) events/climate cycle
- Changes in precipitation patterns and coastal run-off
- Changes in storm tracks, frequencies, and intensities, and
- Other factors such as wave climate, storminess, and land subsidence.

Temperature

Sea level

Drought

Storms

Flooding

Scientists say sea levels could rise by the end of the century. There are two reasons why this could happen.

1. As the water in the oceans warms, it expands and takes up more space.

2. Ice from the polar caps and from glaciers is melting, adding more water to the seas.

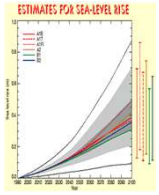
People living on small, low-lying islands may have to evacuate and millions of people in low-lying areas will be at risk of flooding.

Salt from rising sea levels could pollute ground water making it undrinkable and more difficult to grow crops.

Global projections of sea level rise

Emission scenario	Representative Concentration Pathway (RCP)	2100 CO_2 concentration (ppm)	Mean sea level rise (m)		Emission scenario	Mean sea level rise (m)		
			2046–2065	2100		2200	2300	2500
Low	2.6	421	0.24 [0.17–0.32]	0.44 [0.28–0.61]	Low	0.35–0.72	0.41–0.85	0.50–1.02
Medium low	4.5	538	0.26 [0.19–0.33]	0.53 [0.36–0.71]	Medium	0.26–1.09	0.27–1.51	0.18–2.32
Medium high	6.0	670	0.25 [0.18–0.32]	0.55 [0.38–0.73]	High	0.58–2.03	0.92–3.59	1.51–6.63
High	8.5	936	0.29 [0.22–0.38]	0.74 [0.52–0.98]				

PROJECTED SEA LEVEL RISE



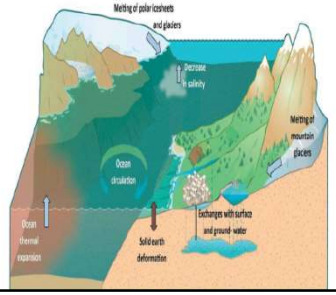
Global Projections (IPCC Scenarios)

Global mean sea level (GMSL) has risen by 0.19 [0.17 to 0.21] m over the period 1901–2010, calculated using the mean rate over these 110 years, based on tide gauge records and since 1993 additionally on satellite data. It is very likely that the mean rate was 1.7 [1.5 to 1.9] mm yr–1 between 1901 and 2010 and increased to 3.2 [2.8 to 3.6] mm yr–1 between 1993 and 2010 (AR5)

Causes for Sea Level Rise

- Climate change associated with sea level rise is one of the major environmental concerns of today
- Increasing concentration of carbon-di-oxide and other gases are expected to warm the several degrees in the next century by a mechanism known as the greenhouse effect
- Such a warming could cause sea level to rise two to five feet by expanding ocean water(Thermal expansion), melting mountains, glaciers and perhaps eventually causing polar glaciers to melt and slide into the ocean

Contribution to SLR



Contribution	Amount of rise
Ocean thermal expansion for the upper 700 m	0.5 ±0.1 mm/year
Ocean thermal expansion below 700 m	0.2 ± 0.1 mm/year
Glaciers and ice caps	0.5 ± 0.2 mm/year
Greenland Ice Sheet	0.1 ± 0.1 mm/year
Antarctic Ice Sheet	0.2 ± 0.4 mm/year
Sum of contributions	1.5 ± 0.4 mm/year
Observed sea-level rise	1.6 ± 0.2 mm/year

Impacts of SLR

- Sea level rise will affect the coastline in India in a variety of ways, including inundation, flood and storm damage associated with severe cyclones and surges, erosion, saltwater intrusion (loss of fresh water supplies) and wetland loss(important to fisheries)
- Operating difficulties in ports and harbours and adverse effects on access to the coast and ocean; coastal flooding
- Coastal and fishing populations and countries dependent on fisheries are particularly vulnerable to climate change

UNEP June 5 th (WED)2014- **'Raise your voice, not the sea level,'**

Temperature

Sea level

Drought

Storms

Flooding

Flooding may increase in some areas.

More intense and unpredictable rainfall could produce more flash floods. In coastal areas flooding could occur due to more frequent storms and higher sea level

Flooding affects lives - washing away homes, schools and even people. People also need clean, fresh water to live. If flood water contaminates the drinking water supply many people can get sick.

Temperature

Sea level

Drought

Storms

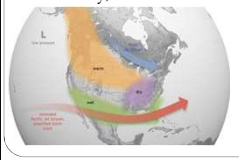
Flooding

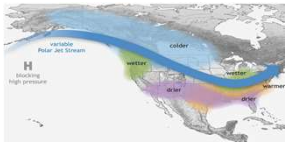
Intense storms, know as hurricanes, cyclones and typhoons (depending on where they occur in the world) could happen much more often and be more intense as a result of rising sea surface temperature.

Storms can be devastating to the lives of people living in the affected area; with damage to homes and schools and loss of lives.

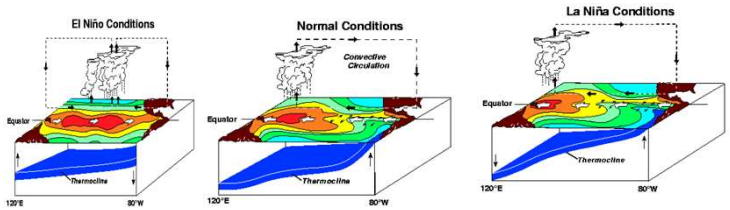
What are El Niño and La Niña?

- El Niño and La Niña are climate patterns in the Pacific Ocean that can affect weather worldwide
- El Niño and La Niña are two opposing climate patterns that break these normal conditions. Scientists call these phenomena the El Niño-Southern Oscillation (**ENSO**) cycle
- Episodes of El Niño and La Niña typically last nine to 12 months, but can sometimes last for years. El Niño and La Niña events occur every two to seven years, on average, but they don't occur on a regular schedule
- Generally, El Niño occurs more frequently than La Niña.

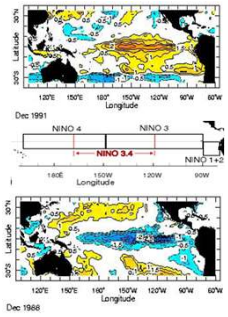




During **El Niño**, the warm pool of water moves eastward and the slope of the thermocline flattens
During **La Niña**, the warm pool moves westward, and the slope of the thermocline steepens
Red/orange colors indicate **warm** ocean surface temperatures, yellow/greenish colors indicate **cooler** temperatures.



El Niño/ La Niña -Southern Oscillation (ENSO)-Another Major Driver of Climate Change



Develops in JulAugSept, strengthen through OctNovDec, and weakens in JanFebMar

- **El Niño - major warming of the equatorial waters in the Pacific Ocean**
  - The anomaly of the SST in the tropical Pacific **increases** (+0.5 to +1.5 deg. C in NINO 3.4 area) from its long-term average;
  - A high pressure region is formed in the western Pacific and low-pressure region is formed in the eastern Pacific —this produces a negative ENSO index (SOI negative).
- **La Niña—major cooling of the equatorial waters in the Pacific Ocean**
  - The anomaly of the SST in the tropical Pacific **decreases** (-0.5 to -1.5 deg. C in NINO 3.4 area) from its long-term average;
  - A high pressure region is formed in the eastern Pacific and low-pressure region is formed in the western Pacific—this produces a positive ENSO index (SOI positive).

El Niño/ La Niña Years (1950-2012)

- The number of El Niño/ La Niña years has considerably increased in the recent years. Scientists argue that this is the result of climate variability and change (instability)
- and…
- This trend is likely to continue in future as we are in a stage of changing climate…
- So, more frequent extreme events are likely in the future.
- El Nino, the warming of waters in the Pacific Ocean near South America, is generally associated with weakening monsoon winds and dry weather in **India**. La Nina, the opposite of El Nino, typically brings good rainfall during the monsoon season

El Niño and La Niña Years

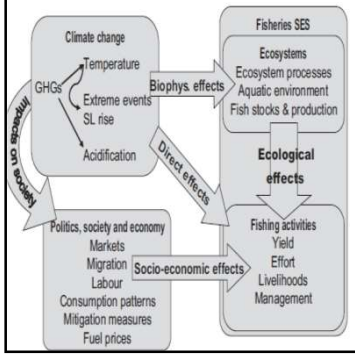
El Niño	Year	La Niña	Year
1	**1951	1	1950-51
2	1953	2	*1954-56
3	**1957-58	3	**1964-65
4	*1963-64	4	1967-68
5	*1965-66	5	*1970-72
6	*1968-70	6	**1973-76
7	**1972-73	7	*1984-85
8	1976-77	8	**1988-89
9	1977-78	9	1995-96
10	**1982-83	10	**1998-2000
11	*1986-88	11	2007-08
12	1990-92		
13	1993		
14	1994-95		
15	**1997-98		
16	2000-01		
17	2004-05		
18	2006-07		

** Strong event, * Moderate event

- Biophysical Impacts

Climate driver (trend)	Main physical/ecosystem effects on coastal ecosystems
• (CO_2) concentration	• Increased CO_2 concentration, decreases ocean acidification negatively impacting coral reefs and other pH
• Surface sea temperature (SST) (I, R)	• Increased stratification/changes circulation; reduced incidence of sea ice at higher latitudes; increased coral bleaching and mortality; pole-ward species migration; increased algal blooms.
(I: increasing, R:Regional variability)	• Inundation, flood and storm damage; erosion; saltwater intrusion; rising water tables/impeded drainage; wetland loss (and change)
• Sea level (I, R)	• Increased extreme water levels and wave heights; increased episodic erosion, storm damage, risk of flooding,etc
• Storm intensity (I, R)	• Altered surges and storm waves, and hence risk of storm damage and flooding
• Storm frequency (?, R); Storm track (?, R)	• Altered wave conditions, including swell; altered patterns of erosion and accretion; re-orientation of beach plan form
• Wave climate	• Altered flood risk in coastal lowlands; altered water quality/salinity; altered fluvial sediment supply; altered circulation and nutrient supply.
• Run-off (R)	

Ecological, direct and socio-economic impacts of climate change on fisheries



Ecological impacts

- Change in yield
- Change in species distribution
- Increased variability of catches
- Changes in seasonality of production

Direct impacts	Socio-economic impacts
Damaged infrastructure	Influx of migrant fishers
Damaged gears	Increasing fuel costs
Increased danger at sea	Reduced health due to disease
Loss/gain of navigation routes	Relative profitability of other sectors
Flooding of fishing communities	Resources available for management
	Reduced security
	Funds for adaptation

Potential impacts of climate change on fisheries

Type of changes	Physical changes	Processes	Potential impacts on fisheries
Physical environment (indirect ecological)	Increased CO_2 and ocean acidification	Effects on calciferous animals e.g. molluscs, crustaceans, corals, echinoderms and some phytoplankton	*Potentially **reduced production** for calciferous marine resources and ecologically related species and **declines in yields***
	Warming upper layers of the ocean	Warm-water species replacing cold-water species	*Shifts in **distribution** of plankton, invertebrates, fishes and birds towards the North or South poles, reduced species diversity in tropical waters*
		Plankton species moving to higher latitudes	
		Timing of phytoplankton blooms changing	*Potential mismatch between prey (plankton) and predator (fish populations) and **reduced production and biodiversity** and **increased variability in yield***
		Changing zooplankton composition	
	Sea level rise	Loss of coastal fish breeding and nursery habitats e.g. mangroves, coral reefs	***Reduced production and yield** of coastal and related fisheries*
Fish stocks (indirect ecological)	Higher water temperatures	Changes in sex ratios Altered time of spawning Altered time of migrations Altered time of peak abundance	*Altered timing and **reduced productivity** across marine and fresh water systems*
	Changes in ocean currents	Increased invasive species, diseases and algal blooms	***Reduced productivity** of target species in marine and fresh water systems*
		Changes in fish recruitment success	*Abundance of juvenile fish affected leading to **reduced productivity** in marine and fresh water*

Ecosystems (indirect ecological)	Reduced water flows and increased droughts	Changes in lake water levels	*Reduced productivity of lake fisheries*
		Changes in dry water flows in rivers	*Reduced productivity of river fisheries*
	Increased frequency of ENSO events	Changes in timing and latitude of upwelling	*Changes in distribution of pelagic fisheries*
		Coral bleaching and die-off	*Reduced productivity coral-reef fisheries*
Disturbance of coastal infrastructure and fishing operations (direct)	Sea level rise	Coastal profile changes, loss of harbours, homes.	*Increased vulnerability of coastal communities and infrastructure to storm surges and sea level*
		Increased exposure of coastal areas to storm damage	*Costs of adaptation lead to reduced profitability, risk of storm damage increases costs of insurance and/or rebuilding*
	Increased frequency of storms	More days at sea lost to bad weather, risks of accidents increased	*Increased risks associated with fishing, making it less viable livelihood options for the poor*
		Aquaculture installations (coastal ponds, sea cages) more likely to be damaged or destroyed	*Reduced profitability of larger-scale enterprises, insurance premiums rise*
Inland fishing operations and livelihoods (indirect socio-economic)	Changing levels of precipitation	Where rainfall decreases, reduced opportunities for farming, fishing and aquaculture as part of rural livelihood systems	*Reduced diversity of rural livelihoods; greater risks in agriculture; greater reliance on non-farm income.* *Displacement of populations into coastal areas leading to influx of new fishers*
	More droughts or floods	Damage to productive assets (fish ponds, weirs, rice fields, etc.) and homes	*Increasing vulnerability of riparian and floodplain households and communities*
	Less predictable rain/dry seasons	Decreased ability to plan livelihood activities – e.g. farming and fishing seasonality	

Source: adapted from Allison *et al.*, 2005.

Tamil Nadu Details

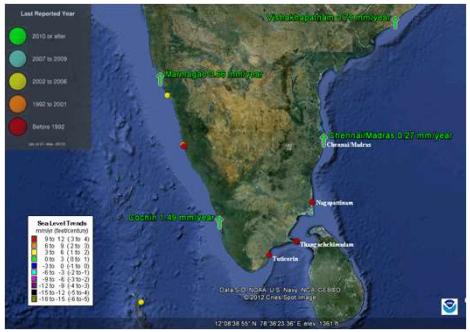
- **Population: 72,138,958 (6 % of the country)**
- **Area: 130,058 Square Kilometers**
- **Capital of the State: Chennai**
- **Coastal Length: 1076 Km**
- **Economy: Second Largest economy of India.**
- **42% of population employed in Agriculture**
- **Present Climate:**
- **Warmer summers, with temperature ranging from 23 0C and 33 0C**
- **The principal rainy seasons are SW (June-Sept) and NE (Oct-Dec) monsoon seasons, with an annual rainfall of 950 mm.**

Tamil Nadu Coastal Districts

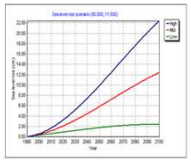
S.No.	Coastal District	Coastal Length (Km)
1	Chennai	19.0
2	Thiruvallur	27.9
3	Villupuram	40.7
4	Pudukottai	42.8
5	Thanjavur	45.1
6	Thiruvarur	47.2
7	Tirunelveli	48.9
8	Cuddalore	57.5
9	Kanyakumari	71.5
10	Kanchipuram	87.2
11	Tuticorin	163.5
12	Nagapattinam	187.9
13	Ramanathapuram	236.8
	Total	1076.0

- The Tamil Nadu coastline is about 1,076 km, with thirteen coastal districts, and it forms a fairly large contiguous and narrow coastal strip dotted with fragile ecological features

A CASE STUDY-TAMIL NADU COAST & SEA LEVEL RISE



Sea Level Rise Projections: IPCC AR4-B1 Scenario (Minimum), A1FI Scenario (Maximum) for Long 80050' E; Lat 11050' N of Tamil Nadu Coast

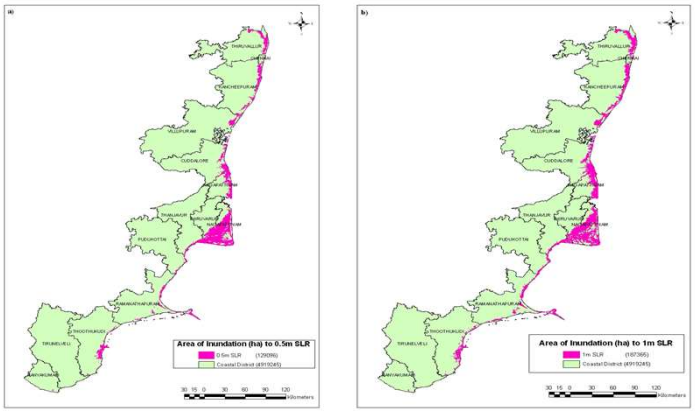


- About 10-20 cm rise occurred during the last century-Globally
- **SimCLIM**, a computer model system for examining the effects of SLR variability and change over time and space for the state of Tamil Nadu.

Projected sea level rise-AR4-Simclim

IPCC SRES Scenarios	GLOBAL PROJECTIONS 2100	REGIONAL PROJECTIONS 2100	
		1.007 m	1.252 m
B1	0.18 to 0.38m	0.19 to 0.41m	0.22 to 0.47m
B2	0.20 to 0.43m	0.21 to 0.47m	0.25 to 0.53m
A1B	0.21 to 0.48m	0.23 to 0.52m	0.26 to 0.60m
A1T	0.20 to 0.45m	0.21 to 0.49m	0.25 to 0.56m
A2	0.23 to 0.51m	0.25 to 0.55m	0.28 to 0.63m
A1F1	0.26 to 0.59m	0.28 to 0.64m	0.32 to 0.73m

- Using CLIM SYSTEM - a model used for predicting sea level rise, with climate inputs from various GCMs(Global climate model).It is projected that by the end of the century i.e. by 2100 the sea level may rise of Tamil Nadu coast is likely to range from 0.19 m to a maximum of 0.73 m.



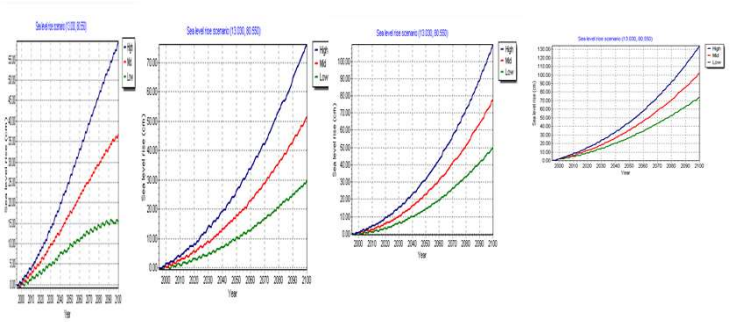
Area of inundation to predicted impact of 0.5 and 1m SLR at 13 coastal districts of Tamil Nadu

S.No	Coastal Districts	Total area in hectares (ha)	Area of inundation in hectares (ha) to 0.5m SLR	Area of inundation in hectares (ha) to 1m SLR
01.	Thiruvallur	355000	1170	3810
02.	Chennai	17400	30	93
03.	Kancheepuram	430700	2399	6124
04.	Villupuram	719000	574	2620
05.	Cuddalore	370600	1675	4355
06.	Nagapattinam	241700	35617	50879
07.	Thiruvarur	237700	17389	24015
08.	Thanjavur	347600	3397	5475
09.	Pudukottai	465100	188	510
10.	Ramanathapuram	417500	2865	4462
11.	Tuticorin	462100	826	3267
12.	Thirunelveli	681000	0	4
13.	Kanyakumari	168400	11	28
	Total	**4913800**	**66685**	**105642**

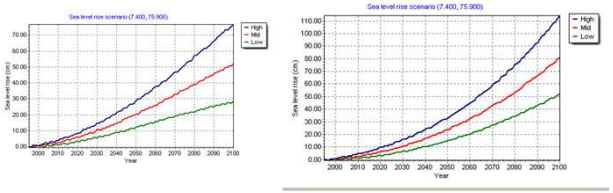
Area Inundated

- 0.5 m SLR 66,685 acres of land will be inundated
- 1 m SLR 105642 acres will be inundated
- Nagapattinam, ,Thiruvarur and Thanjavur coastal districts ,high area will be inundated

Chennai Coast-AR5-SimClim



Kanyakumari

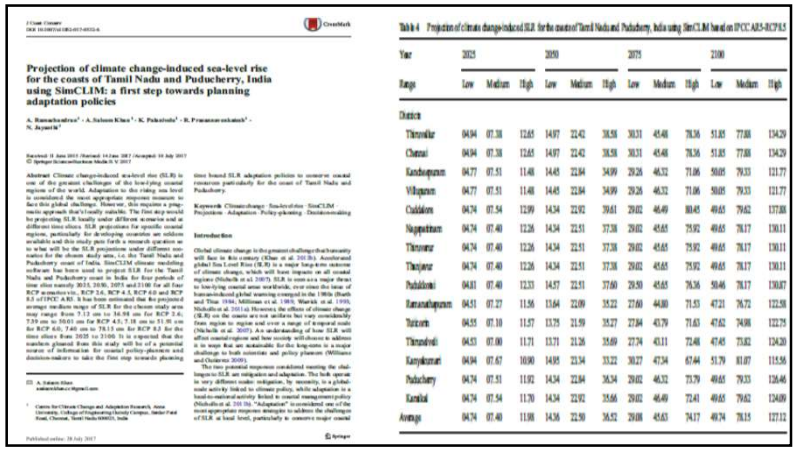


RCP 4.5 -2100

- Low-31 cm
- Medium 50
- High- 81

Ramanathapuram 30 –low, Kanyakumari- High33

Kanyakumari low 73, high Cuddalore 88 cm



Projection of climate change-induced sea-level rise for the coasts of Tamil Nadu and Puducherry, India using SimCLIM: a first step towards planning adaptation policies

Table 4 Projection of climate change-induced SLR for the coasts of Tamil Nadu and Puducherry, India using SimCLIM based on IPCC AR5-RCP8.5

Year	2025			2050			2075			2100		
Range	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
District												
Thiruvallur	04.94	07.38	12.65	14.97	22.42	38.58	30.31	45.48	78.36	51.85	77.88	134.29
Chennai	04.94	07.38	12.65	14.97	22.42	38.58	30.31	45.48	78.36	51.85	77.88	134.29
Kanchepuram	04.77	07.51	11.48	14.45	22.84	34.99	29.26	46.32	71.06	50.05	79.33	121.77
Villupuram	04.77	07.51	11.48	14.45	22.84	34.99	29.26	46.32	71.06	50.05	79.33	121.77
Cuddalore	04.74	07.54	12.99	14.34	22.92	39.61	29.02	46.49	80.45	49.65	79.62	137.00
Nagapattinam	04.74	07.40	12.26	14.34	22.51	37.38	29.02	45.65	75.92	49.65	78.17	130.11
Thiruvarur	04.74	07.40	12.26	14.34	22.51	37.38	29.02	45.65	75.92	49.65	78.17	130.11
Thanjavur	04.74	07.40	12.26	14.34	22.51	37.38	29.02	45.65	75.92	49.65	78.17	130.11
Pudukkottai	04.81	07.40	12.33	14.57	22.51	37.60	29.50	45.65	76.36	50.46	78.17	130.87
Ramanathapuram	04.51	07.27	11.56	13.64	22.09	35.22	27.60	44.80	71.53	47.21	76.72	122.58
Tuticorin	04.55	07.10	11.57	13.75	21.59	35.27	27.84	43.79	71.63	47.62	74.98	122.75
Tirunelveli	04.53	07.00	11.71	13.71	21.26	35.69	27.74	43.11	72.48	47.45	73.82	124.20
Kanyakumari	04.94	07.67	10.90	14.95	23.34	33.22	30.27	47.34	67.44	51.79	81.07	115.56
Puducherry	04.74	07.51	11.92	14.34	22.84	36.34	29.02	46.32	73.79	49.65	79.33	126.46
Karaikal	04.74	07.54	11.70	14.34	22.92	35.66	29.02	46.49	72.41	49.65	79.62	124.09
Average	04.74	07.40	11.98	14.36	22.50	36.52	29.08	45.63	74.17	49.74	78.15	127.12

Land under sea for different SLR(IITM)

		LAND AREA (IN ACRES)				
	District	Up to 1 metre	Up to 2 metres	Up to 3 metres	Up to 5 metres	Up to 10 metres
1	Thiruvallur	13,640	27,721	46,133	84,849	1,61,163
2	Chennai	1,241	2,073	3,139	6,335	21,655
3	Kanchipuram	21,482	34,112	49,164	78,818	1,52,629
4	Villupuram	5,518	11,853	19,010	29,317	47,248
5	Cuddalore	11,882	21,328	35,685	76,150	1,92,230
6	Nagapattinam	1,45,869	1,97,519	2,57,300	3,79,831	5,69,567
7	Thiruvarur	35,570	50,433	65,701	99,809	2,17,353
8	Thanjavur	12,867	17,321	21,926	32,602	61,996
9	Pudukottai	1,419	3,320	7,066	17,160	43,700
10	Ramanathapuram	12,086	22,326	35,314	83,684	2,88,935
11	Tuticorin	7,874	14,154	24,674	57,434	1,55,922
12	Tirunelveli	73	87	140	656	7,368
13	Kanyakumari	104	177	337	985	6,680
	TOTAL	2,69,625	4,02,424	5,65,588	9,47,629	19,26,446

Area of wetland under various elevations

		AREA (IN HECTACRES)				
Mangroves	District	Up to 1 metre	Up to 2 metres	Up to 3 metres	Up to 5 metres	Up to 10 metres
Pichavaram	Cuddalore	551.0	892.0	1,163.0	1,367.0	1,415.0
Vedaraniyam	Nagapattinam	3,970.0	4,376.0	4,537.0	4,654.0	4,662.0
Gulf of Mannar	Rameshwaram	115.0	220.0	378.0	674.0	870.0
Total (Hectares)		4,636.0	5,488.0	6,078.0	6,695.0	6,947.0

NIOT

- In India sea level is being monitored with tide gauges at 18 locations along the coast as a part of Global Sea Level Observing System (GLOSS)
- The rate of relative sea level change along the Indian coast has been found to vary from -3.36 mm/yr to +5.16 mm/yr (positive and negative values indicate rise and fall of sea level respectively). The sea level is showing rising trend at Chennai (0.33 mm/yr),
- Fall in sea level is recorded at Nagapatnam (-1.95 mm/yr), and Tuticorin (-2.70 mm/yr). Compared to the global sea level rise rate of ~3 mm/yr, the above data imply probable subsidence of land at several places

Risk

- Five coastal districts, Nagapattinam, Thiruvarur, Thanjavur, Pudukottai, and Ramanathapuram, the area along the coast that is below 10m above current mean sea level is estimated to be at risk from a 1 metre SLR, because of the very high storm surges that already affect them
- the remaining eight coastal districts, the coastal area that lies below 5m elevation relative to current mean sea level is estimated to be at risk from a 1 metre SLR

Responding

- Mitigation- refers to efforts to cut or prevent the emission of greenhouse gases - limiting the magnitude of future warming. It may also encompass attempts to remove greenhouse gases from the atmosphere.

Globally by all countries- low carbon society AVOIDING THE UNMANAGEABLE

- Adaptation-refers to the actions taken to manage the unavoidable impacts of climate change
- Involves adjusting life to actual or expected future climate with the goal of reducing vulnerability

Regional- climate resilient society MANAGING THE UNAVOIDABLE

INDIA'S ACTION PLAN TO REDUCE CO_2 EMISSIONS

1. Reduce emission intensity by 33 to 35 per cent by 2030 compared to 2005 levels

HOW:

- Introduce new, more efficient, cleaner technologies in thermal power generation
- Reduce emissions from transport sector
- Promote energy efficiency, mainly in industry, transport, buildings, appliances
- Develop climate resilient infrastructure
- Pursue Zero Effect, Zero Defect policy under Make in India programme

2. Produce 40 per cent of electricity from non-fossil fuel based energy resources by 2030

HOW:

- Install 175 GW of solar, wind and biomass electricity by 2022, scale it up in following years
- Aggressively pursue hydropower development
- Achieve target of 63 GW of installed nuclear power capacity by 2032

3. Create additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide equivalent by 2030 through additional forest and tree cover

HOW:

- Full implementation of Green India Mission, other afforestation programmes
- Develop 140,000 km long tree line on both sides of national highways

Water

- Water is essential to human life and to the health of the environment
- Water has two dimensions that are closely linked - quantity and quality
- A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health

Management

- Catchment Area storage & protection, connecting municipal systems to watershed, drainage channels-Hard, soft-building permits

Water Stress and Water Insecurity

- Spreading water scarcity due to CC is contributing to food insecurity and heightened competitions for water both within states and between districts
- Increase in temperature - will in turn lead to reducing water availability, hydropower potential, and would change the seasonal flow of rivers
- A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing
- Available research suggests a significant future increase in heavy rainfall events in many regions, while in some regions the mean rainfall is projected to decrease
- **Flood** potential could increase-River and Coastal areas damage

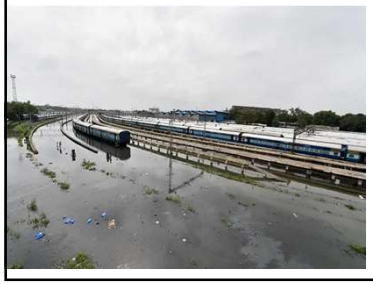
Water

- Increasing floods poses challenges to society, physical infrastructure and water quality.
- Rising temperatures will further affect the physical, chemical and biological properties of fresh water lakes and rivers, with predominantly adverse impacts on many individual fresh water species, community composition and water quality
- In coastal areas, sea level rise will exacerbate water resource constraints due to increased salinisation of groundwater supplies
- Phenomenal increase in the growth of groundwater abstraction structures
- The falling groundwater levels in various parts of the country have threatened the sustainability of the groundwater resources
- Water security in terms of quantity(water stressed state) and quality (TDS, F^-)pose problems

Some Solutions …

- Rain Water Harvesting
- Existing water bodies(Maintenance like periodical desilting, deepening, etc.,)
- Hydrological projects - Construction of new Dams
- Artificial Recharge to Ground Water
- Desalination-RO
- Interlinking of rivers-within states
- Waste water reuse

Dec.2015- Chennai



Summing up

- Climate change is the greatest challenge to sustainable development
- Efforts so far in the direction of meeting the challenges of climate change have been sporadic and incoherent
- Sustainable development based on addressing the needs of the poor and optimal harnessing of scarce natural resources of water, land, and biodiversity will have to be sustained through more cooperative way
- Sector wise vulnerability assessment has to be done with proper adaptation strategies to avoid the climate Risk
- This will save our planet from the brink of climate disasters

CONCLUSION

- SLR is an Indicator of Climate Change, a global threat
- Greatest challenge to low lying coastal regions, may to lead to **refugee**
- Mitigation of GHG is important- global policy
- Adaptation –local to National policy- most appropriate for coastal
- SLR projection – Good source of information for local Adaptation policy planning
- Fund- NABARD- Global Green Climate Fund, National Adaptation Fund

Strategies to enhance the adaptive capacity of coastal communities to climate change

Capacity Building Programme
Centre for Climate Change and Disaster Management
Anna University

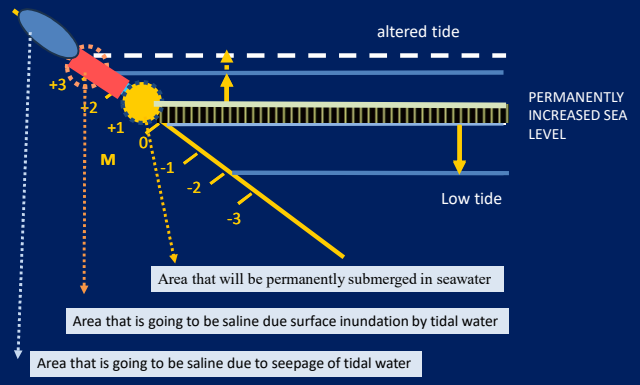
Dr V Selvam
Executive Director, SPEED Trust
1st December 2023

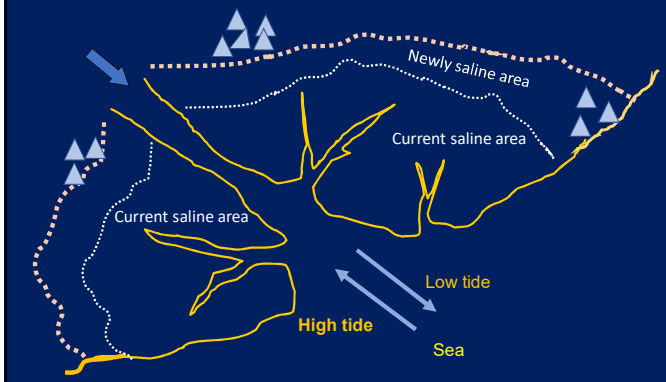
Focusing on adaptive capacity relating to

1.0 Sea level rise

2.0 Increasing number and intensity of cyclone and associated storm surges

Impact of sea level rise will be multiple





Cumulative effect of SLR and Cyclone:

Increased salinisation of land and water resources in the coastal areas

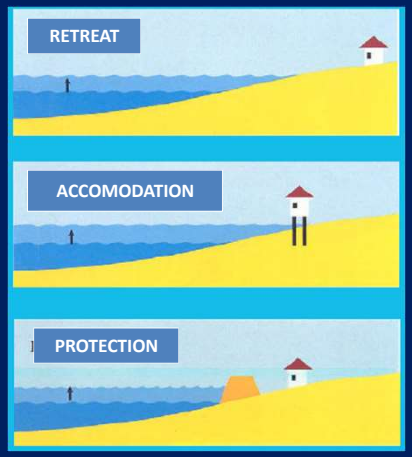
Reduced agriculture productivity

Loss of employment

Reduced availability of drinking water

Loss of lives, property and infrastructure

Adaptive responses to SLR – IPCC Model



Move away from the area predicted to be affected

Change land use
- saline tolerant varieties
- aquaculture
Use soft solutions

Use hard solutions

Strategies to enhance adaptive capacity of the community

Strategy 1:	Restoring and conserving mangrove UNFCCC – critical intervention; blue solution
Strategy 2:	Conserving and establishing non-mangrove bioshield National Disaster Management
Strategy 3:	Promoting integrated mangrove fishery farming system UNFCC - critical intervention; efficient blue solution
Strategy 4:	Promoting cultivation of saline-tolerant crops – traditional and improved
Strategy 5:	Identifying and promoting new sources of saline-tolerant crops from halophytes and promote biosaline agriculture

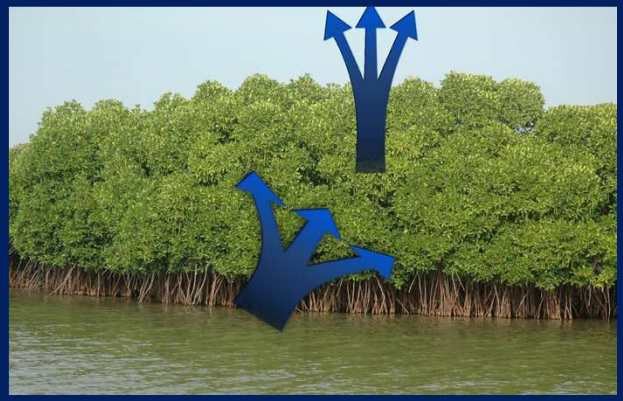
1.0 Mangroves and adaptation to SLR

Prevents inundation of seawater

Mangrove forest floor grows
- Trapping sediment
- Trapping mangrove litter

Vertical growth of the mangrove platform Is equal to the predicted SLR

Deflects the cyclonic winds – well proven during the Odisha Super Cyclone 1999



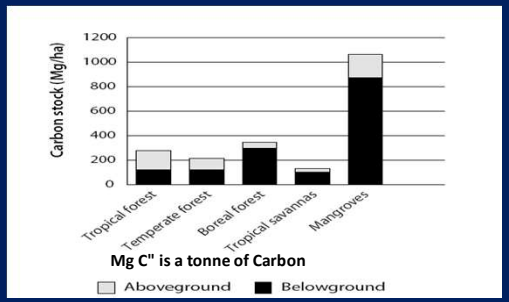
Width of the mangroves to function as an effective barrier

Empirical studies indicate that

mangroves of about 250 m in width can function as an effective barrier against wind speed of around 120 km per hour

mangroves of about 1 km in width can be effective when wind speed ranges between 170 to 200 km per hour

Carbon sequestration rate is high in mangroves



- 1000 tons of Carbon/ ha
- aboveground C stock = 115 ± 7 Mg C/ha and
- mean belowground C stock = 741 ± 30 Mg C/ha

Ensures livelihood security of the local community

Quantities of goods provided by Mangrove Forests (ha^{-1} yr^{-1})

Variable	Mean
Fish, Shellfish, molluscs (Kg)*	539
Shrimp (Kg)	146
Timber (Kg)	5976
Fuel wood, charcoal (Kg)	5140
Carbon (Mg)**	5.27

Restoration of mangroves of India: process started in 1992 .....

Identified real reason for mangrove degradation – past management practices – not by the use of resources by community

Developed a restoration technique with the participation of the Community and FD – Piloted in TN, AP, Orissa and WB

Evaluated and included in the National Action Plan; Replicated in all the mangroves of India by the State Forest Departments

Restored area

State of Forest Report of India - 2015

Mangrove Forest cover of India

1987 404600 ha

2019 497500 ha

increased by 92000 ha

Science-based and community-centred approach

MISTHI Programme

Another 54000 ha is proposed in the next 5 years.

Strategy 2: Conserving and establishing non-mangrove bioshield

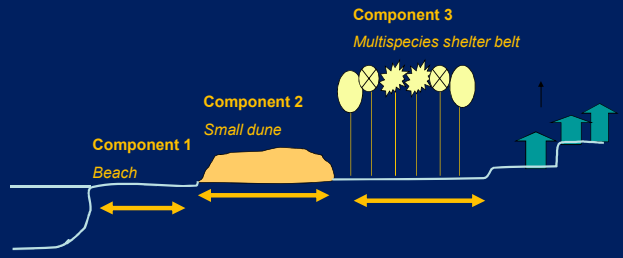
Sand dune with vegetation

Man made Shelterbelt plantation

Casuarina plantation

Casuarina as a monospecific stand is not very effective,

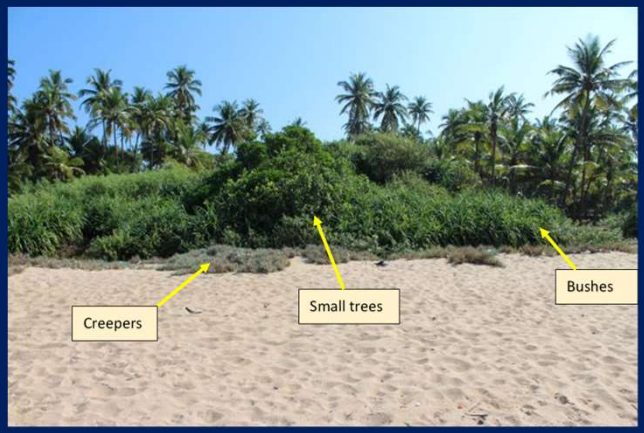
Establishing multispecies shelter is more effective



Component 1: Beach should be left undisturbed for the continuity of the ecological process and as a habitat for turtles and shore crabs

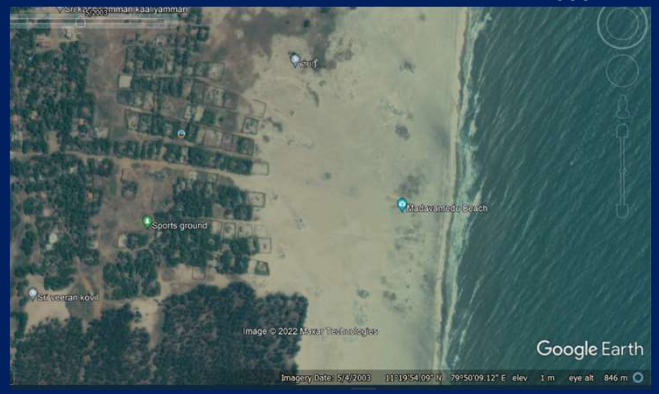
Component 2: is a small sand dune, which can be stabilised by planting creepers

Component 4 Multispecies bioshield: first three rows of casuarina plantation, behind which native trees can be planted



Demonstrated multispecies shelter in Madavamedu village

2003



Strategy 3: Low external input Integrated Mangrove Fishery Farming system

Tidal fed; no energy; About 28.8 ton of CO_2 emission is avoided per ha of IMFFS farm per year*

After4 years

Developed and demonstrated with the support of GIZ and Department of Environment. Government of Tamil Nadu

Economically viable

Rs.80000 to 100000 per ha/ 8 months

GIZ has identified it as one of the Blue Solutions

UNFCCC – Adaptation Funds; Project in Andhra Pradesh

Received Earthcare Award in 2015 – JSW and Times of India

Strategy 4 Promotion of Cultivation of Saline Tolerant Crops

Cultivatoin of traditional saline tolerant paddy varieties Pokkali – Kerala;
Kagga - Karnataka

New saline tolerant varieties developed from pokkali through conventional breeding

3 ton per ha

Strategy 5: Halophytes as a new source crops for saline affected soil

- Halophytes are salt-loving plants – growing only in high saline areas
- Tolerate high concentration of sodium salt; demand sodium chloride for survival and reproduction
- Will not survive in fresh water condition for long time
- Multiple-origin - they differ widely in salinity tolerance
- Can be grown as a cash crop by irrigating with seawater

  edible oil, vegetables, flowers, medicinal plants, fodder crops

Biosaline farming high saline tolerant halophytes

Salicornia brachiata

bio-salt, bio-fuel, edible oil

Sesuvium portulacastrum

Green, salad – nutritional security of coastal poor

Suaeda maritima

Fuel wood

Biosaline farming - Trials

Salicornia brachiata

Sesuvium *portulacastrum*

Suaeda maritima

Halophytes as saline water irrigated crops

limited field trials indicate high yield potential of many halophytes

17 ton of dry biomass of Salicornia per ha in seawater salinity

Technological innovation is needed to domesticate halophytes as crops – Biosaline agriculture

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT FOR COASTAL DISTRICTS OF TAMILNADU

Presentation on

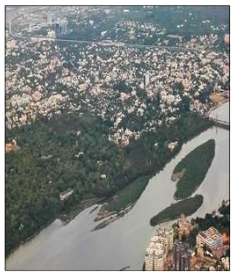
Coastal Morphodynamics and Environmental Variables of Ennore Creek: An Integrated Approach

By
Prof. Dr. M. Krishnaveni
Director, Institute for Ocean Management, Anna University

Date: 30.11.2023
Venue: CCCDM Conference Hall

WHAT IS A CREEK?

A creek



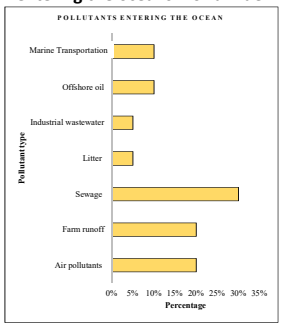
- Rivers and other freshwater sources meet the ocean in creeks and estuaries.
- Creeks are coastal ecosystems and act as a habitat for flora and fauna which help to maintain biodiversity.
- A creek is a naturally smaller stream of water extending farther inland and often considered as tributary to a river.

POLLUTION IN CREEKS

Creeks are polluted by,

- **Marine transportation**
- **Offshore oil**
- **Industrial wastewater**
- **Litter**
- **Sewage**
- **Farm runoff**
- **Air pollutants**

Percentage of various pollutants entering the oceans worldwide



STUDY AREA

Satellite view of the study area

- The Ennore Creek located in North Chennai, Tamil Nadu, on the Southeast coast of India is the study area.
- Ennore Creek is a backwater located in Ennore, Chennai along the Coromandal Coast of the Bay of Bengal.
- It is located between 13°16′ and 13° 26′ N latitudes and between 80° 24′ and 80° 35′ E longitudes.

ENNORE CREEK

• **Ennore creek mouth** is changing frequently due to natural phenomena like cyclones, floods, tidal fluctuations, etc. and **anthropogenic activities.**

• During the Northeast monsoon, the entire coast is **affected by the Cyclones.**

• The construction of **jetties and breakwaters** at Ennore Port has resulted in **sand accretion.**

• The thermal power plant utilizes the **creek water as a coolant** and thus elevating the temperature of the creek and near-shore water **by 5º to 9º C** above the ambient seawater temperature.

• The study is focused mainly on a **detailed analysis of shoreline changes and water quality analysis** in the mouth area **using remote sensing.**

OBJECTIVES

The main objectives of the present study are:

• To assess the environmental issues of Ennore creek through a Socio-economic survey;

• To map the shoreline changes at the creek mouth through remote sensing data; and,

• To analyze the water quality parameters for different periods as a consequence of opening and closure of the mouth.

ENVIRONMENTAL ISSUES OF THE ENNORE CREEK

(i) Socio-economic survey

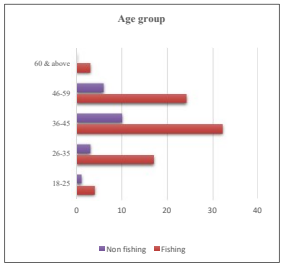
(a) Age group

• This survey is conducted among **70 households**.

• Among this**, 56 households** belong to the **fishermen** community and the **remaining** belong to the **non-fishermen community**.

• Among the 70 respondents, **53 are men** and **17 are women**.

(a) Age group



(b) Annual income

• **33 percent** of the **fishermen** and **11.4 percent** of the **non-fishermen** have yearly earnings of **less than 60,000 rupees.**

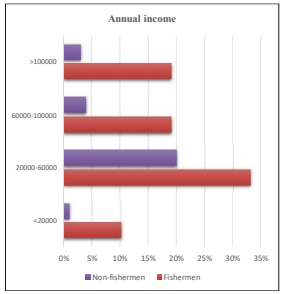
• The **main occupation** of the people around the Ennore creek is **fishing.**

• The **availability of fish** in the creek is affected by local industries and thermal power stations.

• People living around face health issues due to the **effluents** caused by the industries.

• **About 20%** of their income is spent on **health issues.**

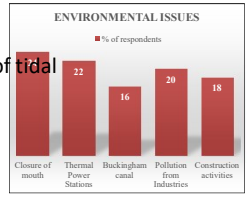
(b) Annual income

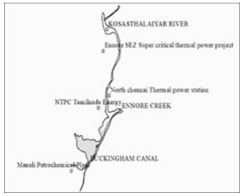


(ii) Major environmental issues

- Closure of mouth due to the siltation, shrinkage of the river, poor regulations of tidal inflow, and sand bar formation.
- Thermal power stations.
- Buckingham canal.
- Pollution from industries.
- Construction activities.

5 Major issues of Ennore Creek





Decadal mouth width variations of Ennore creek

CREEK MOUTH ANALYSIS THROUGH REMOTE SENSING

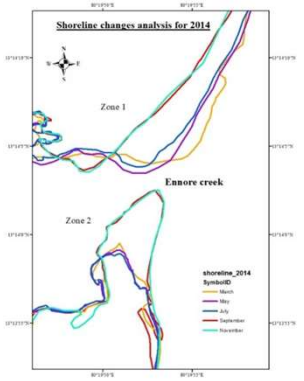
(i) Decadal analysis of the creek width changes

- Analysis carried out – from 2008 to 2015
- Satellite images collected using **Google Earth Pro** - November 2008, October 2009, August 2010, June 2011, February 2012, July 2013, March 2014, August 2014, and December 2015
- Technology used - Remote sensing and GIS

Interpretation

- Mouth width changes range between 32m and 223m from 2008 to 2015.
- The littoral drift, current, wave and wind play a major role in shoreline changes.
- The frequent closure of Ennore Creek mouth has resulted in insufficient tidal inflow and thus reduced the supply of water required for the thermal power stations.

Monthly variations of Ennore creek mouth



(ii) Monthly variations of Ennore creek mouth

- Decadal shoreline change analysis – from 2008 to 2015
- Shoreline changes - from 32m to 223m
- Detailed analysis - Year 2014
- Technology used - Remote sensing and GIS
- The creek mouth is divided into two zones **northern part** is represented by **Zone 1** and the **southern part** is represented as **Zone 2** to find erosion and accretion.

Interpretation

- Northern part, Zone 1 (March, May, July) – Accretion
- Southern part, Zone 2 (March, May, July) – Erosion
- Northern part, Zone 1 (September, November) – Erosion
- Southern part, Zone 2 (September, November) – Accretion
- Accretion results in closure of mouth and erosion results in flooding.

WATER QUALITY ANALYSIS OF THE CREEK

- Samples collected from 9 different stations during three different seasons.
- The physical properties such as temperature, pH, salinity and Total Suspended Solids (TSS) are analyzed.
- The important chemical properties of creek water are ammonium (NH_4), DO, BOD and Nitrogen.

Techniques / Methods used

- pH and salinity - WTW probes.
- Temperature - Digital thermometer of 0.01°c accuracy.
- Dissolved oxygen - Winkler's method.
- Biological oxygen demand (BOD) - DO method.
- The Total Suspended Solids - American Public Health Association method.
- Total nitrogen - Spectrophotometry.

Map showing the locations of samples collected for water quality

Sample stations	Locations
WQE-1	Bar mouth region
WQE-2	South of the railway bridge
WQE-3	North Buckingham Canal
WQE-4	D/S of Kosasthalaiyar river junction
WQE-5	D/SofAmullavoyal junction
EBUCS	South Buckingham Canal
EBUCN	D/S of Kosasthalaiyar River junction
EKRR	Kosasthalaiyar River
EAMC	Amullavoyal Canal

Water Quality Parameters in the year 2014

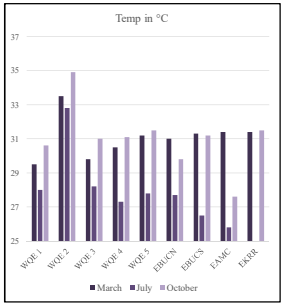
SL.NO	PARAMETERS		March 2014		July 2014		December 2014		RECOMMENDED VALUE (CPCB std)
			min	max	min	max	min	max	
1.	PHYSICAL CHEMICAL	Temperature°C	29	34	26	32	28	35	25-30°C
2.		Salinity (ppt)	2	34	3	30	2	32	0.5-30 ppt
3.		pH	7.8	8.5	7.2	8.8	7.3	8.6	6.6-8.5
4.		TSS (mg/L)	6	81	4	69	2	61	10-20 mg/L
5.		DO (ppm)	2	5.5	0.5	8	1.5	7	4-5 ppm
6.		BOD (mg/L)	1	38	1.9	31	2	70	3-20 mg/L
7.		NH_4(µmol/L)	2	149	1	130	5	145	0.2 -2.0 mg/L
8.		TN (µmol/L)	25	310	40	320	30	500	-

Interpretation

(i) Temperature

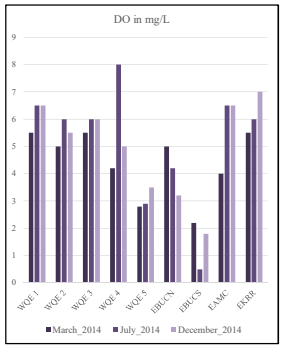
- The maximum temperature of **35°C** was at **WQE2**.
- Temperature **exceeding 32°C** impacts aquatic life.
- Except for **WQE2**, all the other stations recorded less temperature.
- Permissible limit – **25 to 30°C**

Temp in °C



(ii) Dissolved Oxygen (DO)

DO in mg/L



• The reduced DO level in two stations WQE2 and EBUCS are found.

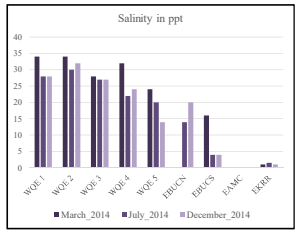
• A lower concentration of DO in EBUCS and WQE-5 stations increases the risk and stress of aquatic life.

• At two stations WQE5 and EBUCS, the DO level is very low.

• Permissible limit – **4 to 5 ppm**

(iii) Salinity

Salinity in ppt



•Permissible limit – **0.5 to 30 ppt**

• The salinity level changes ranges from 2 to 34 ppt.
• Increasing salinity modifies the behavior of the aquatic ecosystem and also limits reproduction and germination, lowering their fitness for survival in that environment.

Final

• DO and temperature increases are enough to affect aquatic life and increase stress.
• A fish's skin can be chemically burned by high pH alkaline or basic substances.

CONCLUSION

• Ennore Creek, a healthy aquatic habitat formerly is well known for its biodiversity but the quality of water and fish stock has reduced now.

• A socio-economic survey conducted indicates that the major **environmental issues** are **closure of the creek mouth and changes in water quality.**

• **Remote sensing and GIS technology** are used to analyze the shoreline changes. According to the decadal analysis of satellite images, the **mouth width** of Ennore Creek varies between **32m to 223m**.

CONCLUSION (Contd.)

• The accretion results in the closure of the mouth and erosion results in flooding. The physicochemical properties of creek water **at 9 stations** for three different seasons are evaluated and compared with the **CPCB standard water quality parameters**.

• **Proper dredging** is recommended to keep the creek mouth open and protect the aquatic habitat.

• **Extending the retention time** of coolant water in thermal power plants will **reduce the temperature** of brackish water to safeguard aquatic life.

• It is recommended to **increase the width** of the creek mouth and its **depth** before the monsoon to ensure adequate dilution and to **maintain the essential water quality** of the creek.

THANK YOU

Impact of Climate Change on Fisheries particularly on Aquatic Food Safety

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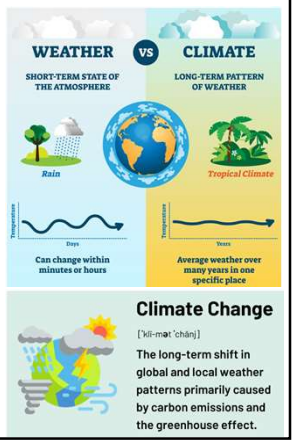
What is Climate change?

- Climate change has literally become a hot topic and an alarming issue worldwide.
- Climate change is defined as a long-term change in statistical properties of the climate system and is demonstrated by an unusual distribution around the recorded mean over an average period of 30 years
- Climate change encompasses variations in atmospheric carbon dioxide, changes in worldwide temperatures and precipitation, which all, in turn, influence sea levels and salinity, crop yields, soil quality, nitrogen deposition, plant diversity, and crop diseases
- Principal cause of climate change is greenhouse gas (GHG) emission, and the climatic factors influenced are temperature, relative humidity, precipitation, and UV, thus resulting in climate variability



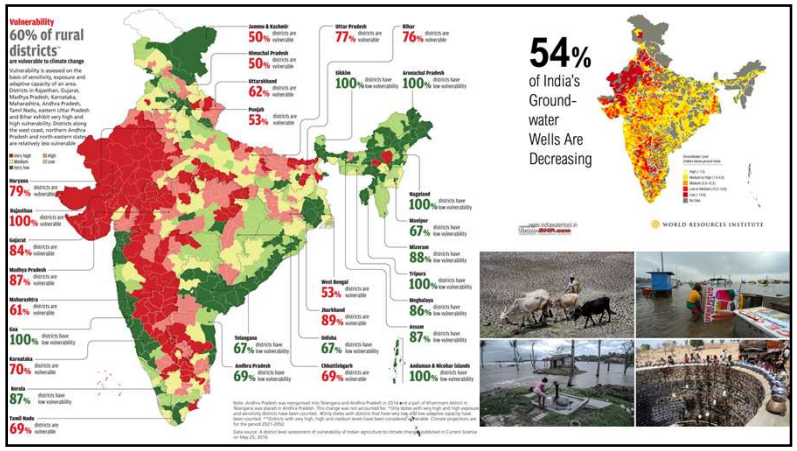
World Scenario

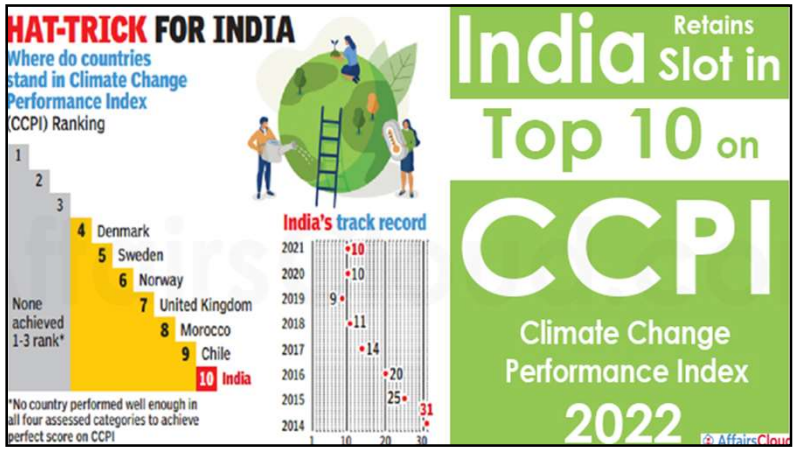
- Mean global warming ranges from 1.5 to 5.8ºC
- Mean global precipitation is from 5 to 15%
- Significant shift in variables can induce meteorological hazards such as Extreme weather events and Natural calamities
- Many extreme weather disasters (floods, heat waves, and winter storms) – Reported in Europe over the last two decades
- Some examples: Several floods in Italy, France, and Switzerland in 2000, the United Kingdom in 2007, and Germany and France in 2016, Heat waves in the summers of 2003, 2010, and 2018, winter storms in 2007 and 2010, extreme snowpack in the northern Alps in 2006 and 2019, wildfires in southern and eastern Europe in 2007, 2010, and 2017, and hailstorms in Germany in 1984 and 2013.

Indian Scenario

As per the report (2020) of Ministry of Earth Sciences (MoES)

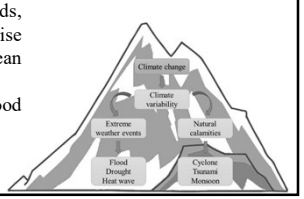
- India's average temperature has risen by around 0.7ºC during 1901-2018
- Frequency of daily precipitation extremes (rainfall intensities >150 mm per day) increased by about 75% during 1950-2015
- The frequency and spatial extent of droughts over India has increased significantly during 1951-2015
- Sea-level rise in the North Indian Ocean occurred at a rate of 3.3 mm per year in the last two and half decades (1993-2017)
- Frequency of Severe Cyclonic Storms over Arabian sea has increased during the post-monsoon seasons of 1998-2018
- In 2019, India was the 7th most affected country due to climate change led extreme weather events – both in terms of the fatalities (2,267 people) as well as the economic losses (US$ 66,182 million)
- UNICEF released the first child-focused global climate risk assessment in 2021- India ranks 26th out of 163 nations, indicating that children in India are at high risk of climate change consequences affecting their health, education, and protection



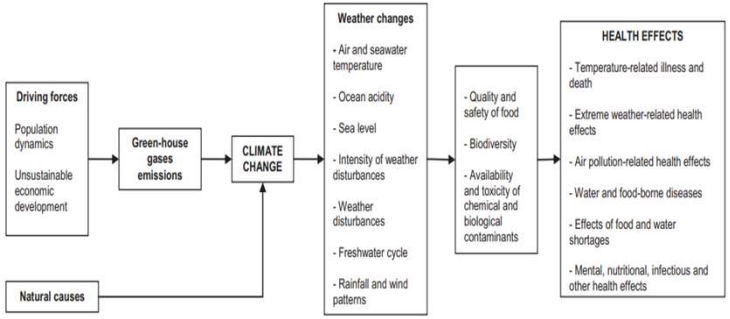


Broad Impact of Climate change

- Due to climate change - extreme weather events and natural calamities become more frequent and more extreme
- Increased release of CO_2 leads to –
  - rise in temperatures,
  - alteration in the water cycle,
  - more severe and more frequent extreme weather events, which include heat waves, droughts, and floods, Melting of ice caps, ocean warming and acidification, rise in sea level, increased erosion, and changes in deep ocean circulation are additional effects of warming.
- Climatic change - Direct impact on the ecosystem food security and indirectly on food safety and human health

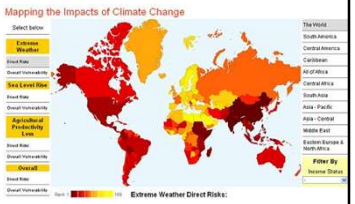


Impact of Climate change to Human Health



mpact of Climate change on Marine/ Coastal Environment

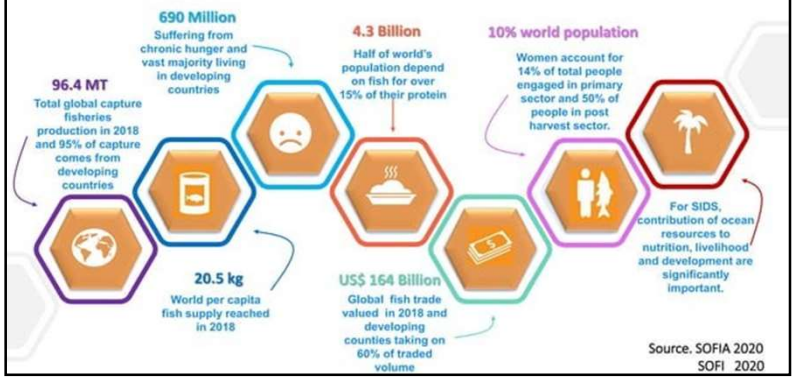
- Climate Change - A triple threat to the Ocean
- Burning fossil fuels, deforestation & industrial agriculture release CO_2 and other heat-trapping gases into our atmosphere, causing earth to warm.
- Ocean has buffered us from the worst impacts of climate change by absorbing more than 90% of this excess heat and about 25% of the CO_2, causing significant harm to marine ecosystems
- Increasing CO_2 causes ocean water warming, reduces oxygen and increases acidity



Major Climate changes in Marine system

- SEA LEVEL - Sea level rise is accelerating, flooding coastal communities and drowning wetland habitats.
- BLEACHING - Warm water coral reefs (marine biodiversity hotspots) could be last if the earth warms by CO_2
- TOXIC ALGAE - Larger and more frequent blooms are making fish, birds, marine mammals and people sick
- HABITATS - Lower oxygen levels are suffocating some marine animals and shrinking their habitats.
- ACIDIFICATION - More acidic water harms animals that build shells, such as corals, clams, and oysters.
- FISHERIES - Disruptions in fisheries affecting marine food web, local livelihoods, and global food security

Significance of fisheries to local livelihood and food & nutritional security



Impact on Fisheries and Aquaculture

Area affected	Impact
Production and ecology	Species composition, Production and yield, Distribution and seasonality, Disease and other disruptions, Coral bleaching and calcification
Fishing, aquaculture and post harvest operations	Safety end security, Efficiency and costs, Infrastructure security.
Communities and livelihoods	Loss and damages to assets, Risks to life and health, Livelihood strategies, Vulnerability and confidence, and Displacement and conflict
Wider society and economy	Cost of migration and adoption, Social and market impacts, Water and other resources

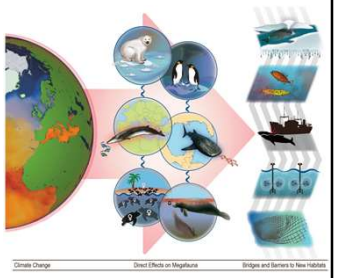
Impact on Fisheries & Aquaculture

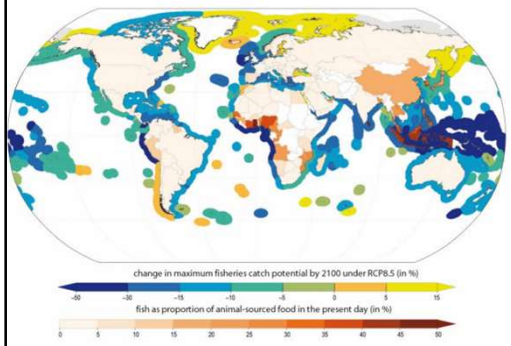
- Climate change impacts fisheries and aquaculture through
  - Acidification
  - Changes in sea Temperature and circulation
  - Rising sea levels
  - Ecological changes
- Direct and indirect implications include
  - Targeted populations' range
  - Productivity, habitats
  - Food webs
  - Fisheries and aquaculture costs and production
  - Fishing community livelihoods and safety

- Ocean warming and increased stratification
  - Change open ocean nutrient cycles from phytoplankton to marine mammals, consequently changing community composition
- Fish feeding, migration and breeding behavior will be directly affected
- Changes in their physical environments will indirectly affect growth, mortality and reproduction
- In addition, the species and ecosystems that fish rely on will be affected with uncertain impacts on fishery catch potential.
- Fish species will probably shift their distributions as warmer-water species and colder-water species are both expected to move polewards
- Coastal areas with coral reefs are particularly vulnerable to changes in temperature and acidity

- Inland aquaculture may provide an important animal protein source in the future.
- However, it will be affected by changing temperatures, water scarcity and salinization of coastal waters.
- Inland fishery productivity will also be affected by increased water temperatures, variability in water availability, eutrophication, stratification, and toxicity of pollutants.
- In addition, reduced habitat quality and availability of dissolved oxygen will affect productivity and the nutritional value of aquatic products.

- Tropical and subtropical areas will experience more reduced ecosystem productivity than temperate and polar ecosystems, with impacts on fishery catch potential in the exclusive economic zones (EEZs) of those countries.
- Some new opportunities and environments may be created with sea-level rise.
- New habitats may open up as polar ice melts, and flooded coastal agricultural land may provide new areas for mangroves and aquaculture opportunities.
- New fisheries may become available as fish populations shift geographic distributions, and some ocean areas may experience increased productivity, which could increase the catch potential of some fisheries.





- Model predictions of catch potentials indicate that tropical countries are likely to experience large decreases in catch potential within their exclusive economic zones in 45 years, while some countries (e.g. Norway and Iceland) will see an increase.
- This is due to fish moving away from warmer waters and ice melt opening up new areas. Temperate countries do not see as extreme a decline in catch potential as, although species are moving away, new species are moving into those areas.

Specific Impact on Food Security

- Due to climate change, the major impacts on food security are
  - Availability
  - Stability
  - Access
  - Utilization
- **AVAILABILITY** - Availability of aquatic foods will vary through changes in habitats, stocks and species distribution
- **STABILITY** - Stability of supply will be impacted by changes in seasonality, increased variance in ecosystem productivity and increased supply variability & risks
- **ACCESS** - Access to aquatic foods will be affected by changes in livelihoods and catching or farming opportunities
- **UTILIZATION** - Utilization of aquatic products will also be impacted and, for example, some scientists and communities will need to adjust to species not traditionally consumed

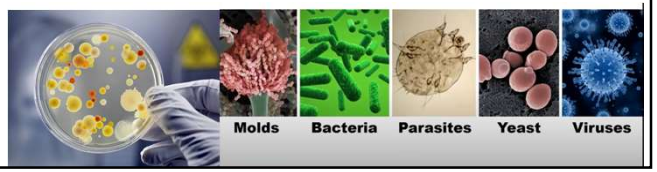
Challenges to Fishing Communities

- Relocation of resources and replacement with less commercially valuable species requires diversification of fishing operations and markets
- In areas where production is already limited by temperature (e.g.) traditional productive areas may be reduced. Dependent communities will need to diversify their livelihoods.
- Changes in timing of fish spawning and recruitment will need adjustments to management interventions
- The impact of ocean acidification may be locally significant, for example in activities dependent on coral reefs.
- Increase in frequency and severity of storms may affect infrastructure, both at sea and on shore.

Food Safety

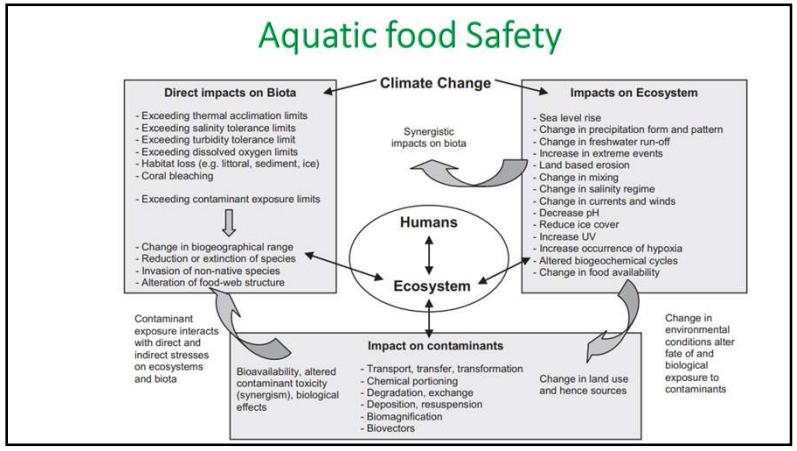
- Climate change poses significant risks to food and feed safety, plant and animal health, and nutritional quality.
- The Fourth Report by the United Nations International Panel on Climate Change states that rising temperatures, higher CO2 levels, altered rainfall patterns, and extreme weather events may pose risks to food safety.
- Climate change affects the occurrence, persistence, dominance, and toxicity of marine and freshwater algal blooms, bacteria, fungi, viruses, parasites, and plant and animal pathogens.
- Climate change impacts food pathogen supplies, transmission, growth, survival, and ecology. Temperature can affect pathogen reproduction, dispersion, growth, and the creation of novel infections for certain hosts. Climate change creates new threats and increases sensitivity to old ones.

- From the farm to the fork, food can be contaminated at any point by pathogenic microbes and climate change.
- Histamine and fish, *Salmonella* and chicken, *Campylobacter* spp. and dairy products, *Vibrio* spp. and mollusks, and noroviruses and leafy green vegetables or shellfish are some examples of common food hazard combinations.
- Many environmental factors impact the likelihood of infectious, toxicoinfectious, or toxigenic organisms contaminating food in different food production sectors such as crop, animal, and seafood.



Effect of climate on environmental factors involved in the growth, survival, and pathogenicity of foodborne pathogens

Temperature	
Increase	Increased occurrence of parasites in freshwater fish and plants *(33)*
	Detection of new mycotoxin-producing fungal species in maize in Europe *(56)*
	Increase in mastitis incidence in cows *(44)*
	Increase in *Salmonella* in poultry *(33)*
	Increased number of *Vibrio* cells in seafood *(50)*
Decrease	Increased contamination of berries by norovirus and hepatitis A *(11, 23)*
Precipitation and humidity	
Increase in precipitation	Internalization of pathogenic *E. coli* and *Salmonella* in leafy green vegetables *(29, 47)*
	Increased contamination of seafood by fecal indicator organisms due to water runoffs *(50)*
	Increased risk of splash dispersal and aerosolized *Salmonella* infecting tomatoes due to increased frequency of short period of heavy rainfall *(15)*
Decrease in precipitation and humidity	Increased mycotoxin contamination by xerophilic fungi in maize at preharvest stage *(56)*
pH and salinity	
Decrease in pH	Ocean acidification leads to increased HABs *(50)*
Decrease in salinity	Increases in bioaccumulation of toxic metals in molluscs *(86)*
Light	
Increase	Favors the growth of HABs *(50)*



- In the last few decades, people have been putting a lot of chemical pollutants into the world through their actions.
- These include persistent natural chemicals, like polycyclic aromatic hydrocarbons (PAHs), toxic metals and synthetic organic chemicals
- Chemical contaminants enter marine ecosystems via direct discharges from land-based sources (e.g., industrial and municipal wastes), river runoff or drainage, atmospheric deposition from local and distant sources, and ships
- Toxic metals in seafood can affect various physiological processes, including tissue damages, inability to regenerate damaged tissues, growth inhibition, damages to genetic material such as DNA, and changes in breeding and development
- The salinity of coastal and estuarine systems will experience fluctuations arising from changes to precipitation and stream flow patterns

- Bacteria, particularly Vibrio spp., are the main pathogenic organisms associated with seafood, and the occurrence, frequency, and severity are greatly affected by rises in temperature
- The main effects of climatic changes associated with seafood contamination are temperature increase in the upper ocean, an accelerated water cycle, ocean acidification, increased stratification, and changes in the degree of weather disturbances and rainfall patterns
- Pohoroo and Ranghoo, (2017) reported higher prevalence of *Vibrio alginolyticus, Vibrio cholerae*, and *Vibrio parahaemolyticus*, in finfish in summer compared with winter seasons.
- Reega et al. (2019) reported a higher *Vibrio* density in oysters in summer compared with winter.
- Other emerging factors that impact *Vibrio*-associated infections include drought conditions, dust emissions, and wind direction

- In Alaska, warmer water increased the number of *V. parahaemolyticus* and resulted in outbreaks with more than 400 confirmed cases in summer 2004
- Ballah et al. (2019) reported the presence of cyanotoxin-producing microalga *Oscillatoria* and further observed that its population density increased during the "winter-to-summer" transition month of October.
- Climate change pressures are believed to have an impact on marine planktonic systems globally, and it is projected that the frequency and severity of harmful algal bloom (HABs) may increase
- Specific climatic factors involved in HAB occurrence and prevalence are temperature, stratification, light, ocean acidification, precipitation, and wind

- The relationship between climate change and outbreaks of marine HABs is exemplified by the case of ciguatera fish poisoning in the tropical Pacific that was observed to increase during the El Nino period
- Climate change may influence the behaviour and distribution of organic chemical pollutants (OCs) in the ocean, thus causing serious environmental damages and health concerns, particularly at metabolic and physiological levels, both in marine vertebrates and invertebrates
- The bioavailability and toxicity of OCs in aquatic organisms is likely to increase in response to rising temperature, salinity, hypoxia and ultraviolet (UV) radiation.

Emerging Climate-related Threats to Aquatic food Safety

- Increase the inputs of chemicals contaminants to marine systems and the consequent exposure level, particularly due to flood events;
- Change their chemical forms to more toxic ones and the consequent exposure level;
- Increase resuspension processes of sediment-bound chemical contaminants;
- Increase their bioavailability, especially in metals, with contaminants being converted to more bioavailable forms (e.g., increases in temperature enhance the methylation rate of mercury)
- Diminish the species' ability to deal with toxic substances and the different physiological regulation processes involved in the detoxification of hazardous substances
- Modification of contaminant transport pathways to marine systems
- Climate change is expected to expand the geographic ranges of some harmful microalgae and pathogens, new region will be exposed to biological contaminants of seafood

Conclusion

- The seafood industry will be disproportionately affected by climate issues
- In future, both chemical and microbiological risks may impair seafood safety as a consequence of climate change, in particular algal toxins, organic chemicals residues and toxic metals
- The combination of higher temperatures, lower salinities, hypoxia and ocean acidification will reduce the general fitness of native marine species by changing their physiology, including metabolic rates and enzyme activities
- Adopting environmentally friendly and fuel-efficient practices to reduce their greenhouse gas emissions, implement sustainable practices to improve the health of fisheries and aquaculture

- Avoiding environmental stressors like overfishing, and adopt an appropriate use of veterinary drugs and chemicals in terms of safety, quality, amounts, frequency and timing and withdrawal times will enable marine life to adapt to future climate changes.
- Food safety is ensured through the implementation of adequate preventive and corrective measures at every step from farm to fork.
- Integrated monitoring and surveillance of seafood for hazards is critical for the early identification of emerging problems and changing trends in order to protect workers and consumers, and the development and utilization of new seafood preservation technologies to prevent contamination from pathogens postharvest

Centre for Climate Change and Disaster Management
Department of Civil Engineering, Anna University, Chennai - 600 025

VISION

The CCCDM to be the Centre for Excellence to address challenges of Climate Change and Disaster Management

MISSION

- Disseminating Knowledge of regional climate risks and cadastral level climate resilient actions to cope up with changing climate
- Promoting climate science and disaster risk reduction research
- Strengthening the capacity for climate change adaptation, mitigation and disaster risk reduction

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