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THE ENERGY AND RESOURCES INSTITUTE

GOVERNMENT OF PUDUCHERRY

DEPARTMENT OF SCIENCE, TECHNOLOGY & ENVIRONMENT

PUDUCHERRY CLIMATE CHANGE CELL

Report on two days workshop

"Integrating Climate Action in the Development Planning of Puducherry Union Territory"

Date: 5th - 6th May 2022

Supported by

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Department of Science & Technology,
Ministry of Science and Technology
Government of India

Contents

INTRODUCTION

Climate change poses significant threat to the ecosystem and biodiversity in Puducherry. The impacts are felt mainly due to alterations in temperature, rainfall patterns, frequency and magnitude of the cyclones, sea level rise, forest fires, soil-water-air pollution, wastes generation, disease outbreaks, etc. In future, the intensity of these impacts is expected to increase further unless adequate planned measures are taken. State Action Plan on Climate Change (SAPCCs) provides a risk-based perspective to developmental planning in the changing climate and are forward-looking planning documents that take view of challenges of climate change and possible future risks while incorporating them into the planning process.

Given the evolving nature of climate science and the developments made in this regard, there was a felt need to update the existing State Action Plan on Climate Change (SAPCC) document for review and revision, in light of the availability of new data on the climate. The Central Government called upon all States and UTs to thereby update and revise their existing SAPCCs to incorporate new findings and strategies in this regard. This presented an opportunity for States and UTs to work towards strengthening their existing policies and addressing challenges and roadblocks that were encountered in the first round of SAPCCs (Puducherry submitted its first SAPCC in 2013). The revised SAPCCs are also an opportunity to further the SDGs and work towards aligning key strategies and interventions of the UT with national priorities.

In this context, a **two-day workshop** on the title **"Integrating Climate Action in the Development Planning of Puducherry Union Territory"** on **5th and 6th May 2022** to support ongoing policies and programs for addressing climate change issues and impacts such as changes in the frequency and impact of cyclones, sea-level rise and extent of urbanization near the coastal regions on the coastal ecosystems. Further, emphasis was also on solid waste management which is an ever-growing challenge for the cities like Puducherry mainly due to the increasing generation of waste, the burden posed on the municipal budget as a result of the high costs associated to its management, the lack of understanding and managing diversity of factors- appropriate disposal facilities, infrastructure, technology use and transportation. Technologies like Electric Vehicles, Renewable energy, sustainable mobility etc. was also discussed.

The workshop was organized by the Puducherry Climate Change Cell (PCCC) functioning in the Department of Science, Technology and Environment, Government of Puducherry and ENVIS Hub functioning under the Puducherry Pollution Control Committee. The program was supported by the Department of Science and Technology, Government of India through the National Mission for Strategic Action on Climate Change (NMSKCC). The Energy Resources Institute, New Delhi also partnered with PCCC in organizing the workshop under The Initiative for Climate Action Transparency (ICAT) – UNEP Project.

Objectives of the workshop

- ✓ Awareness generation on pressing issues and challenges faced by UT on climate change among the stakeholders and their ongoing actions on mitigation and adaptation.
- ✓ Mainstreaming climate actions into UT's policies and planning process, while achieving sustainable development goals and enhancing climate change resilience.
- ✓ Provide a platform to users to understand the importance of climate change knowledge management and communication and the role of Puducherry Climate Change Cell, ENVIS Hub and other resource partner activities and share their suggestions for future development.
- ✓ Share best practices, models, experiences, lessons learned, innovative methods, expertise and knowledge resources.

Potential Outcomes

The workshop was held in Hybrid Mode with physical as well as virtual sessions by the National and International Experts. Technical Experts from United Nations Environment Programme (UNEP), The Energy and Resource Institute (TERI), National Institute of Ocean Research (NIOT), National Centre for Coastal Research (NCCR), Jawaharlal Institute of Post Graduate Medical Education and Research (JIPMER), Pondicherry University (PU) and the University of Illinois, Chicago made presentations on various aspects of climate change mitigation and adaptation during the technical sessions.

Around 114 participants from various government departments, academic institutions and civil societies participated in the workshop. List of participants is given in Annexure I. The participants were exposed to existing vulnerabilities posed by climate change, impacts on various sectors and how to mainstream climate change mitigation and adaptation strategies in the developmental planning. Technical sessions were interactive and participative oriented with discussions and case studies on issues specific to Puducherry Union Territory. Existing vulnerabilities to climate change, mitigation and adaptation strategies and actions required were discussed during the workshop.

The workshop provided Government of Puducherry an opportunity to network with sectoral experts, academicians and researchers and civil societies which will ensure stakeholder's engagement in the consultation process for revision of SAPCC and framing the ways of mainstreaming climate change in the departmental activities.

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Organizing & Supporting Partners

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Government of Puducherry

CHANGE PCCC FOR CLIMATE CHANGE

Nature Protects if She is Protected

WORKING TOWARDS A SUSTAINABLE ENVIRONMENT
ENVIS INDIA

PPCC

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UN environment programme

ICAT INITIATIVE FOR Climate Action Transparency

WORKSHOP SUMMARY

Day 1 (05th May, 2022)		
10:00 A.M. – 11:15 A.M.	**Inaugural Session**	**Welcome Address:** **Tmt. Smitha. R, I.A.S.** *Secretary, Science, Technology & Environment, Government of Puducherry.* **Special Address:** **Dr. Nisha Mendiratta** *Scientist – G, Head, Climate Change Program, DST, New Delhi.* **Key Note Address:** **Dr. S. Mohan** *Vice Chancellor, Puducherry Technological, University, Puducherry.* **Felicitation Address:** **Thiru. L. Sambath** *Member of Legislative Assembly, Mudaliarpet Constituency, Puducherry.* **Chief Guest Address:** **Thiru. Embalam Selvam @ R. Selvam** Hon'ble Speaker, Puducherry Legislative Assembly. **Vote of Thanks:** **Dr. R. Sagaya Alfred** *Senior Scientific Officer, DSTE, Puducherry.*
11:30 A.M. – 01:00 P.M.	**Session I: Mainstreaming Climate Action**	**Climate Change – Overview of Challenges Posed; Global, National and Sub - National Initiatives.** **Opening remarks:** • **Mr. Atul Bagai** *Head-India Office, UNEP, New Delhi.*

		• **Mr. R R Rashmi** *Distinguished Fellow, TERI, New Delhi.* **<u>Technical session:</u>** ▪ **Outlining Puducherry SAPCC & Strategies on Integrating Climate Actions in the Governmental Planning of Puducherry.** ▪ **Climate Projections, Vulnerabilities and Responses.** **<u>Speakers:</u>** **Dr. Henry Neufeldt** *Head, Impact Assessment and Adaptation, UNEP Copenhagen Climate Centre, Denmark.* **Ms. Suruchi Bhadwal** *Senior Fellow & Director, Earth Science and Climate Change division, TERI.* **Mr. Saurabh Bhardwaj** *Senior Fellow & Area Convenor, Centre for Climate Modelling, Earth Science and Climate Change Division, TERI.* **Ms. Vasudha Singh** *Research Associate, Centre for Global Environment Research, Earth Science and Climate Change Division, TERI.* **Ms. Veena CP** *Project Associate, Centre for Global Environment Research, Earth Science and Climate Change Division, TERI.*

02:00 P.M. – 03:30 P.M.	**Session II: Coastal Resilience**	**Climate Change: Coastal Risks and Adaptation Options** **Dr. Tune Usha** *Scientist-G, National Centre for Coastal Research (NCCR), Ministry of Earth Sciences, Govt. of India.* **Blue Economy Opportunities for Climate Change** **Dr. Uma Sankar Panda** *Scientist-E, National Centre for Coastal Research (NCCR), Ministry of Earth Sciences, Govt. of India.*
03:45 P.M. – 05:00 P.M.	**Session III: Knowledge Management**	**Climate Change: Knowledge Management and Communication** **Opening remarks:** **Dr. Susheela Negi** *Scientist – E, Climate Change Programme, DST, New Delhi.* **Presentation by:** **Dr. P. K. Bhattacharya** *Associate Director, Sr. Fellow & ENVIS Coordinator, TERI.* **Mr. P. Vipin Babu** *Scientist & ENVIS Coordinator, Puducherry Pollution Control Committee, Puducherry.* **Mr. K. Kalamegam** *Environmental Engineer, Department of Science, Technology & Environment, Puducherry.*
05:00 P.M. – 05:30 P.M.	**Session IV: Human Health**	**Climate Change and Human Health: Risks and Responses** **Dr. T. Mahalakshmy** *Additional Professor, Department of Preventive and Social Medicine, JIPMER.*

Day 2 (06th May, 2022)		
10:00 A.M. – 10:30 A.M.	**Session V:**	**Sustainable Engineering for Climate Change Adaptation** **Dr. Krishna R. Reddy** *Director of Sustainable Engineering Research Laboratory (SERL), University of Illinois, Chicago.*
10:30 A.M. – 11:30 A.M.	**Session VI: Solid Waste Management**	**Solid Waste Management: Circular economy** **Dr. Suneel Pandey** *Director, Environment and Waste Management, Division, TERI.* **Climate Resilient Waste Management** **Er. Sudalai** *Assistant Professor, Centre for Pollution Control and Environmental Engineering, Pondicherry University.*
11:45 A.M. – 01:00 P.M.	**Session VII: Water Resource Management**	**Enhancing Climate Resilience through Integrated Water Resource Management** **Dr. K. Srinivasamoorthy** *Department of Earth Sciences, Pondicherry University.* **Hydrological Disaster Risk Reduction: Preparedness and Response** **Mr. Prasoon Singh** *Fellow and Area Convenor, Earth Science and Climate Change Division, TERI.*
02:00 P.M. – 03:30 P.M.	**Session VIII: Energy Efficiency & Sustainable**	**Renewable Energy for Climate Change Mitigation** **Mr. Shirish S Garud** *Director, Renewable Energy Technologies, TERI.*

	Habitat	**Roadmap for Sustainable Transport** **Mr. Sharif Qamar** *Fellow and Area Convener, Transport and Urban Governance, TERI.* **Green Campus Initiatives for Climate Change Adaptation** **Dr. M. Nandhivarman** *Coordinator, Office of Green Campus, Pondicherry University.*
03:45 P.M. – 05:15 P.M.	**Focused Discussion**	Addressing the challenges of Climate Change in Puducherry – Focused discussion with participants moderated by DSTE & TERI.
05:15 P.M. – 05:45 P.M.	**Valedictory session**	Summary of Proceedings **Ms. Suruchi Bhadwal** *Senior Fellow & Director, Earth Science and Climate Change division, TERI*

PROCEEDINGS OF THE WORKSHOP

Inaugural Session

The Workshop on "Integrating Climate Action in the Development Planning of Puducherry U.T." was inaugurated by Shri. Embalam R. Selvam, Hon'ble Speaker of Puducherry Legislative Assembly. Shri. L. Sambath, Member of Legislative Assembly for Mudaliarpet Constituency, Puducherry, Dr. Nisha Mendiretta, Scientist-G and Head, Climate Change Division, DST, GoI, Dr. S. Mohan, Vice Chancellor of Puducherry Technological University participated as Special Guests.

Smt. Smitha. R, IAS, Secretary to Government of Puducherry for Science, Technology and Environment delivered the welcome address and set the stage for the workshop by briefing the guests and participants about the background of the workshop.

Dr. Nisha Mendiretta, Scientist-G and Head, Climate Change Division, DST, GoI, in her Special Address through virtual mode, urged that this is the time that all nations and states develop a larger responsibility of a unified climate action. Recalling the German Green Watch report which estimated India as the fifth most affected country by climate change and the World Risk Index which has evaluated that India is the fourth country in South East Asia on the scale of climate risks, Dr. Nisha insisted that the responsibilities of the states and union territories of India stands higher in terms of climate action and in view of this, the Department of Science and Technology, Govt. of India has established the State Climate Change Cells in over 28 states and union territories for the conduct of climate research activities and Vulnerability and Risk Assessment in the respective states / UTs.

Dr. Nisha Mendiretta also informed that ever since the National Action Plan on Climate Change was framed under the Prime Minister's Council on Climate Change, DST has been active in establishing specialized centers of excellence for carrying out studies on regional climate change studies and climate modelling, vulnerability assessments, adaptation and mitigation strategies, agriculture, coastal vulnerability, human health, air quality etc. Appreciating the activities of Puducherry Climate Change Cell, she motivated the Cell to carry out more awareness and knowledge management activities in the U.T. of Puducherry.

Dr. S. Mohan, Vice Chancellor of Puducherry Technological University delivered the Keynote address and stated that it is distressing to see that the Grand Canal designed for carrying storm water in the town is carrying sewage water. Discahrge of waste water into drainage channels should be prevented. People should start treating the waste water at household level and reusing it for non-potable purpose. Any change needs to start from household level. He urged that Government should focus on promoting reuse of treated waste water from STPs which will considerable reduce the drawal of ground water. Over drawal of ground water has already resulted in sea water intrusion. He also said that Bio-energy needs to be promoted in large scale for climate change mitigation.

Shri. Embalam R. Selvam, Hon'ble Speaker of Puducherry Legislative Assembly in his Chief Guest Address said that adequate measures need to be taken to control the declining ground water quality. Clean potable drinking water supply for all needs to be ensured. Government is taking steps to address the problem of drinking water supply. He regretted over the decrease in area of green cover in Puducherry Union Territory and and He urged that the experts present in the workshop should come with climate friendly developmental plan and policies and the territorial Administration would take their views seriously. He said that the Government has plans for and insisted on restoring the lost green cover in the U.T. of Puducherry and in conserving the water resources of the U.T. of Puducherry.

Technical Sessions Day - 1

Session I: Mainstreaming Climate Action:

The technical sessions began with opening remarks by **Mr. Atul Bagai, Head-India Office, United Nations Environment Program (UNEP), New Delhi and Mr. R R Rashmi, Distinguished Fellow, TERI, New Delhi and Dr. Henry Neufeldt, Head, Impact Assessment and Adaptation, UNEP, Copenhagen Climate Centre, Denmark**. The speakers gave an overview of challenges posed by climate change and global, national and sub-national initiatives in their opening remarks.

After the opening remarks, Dr. Suruchi Bhadwal, Senior Fellow & Director, Earth Science and Climate Change division, TERI outlined their work on Puducherry SAPCC and the rationale for mainstreaming climate actions in the developmental planning process of Government of Puducherry. This was followed by presentation on the outcome of the works of revision of SAPCC carried out so far, and in briefing the studies on climate profiling, vulnerability assessment and GHG inventorization carried out as a part of SAPCC and strategies required for mitigation & adaptation. The session was handled by speakers from TERI namely, Mr. Saurabh Bhardwaj, Senior Fellow & Area Convenor, Centre for Climate Modelling, Earth Science and Climate Change Division, TERI, Ms. Vasudha Singh, Research Associate, Centre for Global Environment Research, Earth Science and Climate Change Division, TERI, Ms. Veena CP, Project Associate, Centre for Global Environment Research, Earth Science and Climate Change Division, TERI. The speakers also presented on the Climate trends and projections at different RCP scenarios for all four regions of Puducherry U.T. and briefed on the possibility of increased cyclones and sea level rise that are projected as climate threats for all four regions of the UT. The speakers also narrated on the net GHG emission of the U.T. and briefed on the sector emission inventory with the data collected for the last decade. It was highlighted during the session that "Development as usual", without consideration of climate risks and opportunities, will not allow us to face the growing challenges of the changing climate. Climate change risks need to be considered systematically in development planning at all levels and particular attention should also be paid to policies and projects with long-term consequences in order to build climate resilience in the Union Territory.

Session II: Coastal Resilience

The session on Coastal Resilience was led by Dr. Tune Usha, Scientist – G, NCCR presenting on Coastal Risks and Adaptation O ptions and Dr. Uma Sankar Panda, Scientist – E, NCCR presenting on Blue Economy Opportunities for Climate Change. This session highlighted the importance of concerned department officials developing a better understanding of the coastal risks and vulnerabilities,

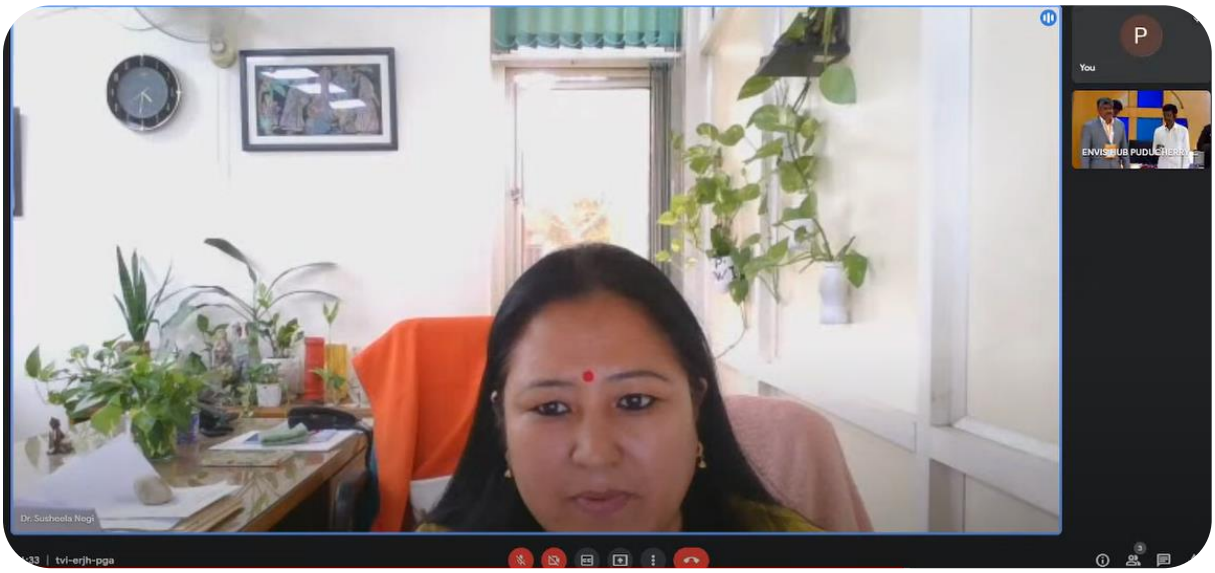
especially those that the union territory would be subjected to in the near and far future and discussions were carried out on climate adaptation strategies to overcome those coastal risks and threats. The session also had discussion on making proper and sustainable use of the ocean resources, termed "Blue Economy" that would help sustain the livelihood of the communities dependent on coastal resources.

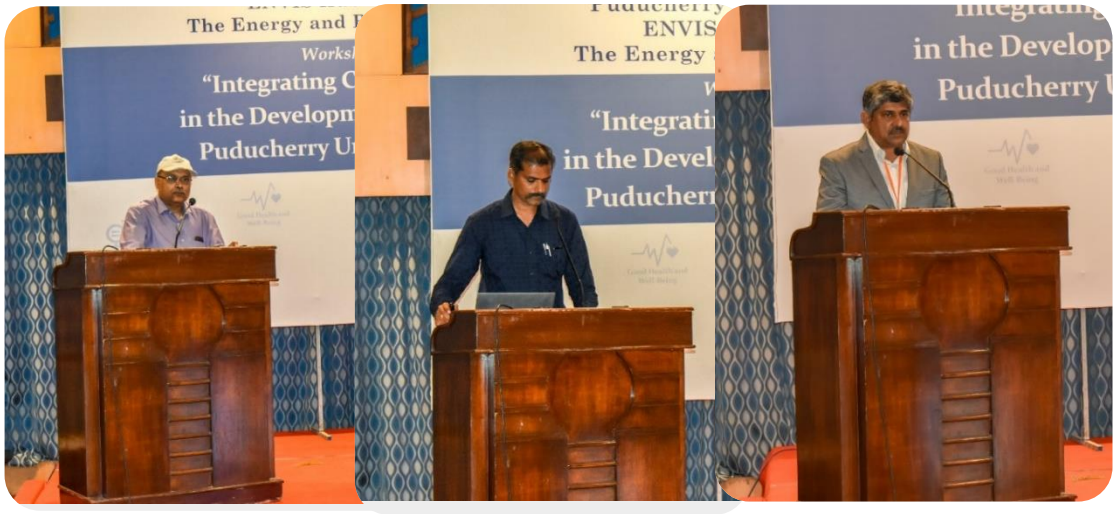
Session III: Climate Change Knowledge Management and Communication

Dr. Susheela Negi, Scientist F, Department of Science and Technology, Govt. of India delivered the opening remarks for the session on Climate Change Knowledge Management and Communication. In her remarks, Dr. Susheela Negi put forth that DST has been steadfast in planning towards climate action for the nation with the NMSKCC and NMSHE missions and the State Climate Change Cells to enhance the ability of the national knowledge system on climate change and for developing effective response strategies to the risks of climate change projected for the coming years. She also highlighted that DST, Govt. of India has conducted a workshop in 2020 to enhance the capacity of stakeholders across the nation to carry out vulnerability assessment exercise based on a common framework developed by DST in association with IISc Bangalore, IIT Mandi, IIT Gauhati and has come out with the National Level Climate Change Vulnerability Maps. She advised the participating officials to foster integrated efforts on climate action so that the U.T. of Puducherry benefits from the SDG targets and makes effective contribution to the INDCs of the nation.

The session on Climate Change Knowledge Management and Communication had presentations from Dr. P.K. Bhattacharya, from the TERI ENVIS Centre, Mr. Vipin Babu, Scientist, ENVIS Hub, PPCC, Puducherry and Mr. K. Kalamegam, Environmental Engineer, Puducherry Climate Change Cell, DSTE, Puducherry. In this session, the speakers emphasized on better use of technology to collect, interpret and

disseminate data on climate change and in bringing about a holistic platform for international, national and regional level data that would help in research, framing policy actions and in the evaluation of risks and vulnerabilities. A demonstration of the knowledge management portals developed by Puducherry Climate Change Cell and Puducherry ENVIS Hub were exhibited to the participating government officials so as to make use of the portals for any climatological and environmental data concerning to the U.T. of Puducherry.





Session IV: Climate Change and Human Health: Risks and Responses

A dedicated session on climate change and human health was presented by Dr. T. Mahalakshmy, Additional Professor, Department of Preventive and Social Medicine, JIPMER. This session focused on streamlining the existing programmes and schemes on the heath sector in the union territory and how climate change can be mainstreamed in the health sector to address the health issues such as heat induced morbidities.

Measures to address the vector borne diseases and water borne diseases that are projected to rise with the rising global temperature were also discussed in the session in addition to addressing the psychological stress of the vulnerable communities when they are relocated during cyclones, floods and other natural calamities.

Technical Sessions Day - 2

Session V: Sustainable Engineering for Climate Change Adaptation

Dr. Krishna R. Reddy, Director of Sustainable Engineering Research Laboratory (SERL), University of Illinois, Chicago. Dr. Reddy presented on the Climate Resilient Design Framework in planning for a sustainable city in view of the projected climate change scenarios of the future. He briefed on the procedure in executing the assessment of Sustainability for a city from the point of view of government entities through standard procedure namely, deciding on the design constraints, vulnerability/risk &

resilience index, deciding and data collection on the qualitative and quantitative sustainability and resilience variables (indicators), carrying out the assessment - Integrated Sustainability Resilience Assessment and putting the assessment into place by framing action points that would help the city becoming a climate resilient and a sustainable city. Dr. Reddy also presented case studies on some of the cities from different nations working on building sustainability and climate resilience.

Session VI: Solid Waste Management

The issue of Solid Waste Management was discussed in this session with professional and academic experts viz., Dr. Suneel Pandey, Director, Environment and Waste Management Division, TERI and Mr. Sudalai, Assistant Professor, Centre for Pollution Control and Environmental Engineering, Pondicherry University. Case studies and better practices on handling and managing municipal wastes, legacy wastes were discussed for bringing in better waste management system for the region of Puducherry. Enforcing waste segregation at source and scaling up waste processing throughout Puducherry were discussed with special focus on creating more awareness among the public on the importance of segregated domestic waste collection. The

speakers explained about the Circular Economy based models for solid waste management in various sectors which can reduce waste to the minimum by reusing, repairing, refurbishing and recycling existing materials and products and aid climate friendly waste management.

Session VII: Water Resource Management

Prof. Srinivasamoorthy, Department of Earth Science, Pondicherry University made a presentation on Enhancing Climate Resilience through Integrated Water Resource Management. He explained the impacts of climate change on water

resources, projected seal level rise along Indian coast and impacts, seal level rise measurement and models and the studies on changes in groundwater dynamics with the rising sea level in the south-eastern coast of India with specific reference to Puducherry.

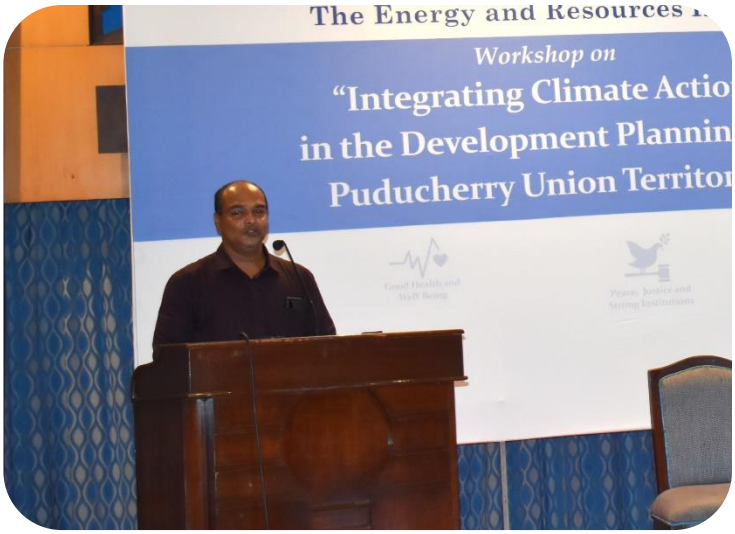
Mr. Prasoon Singh, Area Convenor, Earth Science and Climate Change Division, TERI narrated on the Hydrological Disaster Risk Reduction strategies to be adopted in the union territory. He emphasized on the preparedness and response strategies that would help in mitigating the loss of lives and livelihood and in strengthening the coping capacity of the UT for any inadvertent climate disasters that arise. Emphasis was also given during the discussion hours for the conservation of groundwater resources in the U.T. of Puducherry through stringent regulation strategies for unauthorized groundwater pumping and increasing the groundwater recharge capacity of the union territory.

Session VIII: Energy Efficiency & Sustainable Habitat

In this session, Mr. Shirish Garud deliberated on the importance of a committed

action by the concerned line departments and stressed on making effective use of the financial instruments available to increase the renewable capacity of the UT. In his talk,

he presented a number of practical examples of renewable energy alternatives that are being practiced across the nation.



Dr. Nandivarman, Coordinator of Green Campus Initiative, Pondicherry University presented on the need for adopting certain resource efficiency ideas in offices, institutions and other places. He demonstrated on some of the resource efficiency and green campus ideas being practiced in Pondicherry University and elsewhere which are examples of the ideas being practical and result oriented and hence motivated the participants in adopting these ideas for the benefit of the respective institution and in ensuring a sustainable habitat for the state.

Valedictory Session:

Hon'ble Chief Minister of Puducherry Thiru. N. Rangasamy participated as the Chief Guest in the valedictory session of the workshop. Dr. Sagaya Alfred, Senior Scientific Officer, DSTE welcomed the Chief Guest. Mrs. Suruchi Bhadwal, Director, Climate Change Division, TERI, New Delhi summarized the workshop proceedings.

Hon'ble Chief Minister, in his Chief Guest Address, urged all the government departments of Puducherry U.T., civil societies and academic / research institutes to make concerted efforts in strategizing climate actions for making the union territory climate resilient. He stressed on the need to focus on rejuvenation and maintenance of all the waterbodies, reducing vehicular emissions and making Puducherry Clean and Green by strategizing ideas for better waste management practices. He advised the officials that the developmental plans prepared by the departments should be robust enough for smooth implementation; once implementation starts there should be no bottle necks and the plan should be implemented swiftly as this would be significant in

overcoming the socio-economic losses posed by climate change and in securing the livelihood of the people of Puducherry.

Hon'ble Chief Minister and Mrs. Smitha. R, IAS, Secretary – Science, Technology and Environment distributed the certificates to the participants of the workshop. Mr. K. Kalamegam, Environmental Engineer, Department of Science, Technology and Environment gave the Vote of Thanks.

ANNNEXURE I - LIST OF PARTICIPANTS

S.No.	Name & Designation	Department/Organization
1.	P. Jawahar, I.A.S., Secretary to Government	Chief Secretariat, Puducherry
2.	Vanjulavalli Sridhar, I.F.S.	Deputy Conservator of Forests, Puducherry
3.	S. Sezhian, Deputy Director	Agriculture and farmers Welfare
4.	S. Srinivasan, Deputy Director	Agriculture and farmers Welfare
5.	Dr. S. Anbukkarasu, Joint Director	Animal husbandry and Animal Welfare
6.	Dr. Manimozhi, CMO, SNO, NPCCH	Health and family Welfare
7.	Dr. Pamagal, GDMO, DNO, WPCHHI	Health and family Welfare
8.	V. Lakshmanan Executive Engineer	Local Administration Department
9.	G. Ravichandiran, Assistant Engineer	Local Administration Department
10.	M. Thirunavukarasu, Deputy Director	Planning and Research Department
11.	J. Devidasan, Deputy Director	Planning and Research Department
12.	P.N. Vijayakumar, Assistant Engineer	Port Department
13.	N. Nagarajan, Junior Engineer	Port Department
14.	G. Segar, Assistant Engineer	Public Works Department
15.	A. Madivanane, Assistant Engineer	Public Works Department
16.	N. Balasubramanian, Executive Engineer	Public Works Department
17.	A. Baskaran, Senior Engineer	Public Works Department

18.	S. Johnson, Technical Assistant	REAP Renewable Energy Agency
19.	J. Arunprakash, Technical Assistant	REAP Renewable Energy Agency
20.	K.K. Vibeesh, Tahsildar	Revenue and Disaster management
21.	Prof. M. Bhaskara Rao, Sr. Consultant	Revenue and Disaster management
22.	Dr. S. Thirougnaname, General Manager	Smart City Development limited
23.	M. Mahadoum, General Manager	Smart City Development limited
24.	P. Kanagaraj, Deputy Director	Social Welfare Department
25.	P. Padmavathy, Director, SWD	Social Welfare Department
26.	S. Saravanan, Welfare Officer	Social Welfare Department
27.	M. G. Ravi, Manager	Tourism Department
28.	V. Bhuvaneswaran, STP	Town & Country Planning
29.	S. Sridarane, STP	Town & Country Planning
30.	V. Caliaperumal, Regional Transport Officer	Transport Department
31.	S. Sivakumar, CDPO	Women and Child Development
32.	P. Muthu Meena, Director	Women and Child Development
33.	P. Rajendran, B.D.O.	District and Rural Development Agency
34.	E. Raman, Assistant Engineer	District and Rural Development Agency
35.	T. Kiruttinarasu, Statistical Officer	Department of Economics and Statistics
36.	T. Kannan, Statistical officer	Department of Economics and Statistics
37.	S. Rajkumar, TGT	Directorate of School Education
38.	J. Victoria Santhi, Lecturer	Directorate of School Education

39.	T. Ravitchandrane, Assistant Engineer	Electricity Department
40.	M. Guilbert James, Assistant Engineer	Electricity Department
41.	P. Meera Saheb, Deputy Director	Fisheries and Fishermen Welfare
42.	G. Sivapragasam, Sub - Inspector	Fisheries and Fishermen Welfare
43.	S. Kumaravelu, Deputy Director	Forest and Wildlife
44.	J. Thamizhanban, Technical Officer	Industries & Commerce
45.	R. Chidambaranathan, Assistant Engineer	Public Works Department, Karaikal
46.	N. Nagarajan, Junior Engineer	Public Works Department, Karaikal
47.	U. Prabagaran, Deputy Director (AE)	Public Works Department, Karaikal
48.	N. Balasubramanian, Executive Engineer	Public Works Department, Mahe
49.	M. Suresh, Junior Engineer	Ariyankuppam Commune Panchayat
50.	R. Cartiqueyane, Commissioner	Bahour Commune Panchayat
51.	D. Arumugam, Commissioner	Villianur Commune Panchayat
52.	S. Sivakumar, Commissioner	Pondicherry Municipality
53.	V. Ejileravjane, Commissioner	Mannadipet Commune Panchayat
54.	A. Sivabalane, Executive Engineer	Pondicherry Commune Panchayat
55.	T. Sivacoumar, Municipal Health Officer	Oulgaret Commune Panchayat
56.	N. Jayakumar, Commissioner	Nettapakkam Commune Panchayat
57.	Dr. K. Sivakumar, Professor	Dept. of Ecology, Pondicherry university

58.	Dr. S. Sundaramoorthy	Dept. of Chemical Engineering, PTU
59.	Dr. R. Sridar	Dept. of Chemical Engineering, PTU
60.	Probir Banerjee	Pondy CAN
61.	Joy Ganguly	SVARNIM
62.	Adwaita Banerjee	Pondy CAN
63.	M. Boomiraja	Dhan Foundation
64.	Dr. Nandhivarman, Co-ordinator	Green Campus, Pondicherry University
65.	Dr. K. Srinivasamoorthy, Professor	Dept. of Earth Science, Pondicherry University
66.	S. Sudalai, Assistant Professor	Centre for Pollution Control & Environmental Engineering Pondicherry University
67.	Dr. R. Saravanane, Professor	Dept. of Civil Engineering, PTU
68.	Dr. S. Govindarajan, Professor	Dept. of Civil Engineering, PTU
69.	Dr. M. Bubesh Guptha	UEF, Founder
70.	Ashok panda	INTACH
71.	A. Arul	INTACH
72.	D. S. Grija	MSSRF
73.	P. Nandeesa	MSSRF
74.	Ganeche	CEAD
75.	L. Praveen kumar	ACT, Founder
76.	Akash Sinha	IIT, Madras
77.	A. Rajesh Kanna	EASC
78.	Golda, A. Edwin, Secretary	APSCC
79.	M. Sharanya	APSCC
80.	V. Saravanan	Environmentalist
81.	S. Ilankuzhali	Environmentalist

82.	Dr. R. Sagaya Alfred, Senior Scientific Officer	DSTE
83.	Dr. N. Ramesh, Senior Environmental Engineer	DSTE
84.	Nagalla Srinivasa Rao, Scientific Officer	DSTE
85.	K. Kalamegam, Environmental Engineer	DSTE
86.	P. Vipin Babu, Scientist	PPCC
87.	N. Prabhu, Junior Engineer	DSTE
88.	C. Poogazendi, Junior Engineer	DSTE
89.	L. Xavier Kennedy, Junior Scientific Assistant	DSTE
90.	J. Selvanayaki, Junior Scientific Assistant	PPCC
91.	S. Devaanandan, Assistant Environmental Engineer	PPCC
92.	J. Nithya, Programme Officer	ENVIS
93.	S. Jagan Kumar, Information Officer	ENVIS
94.	S. Dhinesh, Information Technology Officer	ENVIS
95.	N. Sridhar, Data Entry Operator	ENVIS
96.	S. Santhalakshmy, Junior Research Fellow	PCCC
97.	T. Balaji, Junior Research Fellow	PCCC
98.	S. Panner Selvam, Junior Research Fellow	PCCC
99.	R. Thenmozhi, Junior Research Fellow	PCCC
100.	S. Jeyabarathi, Project Assistant	PCCC
101.	J. Jayakumar, Consultant	PCZMA

102.	Rukmani, Scientist	DSTE
103.	Ilango, JLA	DSTE
104.	Jothi, JLA	DSTE
105.	Saravanan, JLA	DSTE
106.	Tamizharasan, JSA	DSTE
107.	Anandhan, JLA	DSTE
108.	Sharmila, Data Entry Operator	DSTE
109.	Ilango, Data Entry Operator	PPCC
110.	Sivakumar, Technical Assistant	PCS & T
111.	Sithishkumar, Technical Assistant	PCS & T
112.	Sivasubramaniyan, DEO	PCS & T
113.	Prabakaran, Helper	PCS & T
114.	Karthika, Scientific Officer	PCS & T

ANNEXURE II - MASS MEDIA COVERAGE

The Hindu dated 06.05.2022

Speaker stresses need for potable water supply

SPECIAL CORRESPONDENT
PUDUCHERRY

Speaker R. Selvam on Thursday stressed the need to address the issue of supply of potable water to the people of Union Territory.

Inaugurating a two-day workshop on 'Integrating climate action in the development planning in U.T.,' the Speaker said there had been a decline in the quality of water supplied. Steps were being taken to address the problem of drinking water supply, he said.

He bemoaned the decline of area under green cover in the Union Territory. Urging experts attending the conference to come up with climate friendly development policies, the Speaker said the territorial administration would take the views of experts seriously. Vice Chancellor of Puducherry Technological University S.Mohan urged the government to adopt measures to conserve groundwater by promoting recycling of wastewater.

The workshop was organised by Department of Science, Technology, Environment, Puducherry ENVIS hub and the Energy and Resources Institute, New Delhi. MLA L. Sambath and Secretary to Government R. Smitha were present.

Dinakaran dated 06.05.2022

புதுவையில் 24 சதவீத காடுகள் அழிப்பு

மக்களுக்கு இயற்கையான குடிநீர் வழங்க நடவடிக்கை

சபாநாயகர் செல்வம் பேச்சு

புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங்கிணைத்தல் பயிற்சி பட்டறையில் சபாநாயகர் செல்வம் பேசினார். அருகில் சம்பத் எம்எல்ஏ, தொழில்நுட்ப பல்கலைக்கழக துணைவேந்தர் மோகன், சுற்றுச்சூழல் துறை செயலர் ஸ்மிதா.

புதுச்சேரி, மே 6: புதுச்சேரி அறிவியல், தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறையின் காலநிலை மாற்றப் பிரிவு, சுற்றுச்சூழல் தகவல் மையம் மற்றும் புதுடெல்லி எரிசக்தி மற்றும் வள நிறுவனம் சார்பில் புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங்கிணைத்தல் என்றதலைப்பில் இரண்டு நாள் பயிற்சி பட்டறை நேற்று நூறடி சாலையில் உள்ள தனியார் ஓட்டலில் துவங்கியது. துறை செயலர் ஸ்மிதா வரவேற்றார். முதலியார்பேட்டை தொகுதி எம்எல்ஏ சம்பத், புதுவைதொழில்நுட்பபல்கலைக்கழக துணைவேந்தர் மோகன் ஆகியோர் வாழ்த்தி பேசினர்.

இப்பயிலரங்கை சபாநாயகர் செல்வம் துவக்கி வைத்து பேசியதாவது:

புதுச்சேரியில் ஒரு காலத்தில் 30 சதவீத காடுகள் இருந்தன. ஆனால், இன்றைய சூழலில் 6 சதவீதமாக குறைந்துவிட்டன. ஏறக்குறைய 24 சதவீத காடுகள் அழிக்கப்பட்டுள்ளது. இதனால் வெப்பநிலை அதிகரித்துள்ளது.கொரோனா தொற்று மிகப்பெரிய அழிவை ஏற்படுத்தினாலும் கூட, ஒரு சில நன்மைகளையும் செய்துள்ளது. குறிப்பாக ஓசோன் படலத்தில் ஏற்பட்ட ஓட்டையை வெகுவாக குறைத்துள்ளது. தற்போது புதுச்சேரியில் ஆக்சிஜன் அளவு குறைந்து வருவதாக சர்வே முடிவுகள் தெரிவிக்கின்றன. இதற்கு காலநிலை மாற்றம்தான் காரணம்.

கடந்தாண்டு ஸ்காட்லாந்தில் நடைபெற்ற மாநாட்டில், 2030க்குள் மொத்த கார்பன் டை ஆக்சைடு அளவை குறைத்து, புதுப்பிக்கவல்ல எரிசக்தி பங்கீட்டை அதிகரிப்பது தான் சரியான தீர்வாக அமையும் என்று கூறி அதற்கான செயல் திட்டங்களை பிரதமர் மோடி முன்மொழிந்துள்ளார். இதற்கான இட்டங்களை மத்திய, மாநில அரசுகள் தீவிரமாக செயல்படுத்தி கொண்டு வருகிறது. சுத்திகரிக்கப்பட்ட குடிநீர் உடலுக்கு கேடு என்று மழைநீரை தான் குடித்து கொண்டிருக்கிறேன்.

நம்முடைய நிலத்தடி நீரில் உப்புத்தன்மை அதிகரித்துள்ளது. இதனால் மக்களுக்கு இயற்கையான குடிநீரை வழங்குவதற்கு நீர்மானம் நிறைவேற்றி, இட்ட வரையறை தயாரிக்கப்பட்டு மிக விரைவில் இத்திட்டத்தை செயல்படுத்துவதற்கு நடவடிக்கைஎடுத்து வருகிறோம். முன்பெல்லாம் நாம் காற்றோட்டம் உள்ள வீடுகளில் வாழ்ந்தோம். இன்று அடுக்குமாடி குடியிருப்பில் வாழவதால் தோட்டமே இல்லாமல் போய்விட்டது.

ஒரு முறை பயன்படுத்தி விட்டு தூக்கி வீசப்படுகிற பிளாஸ்டிக் கழிவுகளை பயன்படுத்தி என்னுடைய தொகுதியில் தார் சாலை அமைத்துள்ளோம். இதனால் சுற்றுச்சூழலும் பாதிக்கப்படாது. இத்திட்டத்தை புதுச்சேரி முழுவதும் செயல்படுத்துவதற்கு முதல்வரிடம் கோரிக்கை வைத்துள்ளேன். காலநிலை மாற்றத்தில் ஏற்படும் பாதிப்பை குறைப்பதற்கு இத்துறை எடுக்கும் அனைத்து நடவடிக்கைகளுக்கும் அரசு உறுதுணையாக இருக்கும். இவ்வாறு அவர் பேசினார்.

'இயற்கைக்கு எதிரானதை நாம் செய்யக்கூடாது'

இப்பயிலரங்கில் புதுவை தொழில்நுட்ப பல்கலைக்கழக துணைவேந்தர் மோகன் பேசுகையில், 'புதுச்சேரி பெரியவாய்க்கால் மழைநீர் வெளியேறுவதற்காக கட்டமைக்கப்பட்டது. ஆனால், இதில் கழிவுநீரை வெளியேற்றுகின்றனர். வரும் காலத்தில் பெரிய வாய்க்கால் சுவம்போல மாறாமல் தடுத்து கத்தப்படுத்த வேண்டும். இதை அரசுக்கு வேண்டுகோளாக வைக்கிறேன். பயோ எனர்ஜியை அதிகளவில் நாம் பயன்படுத்த வேண்டும். தற்போது புதுவையில் உள்ள மரங்கள் போதாது. இதனால் தெருவுக்கு தெரு மரங்களை நட வேண்டும். அப்போதுதான் கரியமில வாயுவை மரங்கள் எடுத்துக்கொண்டு ஆக்சிஜனை தரும். நாம் எள்ள தருகிறோமோ? அதையே இயற்கை திரும்பித்தரும். பிளாஸ்டிக்கை பயன்படுத்தி வீசுவதால் கடலுக்கு செல்கிறது. அது மீன்கள் மூலம் நம்மிடமே திரும்பி வருகிறது. இயற்கைக்கு எதிரானவற்றை நாம் செய்யக்கூடாது' என்றார்.

Dina Malar dt. 06.05.2022

புதுச்சேரியில் 24 சதவீத காடுகள் அழிக்கப்பட்டுள்ளது

சபாநாயகர் செல்வம் வேதனை

புதுச்சேரி, மே 6–

'புதுச்சேரியில் 24 சதவீத காடுகள் அழிக்கப்பட்டுள்ளது' என, சபாநாயகர் செல்வம் பேசினார்.

புதுச்சேரி காலநிலை மாற்றப்பிரிவு, புதுச்சேரி சுற்றுச்சூழல் தகவல் மையம், டில்லி எரிசக்தி மற்றும் வள நிறுவனம் ஆகியவை சார்பில், 'புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங்கிணைத்தல்'என்றதலைப்பில் இரண்டு நாள் பயிற்சி முகாம் ஏற்பாடு செய்யப்பட்டுள்ளது.

இதன்துவக்க விழா ஓட்டல் சன்வேயில் நேற்று நடந்தது.

பயிற்சி முகாமை துவக்கி வைத்து சபாநாயகர் செல்வம் சிறப்புரையாற்றினார். சம்பத் எம்.எல்.ஏ., தொழில்நுட்ப பல்கலைக்கழக துணை வேந்தர் மோகன், புதுச்சேரி அறிவியல், தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறை செயலர் ஸ்மித்தா, சீனியர் சுற்றுச்சூழல் பொறியாளர் ரமேஷ் சிறப்பு அழைப்பாளர்களாக கலந்து கொண்டனர்.

விழாவில் சபாநாயகர் செல்வம் பேசியதாவது:

புதுச்சேரி நிலப்பரப்பில் 30 சதவீதம் காடுகள் இருந்தன. இது, தற்போது 6 சதவீதமாக குறைந்து விட்டது. அதாவது, 24 சதவீத காடுகள் அழிக்கப்பட்டுள்ளது. கொரோனா அதிகளவு நமக்கு தீங்கிழைத்தது.

அதேநேரத்தில் சில நன்மைகளையும் செய்துள்ளது. கொரோனா ஊரடங்கு காரணமாக மாசுக்கள் குறைந்து ஓசோனில் ஏற்பட்ட ஓட்டையின் அளவு குறைந்திருப்பதாக கூறப்படுகிறது.

ஸ்காட்லாந்தில் நடந்த பருவநிலை மாற்ற மாநாட்டில் பிரதமர், வரும் 2030க்குள் கரியமில வாயுவை குறைக்க நடவடிக்கை எடுப்போம் என கூறியுள்ளார்.

இதற்காக புதுப்பிக்கவல்ல எரிசக்தி பயன்பாட்டை அதிகரிக்கப்போவதாக கூறியுள்ளார். ஆர்.ஓ. தண்ணீர் குடிப்பதே கேடு விளைவிக்கும் என்கின்றனர். இதனால் நான் மழை நீரை குடிக்கிறேன். இந்த பயிற்சி முகாமில் எடுக்கும் முடிவுகளை அரசு செயல்படுத்த தயாராக உள்ளது.

இவ்வாறு, சபாநாயகர் பேசினார்.

இன்று 6ம் தேதி வரை நடக்கும் பயிற்சி முகாமில் பல்வேறு துறை அதிகாரிகள், விஞ்ஞானிகள், சமூக ஆர்வலர்கள் பங்கேற்று விவாதிக்கின்றனர்.

நல்ல குடிநீர் வழங்க திட்டங்கள் தயார்

சபாநாயகர் பேசும்போது, 'நிலத்தடி நீரில் 50 டி.சி. நச்சுத்தன்மை இருந்தாலே குடிக்க முடியாது என்பார்கள். தற்போது, புதுச்சேரியில் 700 டி.சி. நச்சுத்தன்மை இருப்பதாக கூறப்படுகிறது. நல்ல குடிநீரை மக்களுக்கு வழங்க திட்டங்கள் தீட்டியுள்ளோம். விரைவில் செயல்படுத்த உள்ளோம்' என்றார்.

சன்வே ஓட்டலில் நடக்கும், 'புதுச்சேரி வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங்கிணைத்தல்' என்ற பயிற்சி முகாமை, சபாநாயகர் செல்வம் துவக்கி வைத்தார். அருகில் சம்பத் எம்.எல்.ஏ., சுற்றுச்சூழல் துறை செயலர் ஸ்மித்தா, சீனியர் சுற்றுச்சூழல் பொறியாளர் ரமேஷ்.

Dinakaran dated 07.05.2022

இன்னும் சில ஆண்டுகளில் குடிதண்ணீர் மோசமாக பாதிக்கப்படும்

நல்ல குடிநீர் எப்போதும் கிடைக்க நடவடிக்கை எடுக்க வேண்டும்

முதல்வர் ரங்கசாமி பேச்சு

புதுச்சேரி, மே 7: புதுச்சேரி அரசின் அறிவியல், தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறையின் காலநிலை மாற்றப் பிரிவு, சுற்றுச்சூழல் தகவல் மையம்மற்றும்புதுடெல்லி எரிசக்தி மற்றும் வளநிறுவனம் சார்பில் 'புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங்கிணைத்தல்' என்ற தலைப்பில் பயிற்சி பட்டறை நூறடி அடி ரோட்டில் உள்ள தனியார் ஓட்டலில் கடந்த 2 நாட்கள் நடைபெற்றது.

இதன் நிறைவு விழா நேற்று மாலை நடந்தது. துறை செயலர் ஸ்மிதா தலைமை தாங்கினார். சிறப்பு விருந்தினராக முதல்வர் ரங்கசாமிகலந்து கொண்டுபயிற்சிபட்டறையில் பங்கேற்றவர்களுக்கு சான்றிதழ் வழங்கிபாராட்டினார். பின்னர் அவர் பேசியதாவது:

ஏரி, குளம் உள்ளிட்ட நீர்நிலைகளை தூர்வாரி பாதுகாக்க வேண்டும் என்றுநாம்சொல்கிறோம். ஆனால் அதனைமுழுமையாக செய்திருக்கிறோமா? என்றால்இல்லை.இதனால் நல்ல குடிநீர் கிடைப்பதில் சிரமம் ஏற்படுகிறது. புதுவையில் பல இடங்களில் உப்புநீர் உட்புகுந்து விட்டது. எனவே நல்ல குடிநீர் கிடைக்க வேண்டும் என்றால் நீர்நிலைகளை பாதுகாத்து பராமரிக்க வேண்டும். அதற்குரிய திட்டங்கள் நமக்கு சரியாக இருக்க வேண்டும். இன்றைய சூழ்நிலையில், குடிதண்ணீரின் நிலையை பார்த்தால் இன்னும் ஒரு சில ஆண்டுகளில் மோசமாக பாதிக்கப்படும். அதற்கேற்றவாறு இப்போதே திட்டமிட்டு நல்ல குடிநீர் எப்போதும் கிடைக்க நடவடிக்கையை நாம் எடுக்க வேண்டும். அதேபோன்று நிடக்கழிவு மேலாண்மை குறித்து தொடர்ச்சியான முயற்சிகளை அரசு எடுத்து வருகிறது. அது முழுமையாக இருக்கிறதா? என்றால் இல்லை. இதில் சம்மந்தப்பட்ட துறையினர் தேவையான நடவடிக்கை எடுக்க வேண்டும். அது இன்றைய காலநிலை சூழலுக்கேற்ப அனைத்து துறையினரும் இணைந்து செயல்படுவது முக்கியம்.

இவ்வாறு முதல்வர் பேசினார்.

நிகழ்ச்சியில் முதுநிலை அறிவியல் அதிகாரி சகாய ஆல்பரட் சீனியர் சுற்றுச்சூழல் பொறியாளர் ரமேஷ், விஞ்ஞானி விபின் பாபு உள்ளிட்டோர் கலந்து கொண்டனர். சுற்றுச்சூழல் பொறியாளர் காலமேகம் நன்றி கூறினார்.

புதுச்சேரி அரசின் அறிவியல், தொழில்நுட்பம், சுற்றுச்சூழல் துறை சார்பில் நடந்த பயிற்சி பட்டறையில் பங்கேற்றவர்களுக்கு முதல்வர் ரங்கசாமி சான்றிதழ் வழங்கினார். அருகில் துறை செயலர் ஸ்மிதா.

Dina Thandi dated 07.05.2022

கருத்தரங்கில் கலந்து கொண்டவர்களுக்கு முதல்–அமைச்சர் ரங்கசாமி சான்றிதழ் வழங்கியபோது எடுத்த படம்.

பருவநிலை மாற்றம் குறித்த கருத்தரங்கு:

திட்டமிடுவதற்கு ஏற்ப துறைகள் செயல்படுவதில்லை

முதல்-அமைச்சர் ரங்கசாமி அதிருப்தி

புதுச்சேரி, மே.7–

திட்டமிடுவதற்கு ஏற்ப துறைகள் செயல்படுவ தில்லை என்று பருவ நிலை மாற்றம் குறித்த கருத்தரங்கில் முதல்-அமைச்சர் ரங்கசாமி அதிருப்தி தெரிவித்தார்.

நிறைவு விழா

புதுவை காலநிலை மாற்றப் பிரிவு, சுற்றுச்சூழல் தகவல் மையம், எரிசக்தி மற்றும் வள நிறுவனம் சார்பில் புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் பருவ நிலை நடவடிக்கைகளை ஒருங் கிணைத்தல் என்ற தலைப்பில் 2 நாள் கருத்தரங்கு சன்வே ஓட்டலில் நடைபெற்றது.

2-வது நாளான நேற்று மாலை நிறைவு விழா நடந்தது. விழாவுக்கு அறிவியல் தொழில் நுட்பம் மற்றும் சுற்றுச்சூழல் துறை செயலாளர் ஸ்மிதா தலைமை தாங்கினார். முதல்-அமைச்சர் ரங்கசாமி கலந்து கொண்டு கருத்தரங்கில் பங்கேற்றவர்களுக்கு சான்றி ழ் வழங்கி பேசினார். அப் போது அவர் கூறியதாவது:-

நல்ல குடிநீர்

இந்த கருத்தரங்கு மிகவும் க்கியமானது. எந்த ஒரு செயலிலும் திட்டமிடுதல், செயல்படுத்துதல் மிக்கியம். நாம் திட்டமிடுகிறோம். ஆனால் அதனை செயல்படுத்துவது இல்லை. இதற்கு பல தடங்கல்கள் வரலாம். அதனை எதிர்த்து நாம் செயல்பட வேண்டும். புதுச் சேரியில் முன்பு இருந்த பசு மையை மீண்டும் உருவாக்க வேண்டும். அதற்கு சரியாக திட்டமிட்டு செயல்பட்டால் தான் முழுமையான பயன் கிடைக்கும்.

புதுச்சேரி குறைந்த பரப்பள வு கொண்டிருந்தாலும் அதிக மக்கள் உள்ளனர். இங்கு வாகன பெருக்கம் அதி கமாக இருப்பதால் காற்று மாசுபடுவதை நாம் காண முடிகிறது. அதேபோல் நிலத் தடி நீர்மட்டமும் குறைந்து கொண்டே செல்கிறது. இதனை பாதுகாக்க ஏரிகள், குளங்களை முழுமையாக தூர்வாரி வைத்திருக்கி றோமா? என்று பார்த்தால் இல்லை. கடல்நீர் உள்ளே புகுந்து வருவதால் இன்னும் சில ஆண்டுகளில் குடிநீர் தேவைக்காகாதாம். மோசமாக பாதிக்கப்படலாம். வருங்கா லத்தில் நல்ல குடிநீர் கிடைக்க தற்போதே திட்டமிட்டு செயல்பட வேண்டும்.

மக்களின் பாதுகாப்பு

திடக்கழிவு மேலாண் மைக்கு தேவையான முயற் சியை அரசு செய்து வருகிறது. இருப்பினும் அதற்கு முழுமை யாக பயன் இல்லை. பருவ நிலை மாற்றத்திற்கு ஏற்ப துறைகள் இணைந்து செயல் பட வேண்டும். தற்போது உள்ள சூழலில் சுற்றுச்சூழல் பாதுகாப்பு என்பது மிகவும் முக்கியமான ஒன்று. அதற்கு நாம் அதிக கவனம் செலுத்தி வருகிறோம்.

புதுவையில் இளைஞர்க ளுக்கு வேலை வாய்ப்பு கிடைக்க, மாநிலத்தின் பொரு ளாதாரம் உயர புதிய தொழிற் சாலைகள் வர வேண்டும். இருப்பினும் சுற்றுச்சூழல் பாதிப்பு இல்லாத தொழிற் சாலைகள் மட்டும் தான் கொண்டு வரப்படுகிறது. மக்க ளின் பாதுகாப்பை கருத்தில் கொண்டு அரசு செயலாற்றி வருகிறது.

செயல்படுவது இல்லை

திட்டமிடுவதற்கு ஏற்பதுறை கள் செயல்படுவதில்லை. ஒவ் வொரு துறைகளும் தங்களின் பணிகளை உணர்ந்து சரியாக செய்ய வேண்டும். அப்போது தான் பருவநிலை மாற்றங் களில் இருந்து நம்மை முழுமை யாக பாதுகாத்துக்கொள்ள முடியும்.

இவ்வாறு அவர் கூறினார். நிகழ்ச்சியில் சுற்றுச்சூழல் துறையின் முதுநிலை அறிவி யல் அதிகாரி சகாய ஆல் பர்ட், முதுநிலை பொறியா ளர் ரமேஷ், பொறியாளர் காளிமேகம், விஞ்ஞானி விபின் பாபு உள்பட பலர் கலந்துகொண்டனர்.

Dina Malar dated 07.05.2022

நீர்நிலைகளை பராமரிக்க வேண்டும் முதல்வர் ரங்கசாமி வலியுறுத்தல்

புதுச்சேரி, மே 7–

'ஒரு சில ஆண்டுகளில் குடிநீர் மோசமாக பாதிக் கப்படும்' என, முதல்வர் ரங்கசாமி கூறினார்.

'புதுச்சேரி யூனியன் பிரதேசத்தின் வளர்ச்சி திட்டத்தில் காலநிலை நடவடிக்கைகளை ஒருங் கிணைத்தல்' என்ற தலைப் பில் இரண்டு நாள் பயிற்சி முகாம் ஓட்டல் சன்வேயில் நேற்றுமுன்தினம் துவங்கி யது. நிறைவு விழா நேற்று நடந்தது. சுற்றுச்சூழல் துறை செயலர் ஸ்மித்தா தலைமை தாங்கினார்.

பயிற்சி பட்டறையில் பங்கேற்றவர்களுக்கு சான் றிதழ் வழங்கி முதல்வர் ரங்கசாமி பேசியதாவது:

புதுச்சேரி மாநிலத் தினை 'கிளீன் அண்டு கிரீன் புதுச்சேரி' என்று சொல்கிறோம். ஆனால், அப்படி இருக்கிறதா என் பதை பார்க்க வேண்டும். என்னை பொறுத்தவரை சரியாக இல்லை என்பது தான் எனது எண்ணம். இன்னும் நிறைய சரி செய்ய வேண்டும். பசு மையான நிலையும் இப் போது குறைந்துள்ளது. பசு மையை நாம் உருவாக்க வேண்டும்.

முக்கிய சாலைகளில் செல்ல முடியாத வகை யில் வாகனங்களின் எண் ணிக்கை அதிகரித்துள்ளது.

இதனால் காற்றில் எவ் வளவு மாசு ஏற்பட்டுள்ளது என்பதையும் நாம் பார்க்க வேண்டும். ஏரி, குளம் உள் ளிட்ட நீர்நிலைகளை தூர் வாரி பாதுகாக்க வேண்டும் என்று சொல்கிறோம்.

ஆனால், முழுமையாக செய்திருக்கிறோமா என் றால் இல்லை. எனவே, நல்ல குடிநீர் கிடைக்க நீர்நிலைகளை பாதுகாத்து பராமரிக்க வேண்டும்.

இன்றைய சூழ்நிலை யில், குடிநீரின் நிலையை பார்த்தால் இன்னும் ஒரு சில ஆண்டுகளில் மோச மாக பாதிக்கப்படும். அதற்கு ஏற்றவாறு இப் போதே நாம் திட்டமிட்டு நல்ல குடிநீர் எப்போதும் கிடைக்க நடவடிக்கையை எடுக்க வேண்டும்.

சுற்றுச்சூழலுக்கு பாதிப்பு ஏற்படாத தொழிற் சாலைகள் புதுச்சேரிக்கு வர வேண்டும் என்பதிலும் கவனம் செலுத்துகிறோம் என்றார்.

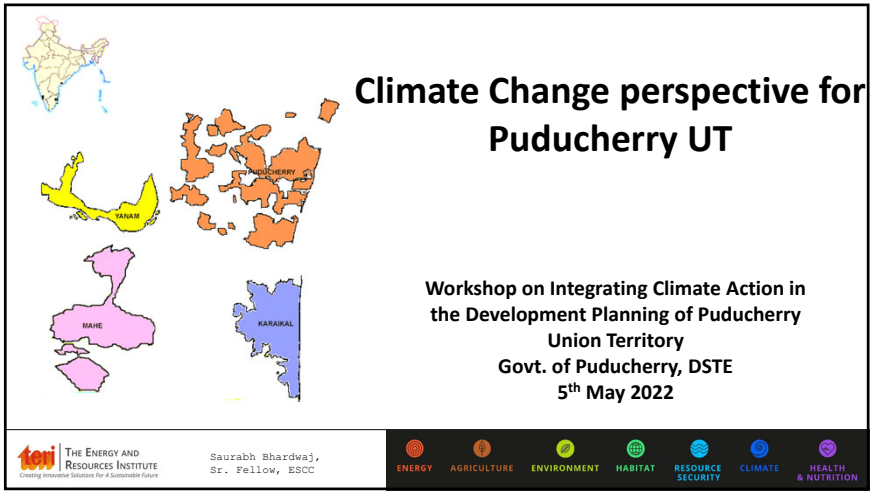
முதுநிலை அறிவியல் அதிகாரி சகாய ஆல்பிரட், சீனியர் சுற்றுச்சூழல் பொறி யாளர் ரமேஷ், விஞ்ஞானி விபின் பாபு உள்ளிட்டோர் கலந்து கொண்டனர். சுற் றுச்சூழல் பொறியாளர் காளிமேகம் நன்றி கூறி னார்.

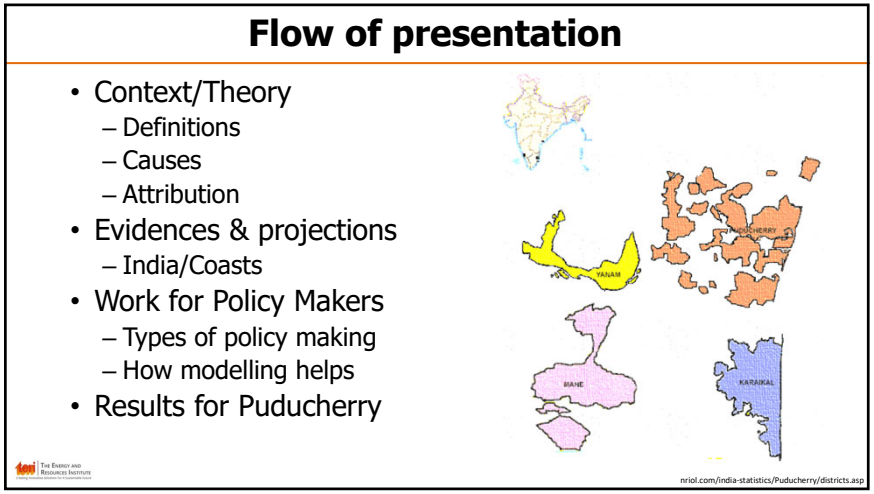
அறிவியல், தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறை சார்பில் நடந்த பயிற்சி பட்டறையில் பங்கேற்ற புதுச்சேரி நகராட்சி ஆணையர் சிவக்குமாருக்கு, முதல்வர் ரங்கசாமி சான்றிதழ் வழங்கினார்.

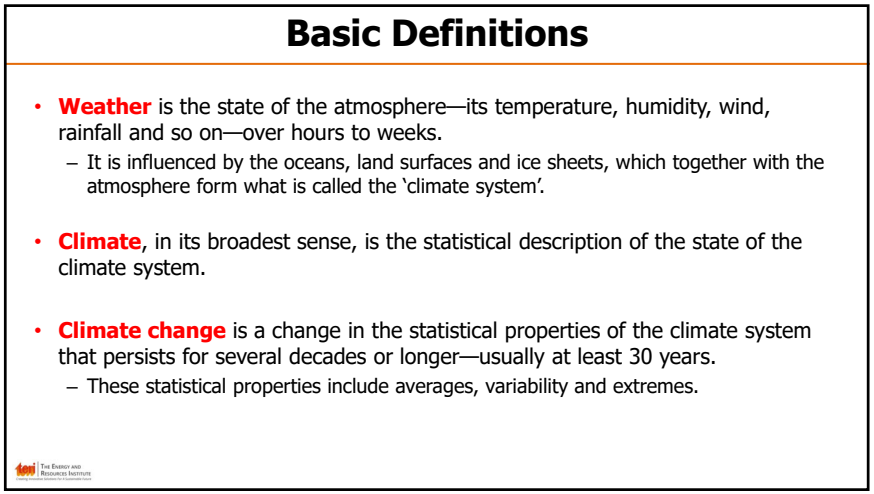
Climate Change perspective for Puducherry UT

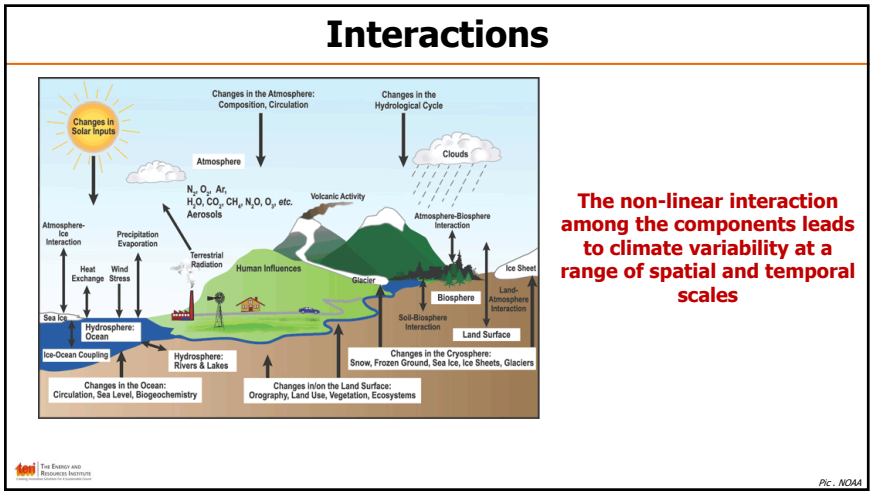
Speaker :Mr. Saurabh Bhardwaj,
Senior Fellow & Area Convenor, Centre for Climate Modelling, Earth Science and Climate Change Division, TERI.

Date : 05.05.2022.

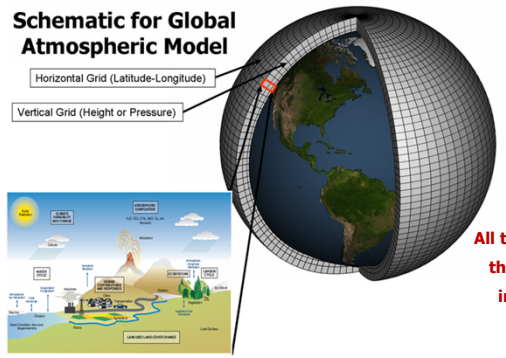








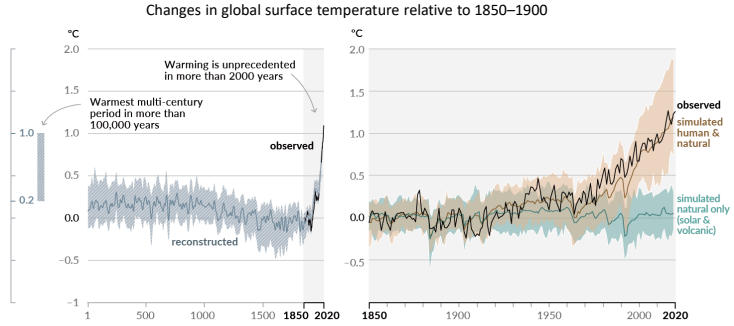
Numerical Solution: Time steps and Grid boxes



All the physical processes occurring in the climate system are resolved at individual grid and the coupling occurs at these grids.

Source: NASA

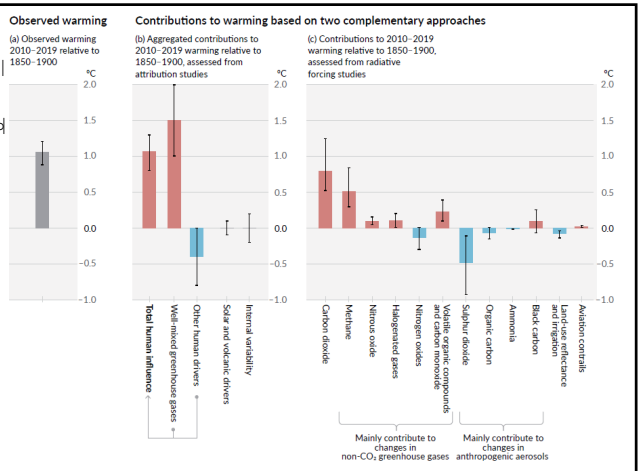
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years



Source: IPCC AR6 SPM

R evhuyhg#dup lgj#dvhjulyhq#e hp lvvlrqv#iurp #xsp dq# dfwlylwlhv/#e lwk juhqkrxvh#jdv#e dup lgj#eduwo p dvnhg#e #dhurvro#frrdgj

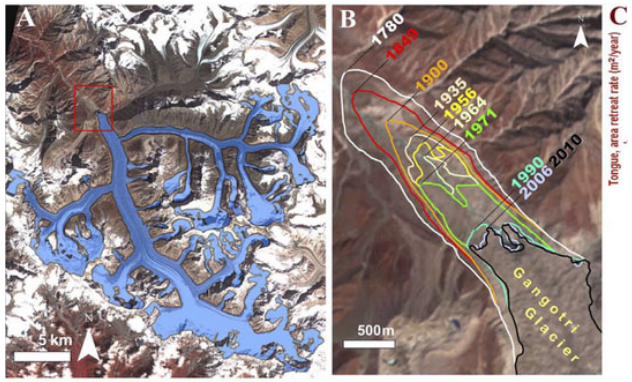
Carbon dioxide is causing the bulk of the forcing. On average, it lives more than a hundred years in the atmosphere and therefore affects climate over long time scales.



Source: IPCC AR6 SPM

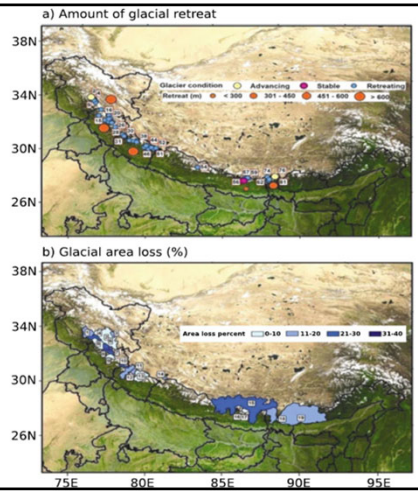
Evidences and Indicators of climate change (India context)

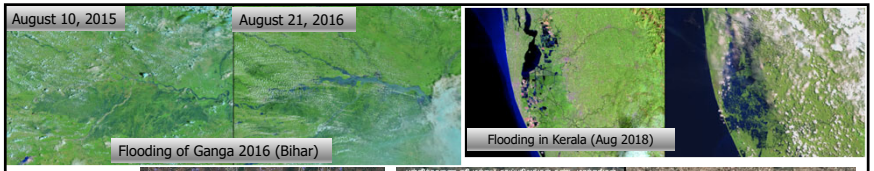
Gangotri Glacier

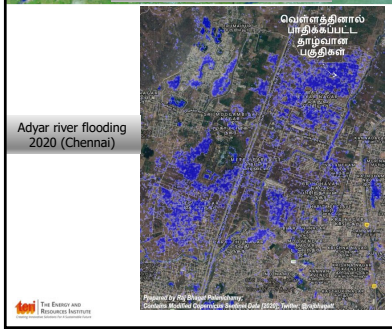


Kargel et al 2011

Glacial Retreat And Loss





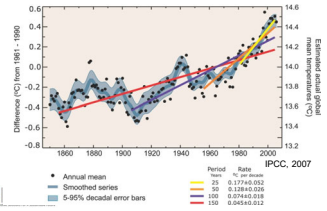


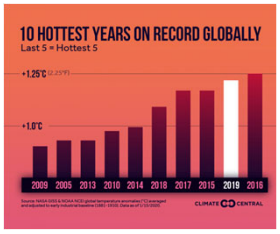
Pallikaranai wetland (flood buffers) being lost as built areas.

Headlines

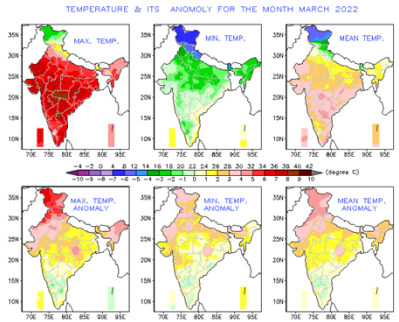
The five warmest years in the global record have all come in the 2010s
The 10 warmest years on record have all come since 1998
The 20 warmest years on record have all come since 1995

India: Thirteen out of the 15 warmest years since 1901 were the past 15 years (2002-2016) and the last decade (2001-2010/ 2007-2016) was also the warmest on record

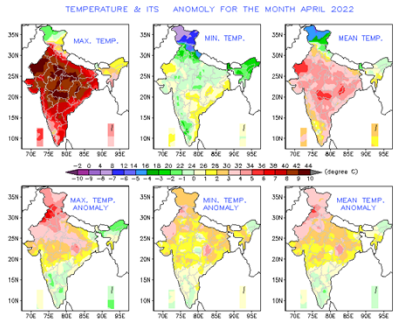




India in 2022

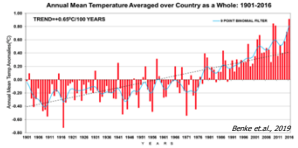


March: 122yr record warmest



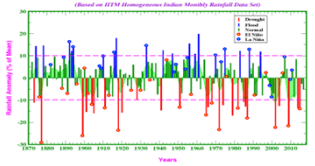
April: 72yr record warmest

All India Mean Annual Temperature Anomalies (1901-2016)



The trend of warming in recent past (1971-2016) is higher over India and comparable to global trend in warming

All India Summer Monsoon from 1871-2017



All-India monsoon season rainfall time series shows NO long term trends. It is marked by large year to year variations.

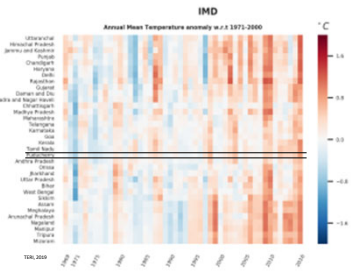
Thirteen out of the 15 warmest years since 1901 were the past 15 years (2002-2016) and the last decade (2001-2010/ 2007-2016) was also the warmest on record.

Sea level along the Indian coast has been rising at the rate of about 1.3mm/year on an average and projected to rise due to influences from global rise and regional effects.

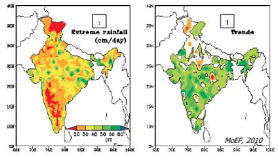
Increasing SLR and intense cyclones have caused coastal flooding due to storm surges in the past. The trend will continue in the future with higher surge heights making coastal inundation a big concern.

MoEF 2010, SREX, 2012

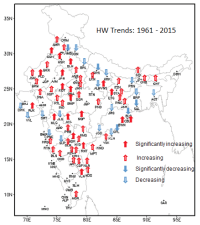
All India Annual Mean Temperature Anomalies (1969-2016) (Base: 1971-2000)



Regional Trends are high with higher warming in recent past.

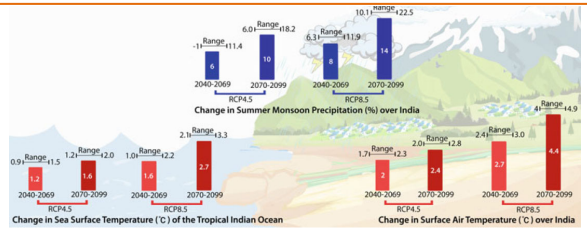


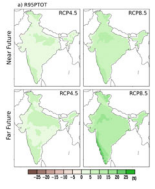
The extreme rainfall have increased over India with positive trends over most places

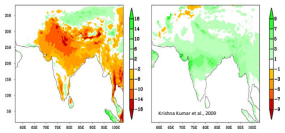


Significant evidences and analysis on increasing extremes.

PROJECTIONS FOR INDIA





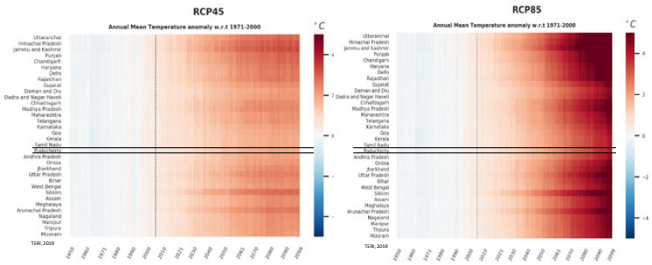


Projected future change in number of rainy days (rainfall >2.5 mm) during monsoon season (JJAS).

Projected change in the intensity (mm/day) of rainfall on a rainy day.

MoES, 2020

India context for future

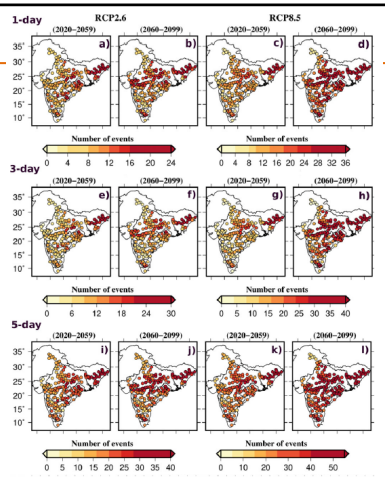


Significant evidences and analysis on increasing extremes in future on India wide / homogeneous scale

Future Flooding

Models indicate an increase in frequency of urban and river floods, under different levels of warming, 1.5 and 2.0 °C, as in association with an expected rise in heavy rainfall occurrences

Flood frequency and associated risk are projected to increase over the major river basins of India, with a higher risk for the Indus-Ganges-Brahmaputra river basins



Expected Effects over India

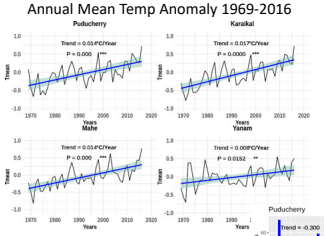
- **Temperature:** Rise between 1.7° to 2.0°C by 2030s and 3.5° to 4.3°C by 2080s
  - on avg. 27 more hot days (>45°) each year and around 1.3 more consecutive hot days (heat waves) events each year for next 30 years.
- **Precipitation:** Highly variable and unpredictable, avg. 0.3%-15% all India by 2030s and 9-15% by 2080s.
  - with around 4 – 18 more days of very high rainfall in near future (till 2050s).
- **Extremes:** Both temp and rainfall extremes to increase in future:
  - higher minimum temperatures and more intense rainy days as well as more drier days
- **Cyclones:** A decrease in projected number of cyclonic disturbances along both the coasts by 2030s but intensity to increase.
- **Storm Surges:** 5%-20% increase in 100-year return periods of storm surges over East coast in 2030s.
- **Sea Level Rise: Sea Level Rise:** At the end of the twenty-first century, steric sea level in the NIO is projected to rise by approximately 300 mm relative to the average over 1986–2005 under the RCP4.5 scenario

Climate analysis over Puducherry

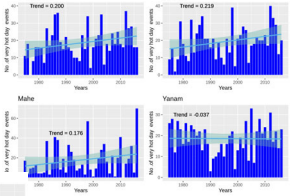
- Data used in this study is from IMD for historical analysis and NEX-GDDP data for future study.
- IMD rainfall data (1951-2016) at 0.25°X0.25° & temperature data 1°X1° (1969-2016). NEX-GDDP @0.25°
- To reduce the uncertainties in future change projections, a robust model selection methodology has been followed to select the best performing models over Puducherry out of the 21 NEX-GDDP models for the multimodal ensemble mean.
- Multimodal Ensemble mean of five best performing NEX-GDDP dataset has been used to assess the projected changes towards Mid-Century period (2021 – 2050)
- The change has been calculated as a difference between the 30 year average of mid-century (2021-2050) with respect to baseline (1975-2005).

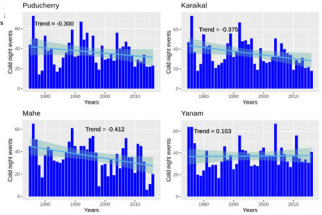
Historical Analysis (temp)

Annual Mean Temp Anomaly 1969-2016



Annual Very hot day events (>95th %tile)

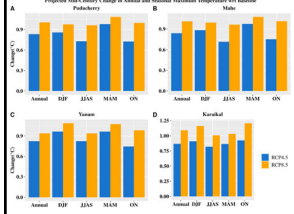




Annual cold nights (<10th %tile)

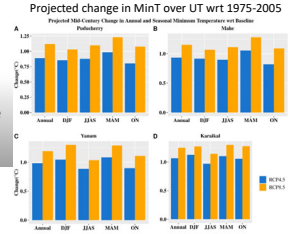
Future Climate Analysis (temp 2021-2050)

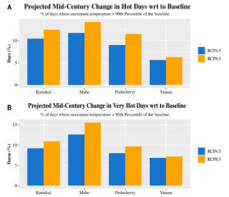
Projected change in MaxT over UT wrt 1975-2005



- Annual/Seasonal warming for the UT under both RCPs
- Change in MinT more than MaxT
- Extremes Temp also show increase in future with Mahe showing the most changes.

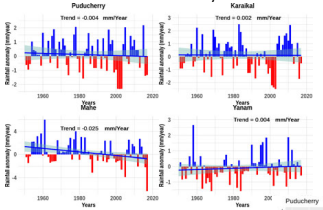
Projected change in MinT over UT wrt 1975-2005



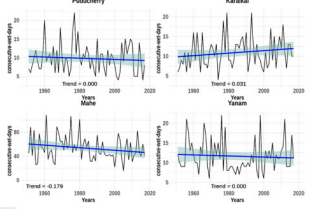


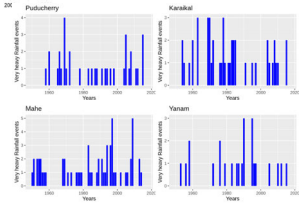
Historical Analysis (rainfall)

Annual Mean rainfall Anomaly 1951-2016



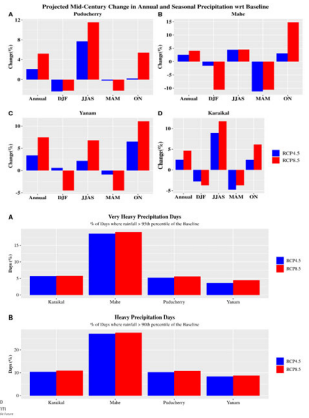
Consecutive wet days (>3days)





Very Heavy rainfall events (>124.4mm/day)

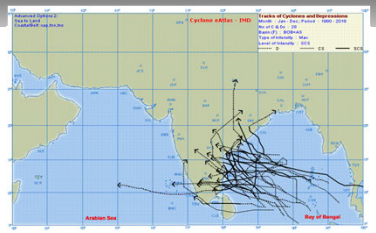
Future Climate Analysis (Rainfall 2021-2050)



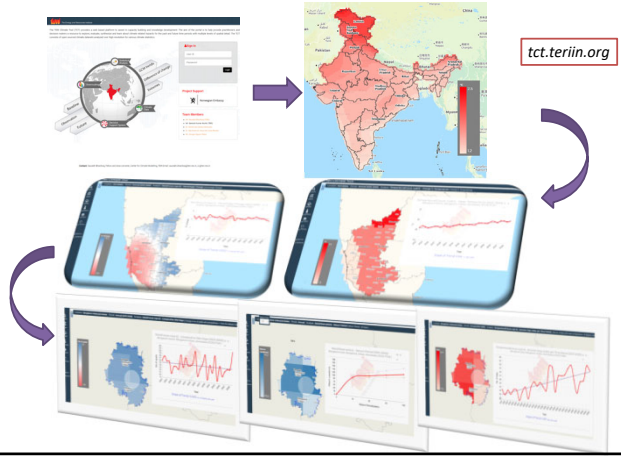
- **Annual average and Monsoon rainfall is projected to increase for all the districts** in the UT of Puducherry for both RCP4.5 and RCP8.5 scenarios for the 2021-2050
- **Puducherry** shows a projected change in annual rainfall of **2% and 6%** for RCP 4.5 and RCP8.5.
- **Mahe** shows a projected change in annual rainfall of **2% and 4%** for RCP4.5 and RCP8.5.
- **Yanam** shows a projected annual change of **3% and 7%** for RCP4.5 and RCP8.5.
- **Karaikal** shows a projected increase in rainfall of **3% and 4%** for RCP4.5 and RCP8.5.
- Heavy and very heavy precipitation are projected to increase over all the districts of the UT of Puducherry .
- Wet days and dry days also shows high variability but overall it shows increase for most of the UTs for the future.

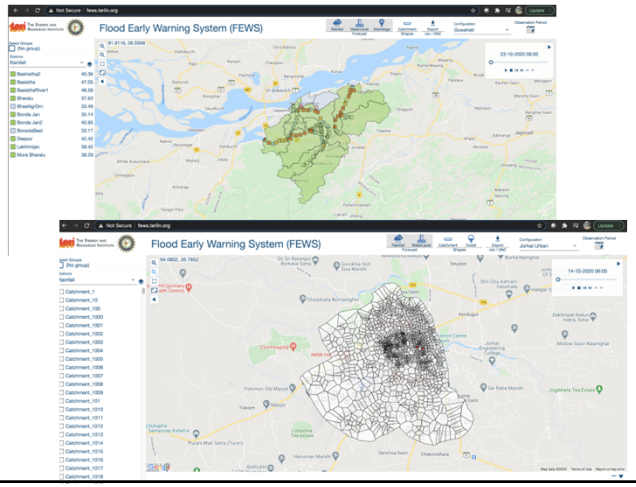
Tropical Cyclones

- During 1980-2018 (38 years): 44 TC have crossed the Bay of Bengal Basin to A.P. & T.N. coastal belt, of which 28 were severe SCS.
- During OND season the TC occurrence are more frequent.
- The Bay of Bengal TC more often strike Odisha-West Bengal coast in October, Andhra coast in November and the Tamil Nadu coast in December.
- More intense CS projected for future however no evidence of increasing frequency in long dataset.



Climate Services and tool



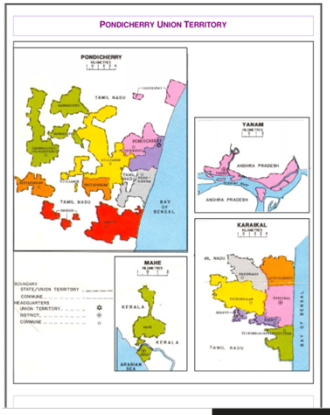


Source: Reuters, 2015

Climate Action in Puducherry Union Territory - Adaptation

Speaker :Ms. Vasudha Singh,
Research Associate, Centre for Global Environment Research,
Earth Science and Climate Change Division, TERI.

Date : 05.05.2022.



Climate Action in Puducherry Union Territory

Adaptation

State Action Plan on Climate Change 2.0

- Different vulnerabilities and exposure in each state leading to different impacts
- Proactive stance from Government of India in decentralizing the efforts towards climate change actions
- The State Action plans on Climate Change (SAPCC) are an instrument for the states and UT to identify their vulnerabilities to climate change and work towards addressing these in a coherent manner
- Puducherry submitted its first SAPCC in 2013.
- MoEFCC- All states and Union Territories were directed to revise their State Action Plan on Climate Change in 2018
- Evolving context of climate science, policy and actions
- Lessons learned from SAPCC 1.0

Framework for the Revision of State Action Plan on Climate Change

1. Introduction
2. State Profile
3. Climate Profile
4. Vulnerability Assessment
5. Climate Change Strategy: Mitigation
6. Climate Change Strategy: Adaptation
7. Financing the SAPCC
8. Institutional Mechanisms
9. Monitoring and Evaluation

Adaptation Action

- "Development as usual", without consideration of climate risks and opportunities, will not allow us to face the growing challenges of the changing climate
- Climate change risks need to be considered systematically in development planning at all levels in order to build in adaptation measures
- Particular attention should also be paid to policies and projects with long-term consequences
- Building in timely climate change adaptation measures will greatly enhance the benefits and sustainability of many development initiatives

The local level is important for mainstreaming climate change adaptation

climate change impacts are manifested locally, affecting local livelihood activities, economic enterprises, health risks, etc.

vulnerability and adaptive capacity are determined by local conditions.

adaptation activities are often best observed at the local level.

Framework for interventions

- Major initiatives and strategies reflecting the commitments and proposed actions in the state to tackle the vulnerabilities and impacts of climate change across socio-economic sectors
- Synergy with the goals of NDCs and linkages to the SDGs
- Aligned with the National Missions on Solar, Enhanced Energy Efficiency, Sustainable Habitat, Sustainable Agriculture and Green India Mission, Water mission and the Strategic Knowledge Mission and Coastal Resources and Disaster Management
- Clearly defined targets and time period of implementation
- Institutional Mechanism: implementation, stakeholder engagement, capacity building, monitoring and evaluation

Adaptation Interventions for the Water Sector

- **Key Issues**: Surface water sources and siltation, depleting quantity and quality of ground water, seasonal flooding
- Promotion of conjunctive use of ground and surface water and reducing dependence on ground water for irrigation
- Management of borewells
- Effective community mobilization & participation through a well-charted IEC plan by the UT
- Revamping water supply infrastructure
- Stormwater Management
- Enhanced assessment, monitoring and transparency in water resources assessment and usage
- Strengthening Public Health Infrastructure and ensuring clean water and sanitation
- Scaling up treatment and reuse of greywater

- Urgency, cost and political will and social acceptance can help to prioritise adaptation options such as flood preparedness measures, improvement of drainage systems, wetland restoration, coastal management.
- Adaptation is a learning process. Adaptation activities need to be continuously improved.
- Involve decision makers, increase understanding about climate change, create awareness about the need for society to adapt.

Climate action in Puducherry Union Territory - Mitigation

Speaker :Ms. Veena CP

Project Associate, Centre for Global Environment Research,

Earth Science and Climate Change Division, TERI.

Date : 05.05.2022.

Climate action in Puducherry Union Territory

Mitigation

Introduction

Objective:

The ultimate objective of the Climate Change Convention (UNFCCC) is to achieve "... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

Approach:

Estimating the levels of greenhouse gas (GHG) emissions and removals is an important element of the efforts to achieve this objective.

Method:

A greenhouse gas (GHG) inventory is a list of emission sources and the associated emissions quantified using standardized methods.

GHG EMISSION PROFILE OF PUDUCHERRY UT

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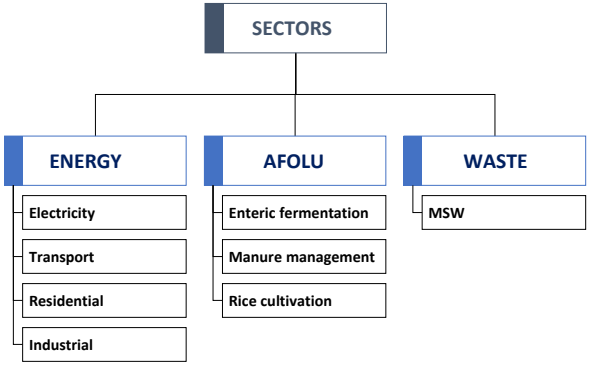
Developing GHG Inventory for Puducherry UT

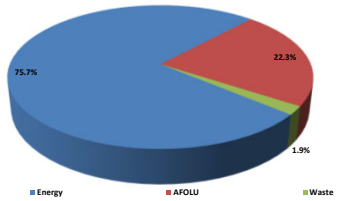
- The UT's GHG inventory was carried out in reference to the **2006 IPCC Guidelines for National Greenhouse Gas Inventories.**
- The study exercise primarily adopts the Tier 1 approach for estimating GHG emissions, where the default emission factors for various activity data are applied.

Annual emissions (tCO2e/y)= Activity data x emission factor

SECTORS & SUB-SECTORS



Sectorial emission contribution percent between 2014 to 2019



THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions For A Sustainable Future

ENERGY AGRICULTURE ENVIRONMENT HABITAT RESOURCE SECURITY CLIMATE HEALTH & NUTRITION

ENERGY SECTOR

The energy sector is responsible for about **76% of total emissions** during the study period between 2014 to 2019.

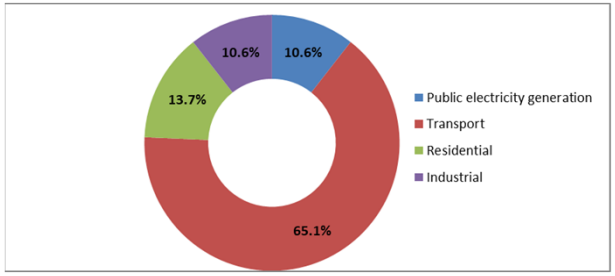
The transport sector emits the maximum emissions amongst all sectors, due to its high density vehicle population, rapid growth in vehicle ownership and tourism needs.

The household sector is one of the second largest contributors of GHG emissions due to the increasing consumption of LPG for cooking. The residential sector consistently emits about **1.3 lakh tCO2e/y.**

The industry sector has the third largest contribution, an average estimated emission of about 1 lakh tCO2e/y.

Sub-category	Emissions in tonnes of carbon dioxide equivalent per year (tCO_2e/y)					
	2014	2015	2016	2017	2018	2019
Electricity generation	78,438	75,750	1,10,954	1,14,984	1,10,933	1,01,887
Transport	7,01,652	7,18,462	5,58,109	5,61,006	5,59,948	5,54,594
Residential	1,13,910	1,25,848	1,31,817	1,31,488	1,31,324	1,34,371
Industrial	71,920	71,920	87,555	1,15,698	1,25,078	1,21,951

Sub-sectorial emission contribution percent between 2014 to 2019



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Agriculture, Forest and Other Land Use (AFOLU)

The overall average emission from the AFOLU sector was **1.75 million tCO2e/y** annually contributing to **22.3 % to the total UT's emissions.**

Average GHG emissions from the agriculture sector during 2014-2019 from

- Rice cultivation= 1.4 lakh tCO2e/y
- Livestock (Enteric fermentation & Manure management) =1.37 lakh tCO2e/y

Sub-category	Emissions in tonnes of carbon dioxide equivalent per year (tCO2e/y)					
	2014	2015	2016	2017	2018	2019
Enteric fermentation	1,17,044	1,21,598	1,26,336	1,31,264	1,31,264	1,31,264
Manure management	9,860	10,227	10,607	11,003	11,003	11,003
Rice cultivation	1,47,316	1,44,271	1,40,313	1,30,895	1,31,363	1,34,521

Waste sector

- The Waste sector averagely contributed to almost **2% to the total emissions for the UT of Puducherry** during the studied timeline 2014-2019.
- For a population of 1.6 million people, an estimated average amount of 1.76 lakh tonnes of municipal solid waste were sent to disposal sites which contributed to an overall **23,300 tCO2e/y.**

Sub-category	Emissions in tonnes of carbon dioxide equivalent per year (tCO_2e/y)					
	2014	2015	2016	2017	2018	2019
MSW	7,754	14,295	20,252	26,514	33,098	37,931

MITIGATION STRATEGIES

Background

Puducherry is a rapidly urbanizing and developing UT, however, it is still prone to the changing extreme weather primarily to rising temperatures and formation of Urban Heat Islands.

The biggest challenge facing would be ensuring the growth of the economy, infrastructure, and industrial production while reducing GHG emissions across all the sectors.

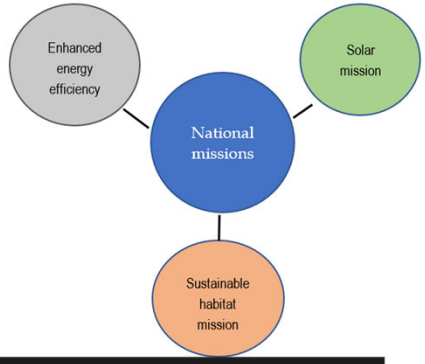
This requires for a robust framework of strategies and interventions that address the concerns of the population at the regional level.

The SAPCC of Puducherry UT has mapped out several short, medium and long-term climate interventions for lowering emissions from carbon-intensive sectors.

Sectors in focus

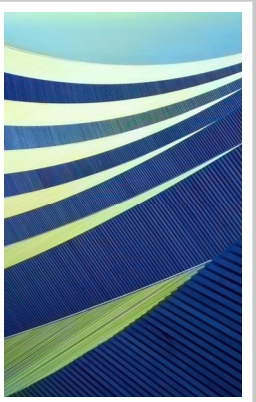
Mitigation strategies in Puducherry UT are mainly focused on four areas that align with the sectoral GHG emissions, namely: -

- Renewable energy
- Energy efficiency
- Transport
- Waste



Renewable energy

- To raise impetus of solar energy in the UT, The Government of UT Puducherry recently formulated a Solar Power Policy in 2015.
- The Solar Power Policy aims to promote solar photovoltaic and solar thermal energy through implementation of policies, projects and programs.
- Owing to the high potential of rooftop solar in urban areas and the availability of grid connections in the rural areas as well makes Puducherry in an advantageous position to make use of solar energy.



Interventions

- Deployment of Solar utility scale and Rooftop systems
- Subsidy scheme for rooftop solar model across residential sector
- Establishing solar PV plants
- Installation of solar lights
- Installing rooftop solar system in public buildings in smart city area
- To increase renewable based energy generation through power purchase

Energy efficiency

- Puducherry has limited power generation capacity of its own and relies mainly on central electricity generating stations to meet its power demand.
- The remaining power demand is met by adjoining Tamil Nadu Electricity Board, Kerala State Electricity Board and Central generating stations. Almost 75% of the installed capacity comes from thermal sources followed by 11% from nuclear energy and a limited share from renewable energy sources.
- The domestic sector (46%) and the commercial sector (31%) are the major consumers of electricity constituting a quarter of the total consumption.

Interventions

- EE activities in Government and public institutions
- EE activities in urban areas
- Perform, Achieve and Trade (PAT) Scheme
- Capacity building programs and initiatives
- Energy conservation Building Code (ECBC)
- Installing LEDs as street lights in smart city areas

Transport

- The Union Territory of Puducherry, also known as Pondicherry, is well connected to parts of the country and the globe by road, air and rail network.
- The city is visited by many local, national and global tourists all year round and hence needs to have an efficient public transport system to ease movement for the tourists.
- The current public transport in the city has Puducherry Road Transport Corporation (PRTC) inter-state and intra-city bus service, privately operated bus services.
- The taxi cabs and auto-rickshaws are important intermediate paratransit modes that the city has.

Click to add text

Interventions

- Promotion of public transport
- Promoting EV vehicles/e-rickshaws and EV charging stations
- Setting up EV charging stations
- Installing Intelligent Transport System
- Developing pedestrian and cyclist pathways

Waste

- Puducherry UT has systematic waste management schemes and programs under the Swachh Bharat Mission and sustainable habitat mission.
- The municipalities in Puducherry adopted different methods such as door-to-door collection with segregation of garbage at source for effective MSW management.
- Puducherry has improved its previous year's rank from 344 to 171 in Swachh Survekshan 2020 rankings.

Interventions

- Setting up Waste to Energy (WTE) plant
- Initiation and completion of Bio mining plant
- Integrated Waste Management Plan for handling and processing waste
- Setting up modern slaughterhouse

Way forward

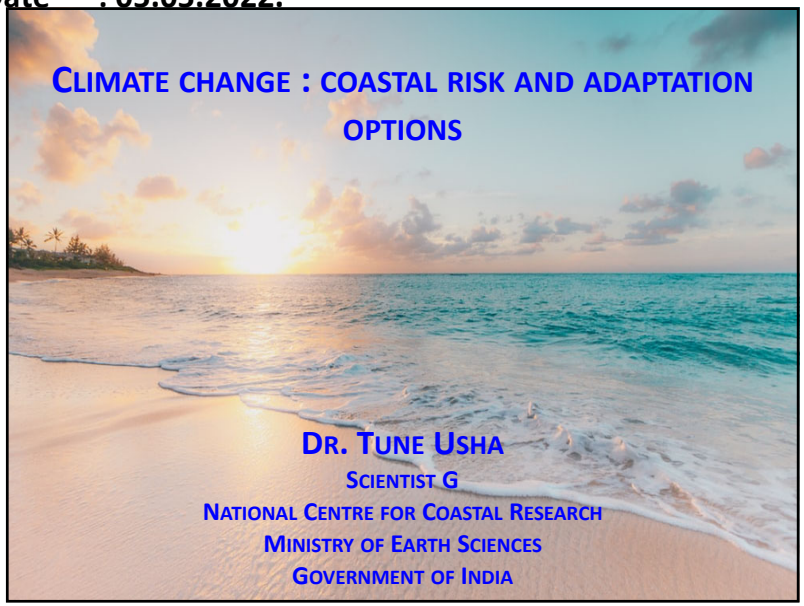
The UT of Puducherry is rapidly urbanizing and developing, this comes with challenges as well. In general, infrastructure and other services are not accompanied along with the increasing urban population.

Therefore, policy actions should be more intended towards have a meaningful impact on emissions reduction and resilience-building in a coordinated way.

The best practice to follow will be the comprehensive development plan of Puducherry which entails all the sectors. This will help in the effective implementation of mitigation strategies.

THANK YOU

CLIMATE CHANGE : COASTAL RISK AND ADAPTATION OPTIONS
Speaker :DR.TUNE USHA
SCIENTIST - G,NATIONALCENTRE FOR COASTAL RESEARCH, MoES,GoI
Date : 05.05.2022.



OUTLINE

- Coastal Hazards – Inundation and Erosion
- Coastal Inundation
  - ✓ Causes
  - ✓ Flood Warning Systems– Chennai, Mumbai, Kolkotta..
- Coastal Erosion
  - ✓ Causes- Assessment of Coastal Erosion
  - ✓ Protection– Puducherry and Kadalur Periyakuppam
- Effect of Climate change
- Adaptation and Investments

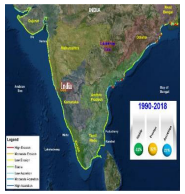
2

National Centre for Coastal Research (NCCR)

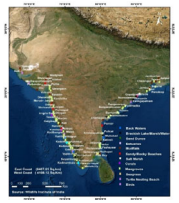
- Shoreline Management
- Coastal hazards
- Marine Spatial Planning
- Marine Pollution
- Ecosystem Services
- Capacity Building

Coastal Research at NCCR, MoES

MARINE POLLUTION – MONITORING, PREDICTION AND RISK ASSESSMENT



National Shoreline Assessment System
Shoreline information/Erosion/accretion data

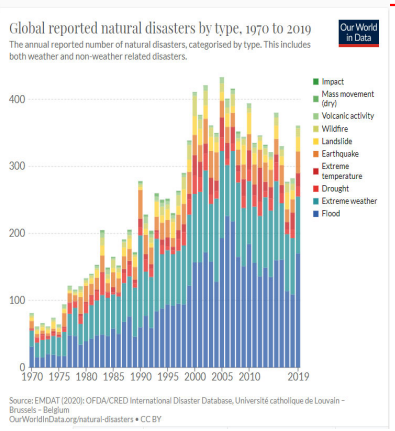


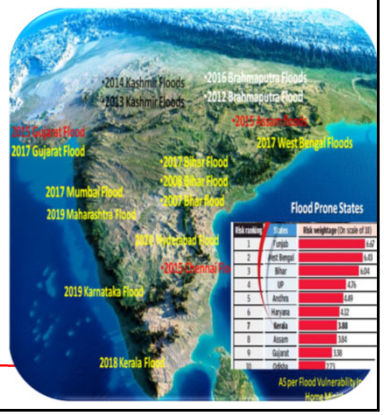
Coastal BioGeo Information System (CBIS)

Climate Change Risk Information system for the Indian Coast (CRIS)

Projects in association with coastal states

NATURAL DISASTERS – GLOBAL TREND

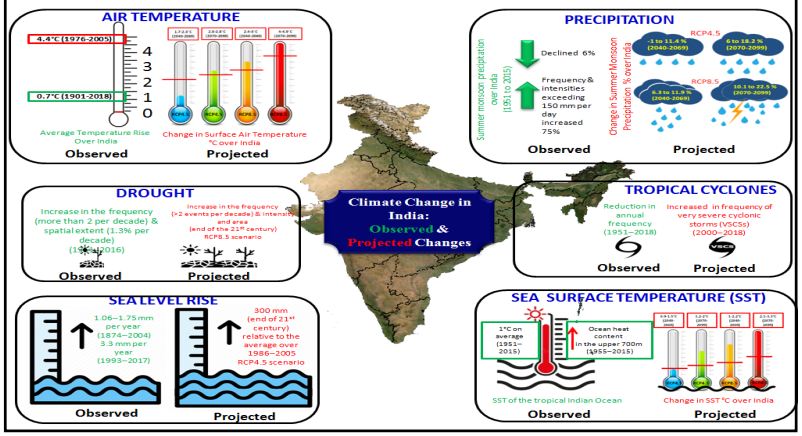




Climate Change – The happening reality

Assessment of climate change over Indian Region from CCCR, MoES

Warming since the 1950s has already contributed to a significant increase in weather and climate extremes globally (e.g., heat waves, droughts, heavy precipitation, and severe cyclones), changes in precipitation and wind patterns, warming and acidification of the global oceans, melting of sea ice and glaciers, rising sea levels, and changes in marine and terrestrial ecosystems

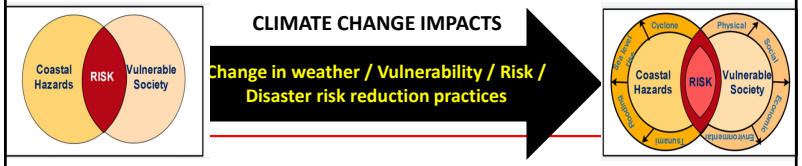


Shift in perspective globally :

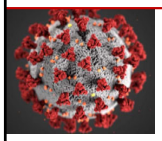
"what the weather will be" to "what the weather will do

- The International Network for Multi-Hazard Early Warning Systems (IN-MHEWS)
- Sendai Framework DRR
- WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services

In view of the changing climate and its impacts, it is imperative to aid and build capacity of Coastal India by generating usable information and operational tools related to coastal hazards such as *cyclones, coastal floods, storm surge, tsunami, Sea level rise, extreme weather due to climate change*, their impacts, vulnerability and risk for effective disaster risk reduction and mitigation activities.



Disaster Risk



Hazard is a potentially damaging physical event, that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Exposure : All objects, persons, animals, activities and processes that may be adversely affected by hazardous phenomena, in a particular area, either directly or indirectly.

Vulnerability represents the proneness of society and its full structure to be affected by the hazard

Risk is the probability of harmful consequences, or expected losses resulting from interactions between hazards and vulnerable conditions

SEVERE IMPACTS

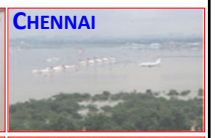
Vaccination

Adaptive Capacity

COASTAL HAZARDS

COASTAL EROSION

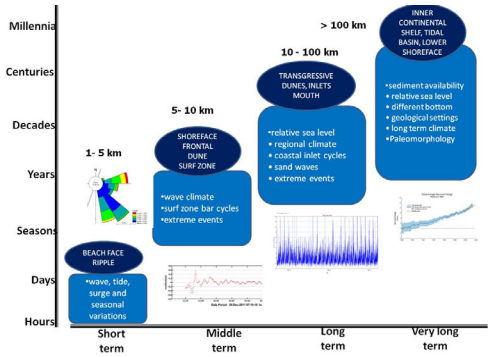
COASTAL FLOODS



Alarming…

10

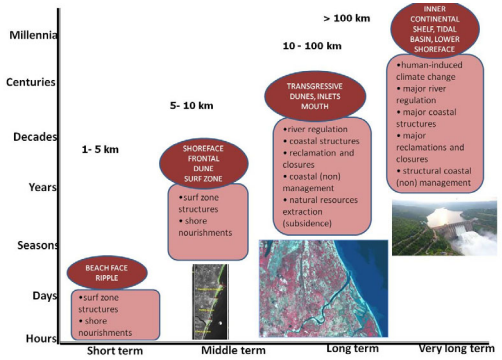
SHORELINE EVOLUTIONS : NATURAL



MINISTRY OF EARTH SCIENCES

11

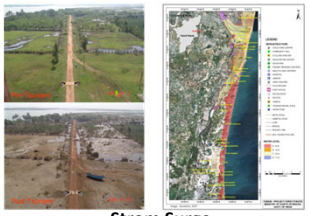
SHORELINE EVOLUTIONS : MAN MADE



12

COASTAL INUDATION

Tsunami

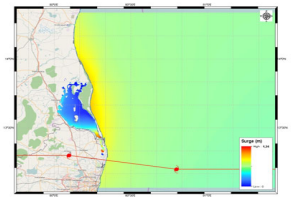


Urban Flood

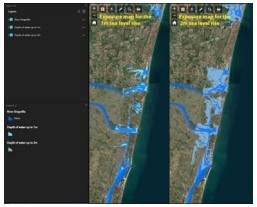
Chennai
1 Dec 2015 : 494mm in 24 hours,

Mumbai
26 July 2005 : 944mm in 24 hours,

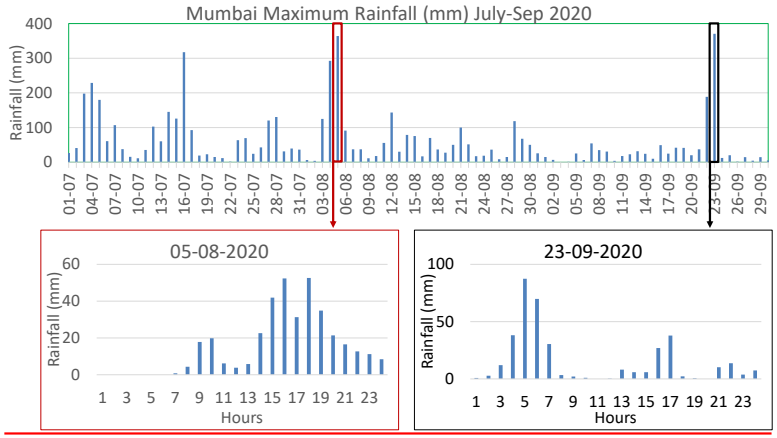
Strom Surge



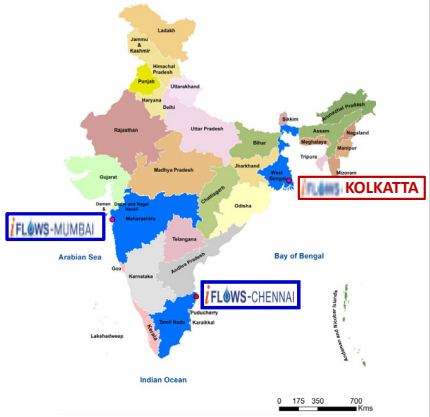
Sea Level Rise



RAINFALL INTENSITY - MUMBAI



INTEGRATED FLOOD WARNING SYSTEM



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

Developed and made Operational

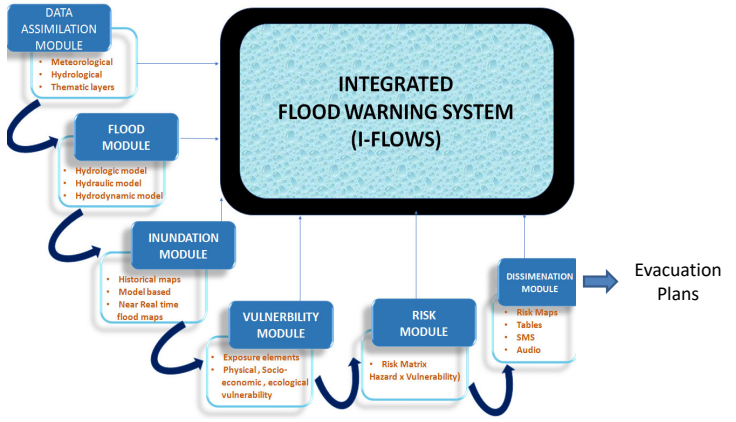
- **iFLOWS-Chennai (CFLOWS ver 2.0)**
- **iFLOWS-Mumbai**

In the Pipeline

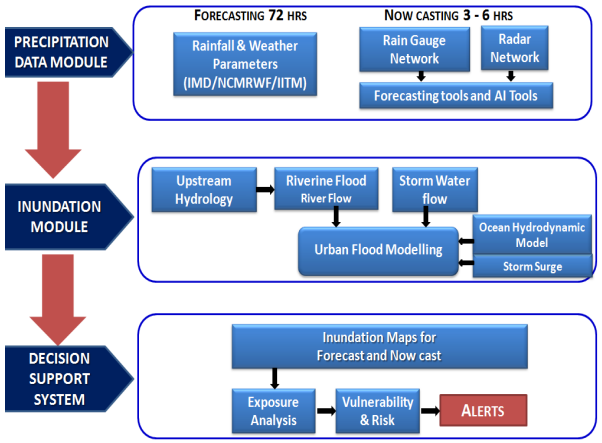
- **iFLOWS-Kolkata**

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

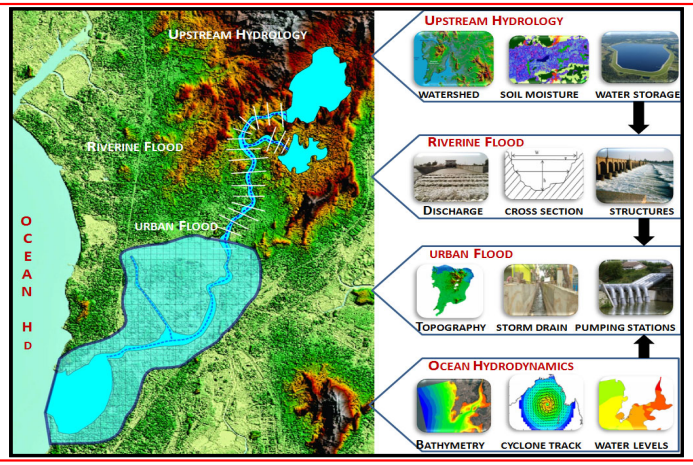
INTEGRATED FLOOD WARNING SYSTEM
SYSTEM ARCHITECTURE



INUNDATION MODULE - ARCHITECTURE

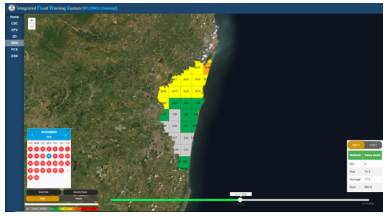


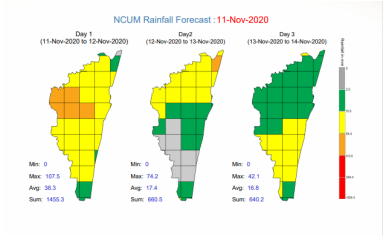
NUMERICAL FLOOD MODULE - ARCHITECTURE

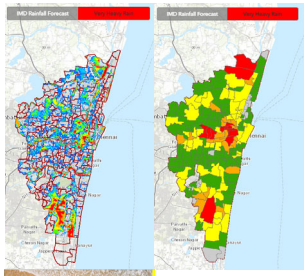


END TO END SYSTEM - iFLOWS

Option 1 : Flood inundation based on NCUM Model

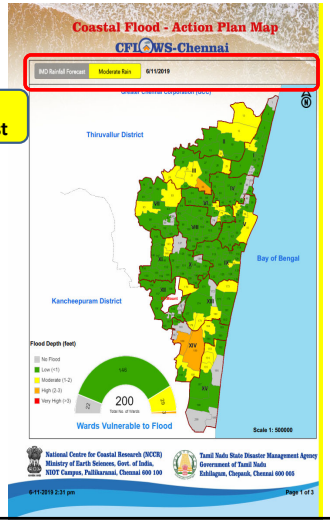


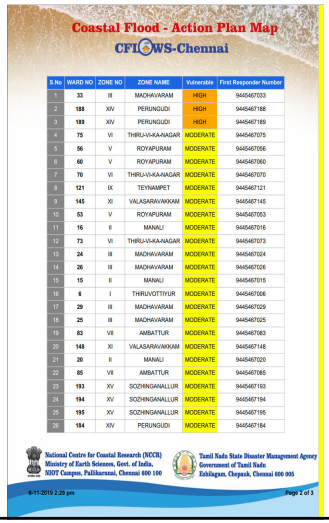




Ward level flood vulnerable report

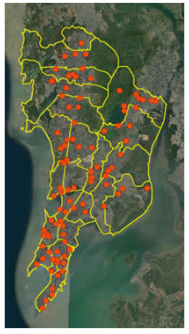
IMD forecast



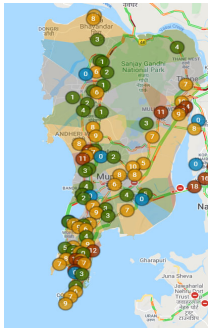


Option 4 : Based on Field data

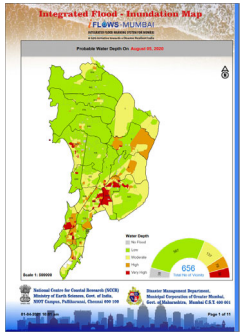
AWS Locations



Observed Rainfall

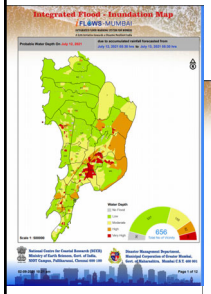


Flood Vulnerability



Based on IMD SOP for IBF

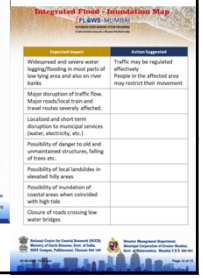
flood inundation and statics



Ward level flood inundation Report

Street level flood inundation Report

Impact and Action suggested



Integrated Flood Warning System

Integrated Flood Warning System (IFLOWS) is a WebGIS based decision support system developed for the Coastal metropolitan city of Chennai and Mumbai, incorporating weather, hydrologic, hydraulic, and hydro dynamic models along with thematic data pertaining to local administration, landuse, socio-economics and infrastructure to serve as operational decision support system for flood mitigation operations by the state administration.

Chennai Flood Warning System inaugurated on Nov, 2019 and made operational by the TNSDMA, Govt of Tamil Nadu

Integrated Flood Warning System for Mumbai Inaugurated on June 2020 and made operational by DMD, MCGM

Flood Warning Models- Resilience

What Model can do???

- Inundation due to
  - ✓ Rainfall
  - ✓ River bank breach
  - ✓ Strom surge
  - ✓ Obstruction of flow by roads and railway
  - ✓ Impact of tides on river and adjacent areas

Application of Model results other than Flood warning

- ✓ River training and suitable measures to reduce flooding
- ✓ Improvement in Storm water drainage system
- ✓ Locations for pumping stations, flood relief buildings and etc
- ✓ Operation of lock gates for reservoirs and other lakes.
- ✓ Study the impact of Sea level rise on floods.

Climate Change – Urban Flood Threshold Limits

1. Changes in Catchment Area
2. Improving Storage of Reservoirs
3. Improving River embankments with Control structures
4. River desiltation and improving capacity
5. Coastal Barriers with Flood gates and pumping stations
6. Advanced Drainage Network
7. Elevating Low lying areas and Buildings

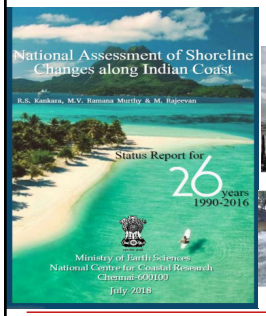
How to make investments ???

Coastal Erosion and Coastal Flooding in India

34 % of coast are eroding in varying degrees as per National Assessment of Shoreline changes along Indian Coast (1990-2016) report prepared by National Centre for Coastal Research(NCCR)

Sea Level rise has potential cause of coastal erosion and flooding in eroding and low lying coastal areas in long term.

- ➢ >7500 km long coastline
- ➢ 14 major and 250 minor ports



Images from recent coastal flooding due Cyclone Tauktae in Kerala and Cyclone Yass in Bengal

COASTAL EROSION

Recent times, coastal areas along Indian Coast experienced severe erosion

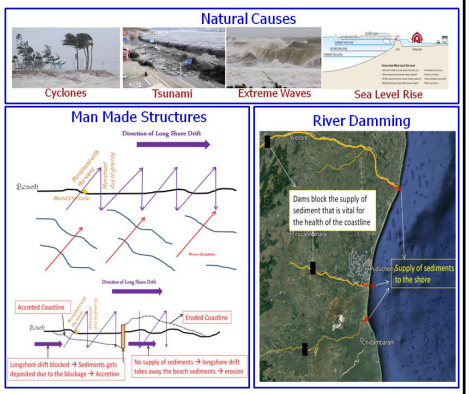
Causes

Natural:

Storms, Extreme waves, Sea level rise, persistent low pressure due to climate change

Man-Made:

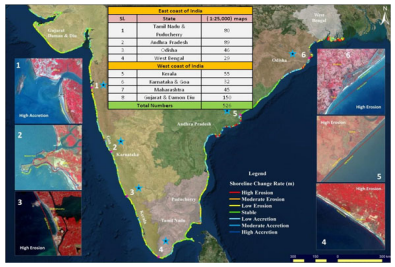
Development of ports, Damming of rivers, Dredging of Tidal inlets

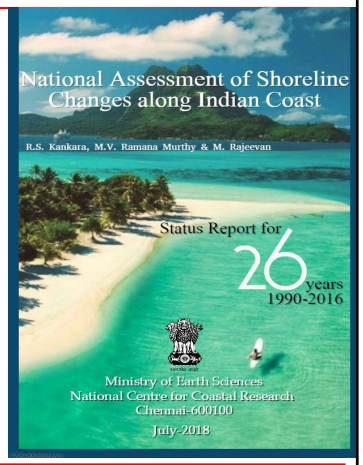


Understanding of Coastal processes --- Data ????

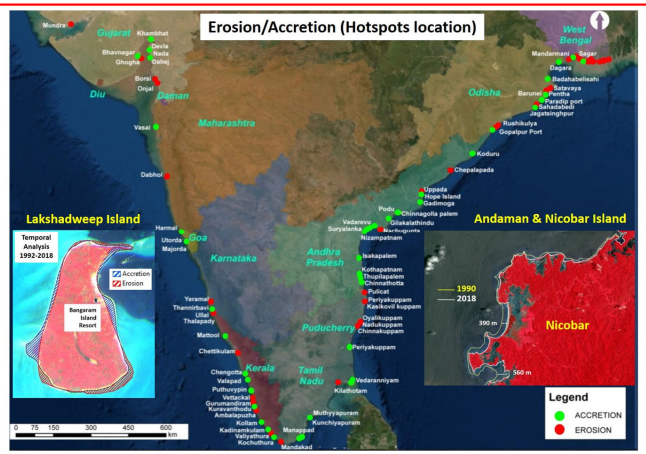
SHORELINE CHANGE MAPS

- Shoreline changes for entire mainland coast last 27 years i.e. 1990 to 2017
- A database to make record of annual shoreline changes & land loss/ gain

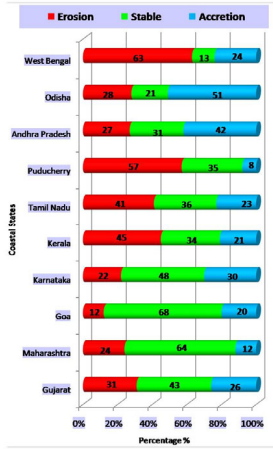


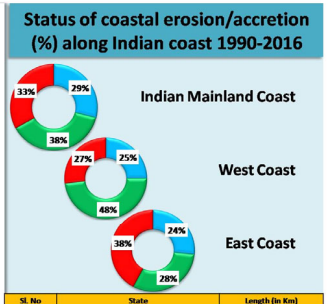


EROSION HOTSPOTS



STATUS OF COASTAL EROSION (1990-2018)



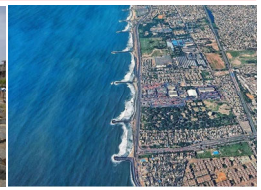


Sl. No		State	Length (in Km)
1	West Coast	Gujarat, Daman & Diu	1701.78
2		Maharashtra	739.57
3		Goa	139.64
4		Karnataka	313.02
5		Kerala	592.96
6	East Coast	Tamil Nadu	991.47
7		Puducherry	41.66
8		Andhra Pradesh	1027.58
9		Odisha	549.50
10		West Bengal	534.35
Total (Interior of river mouth is excluded from the total length)			6631.53

Coastal Protection Measures..??

Revetments

Sea Walls



Groynes

Offshore Break Waters

Submerged Reef

Beach Nourishment

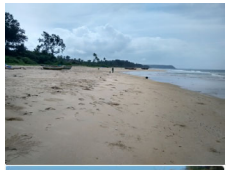
33

Key Principles of Coastal Protection

1 "If it's not broken, don't fix or break it" … Comparison of stable and eroding beaches…Ramayapattinam- Orissa.

2 "The beach may be the best form of coastal protection" … Sand-based Solutions. (Pondicherry, Kadalur Periyakuppam)

3 "When the going gets tough, build something" … Structural Solutions.



34

Nature based solution, Ramayapatnam, Odisha

Dynamics of Bahuda River @ Ramayapatnam

35

Beach after intervention

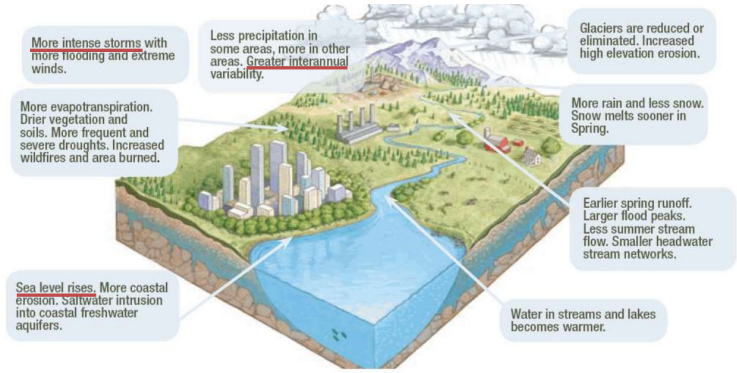
Before Opening the mouth (September, 2019)

After Opening the mouth (November 2019)

36

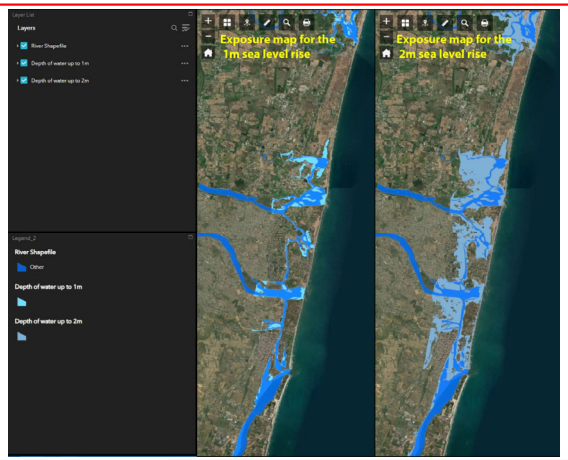
37

Effect of Climate Change Hydrology Cycle



Source: The Climate Science Approach in Floodplain Management, Kristina Murthy, EIT, CFM

Inundation due to Sea level Rise



39

Effects of Sea level Rise Coastal Erosion

Sandy shores:

- Coastal retreat → loss of land and infrastructure
- Extent dependent on the average slope of nearshore profile and the magnitude of SLR (Bruun)

Coastal Structures:

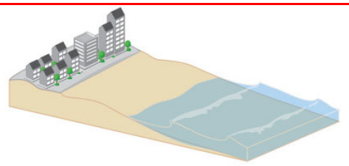
- Structure may lose its functional value leaving the area vulnerable
- Significant investment will be required

Vegetated Coast:

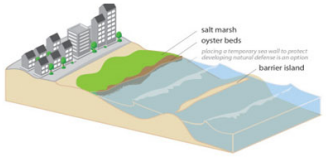
- Some evidence that mangroves can adjust to sea level rise by trapping sediments but not completely understood.
- In case the vegetation doesn't survive, the coastal stretch loses the protection it historically had due to the vegetation. This makes coast vulnerable under extreme events.

40

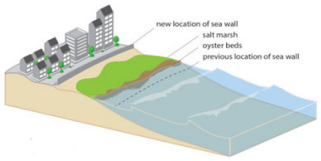
CLIMATE CHANGE – COASTAL INUNDATION THRESHOLD LIMITS



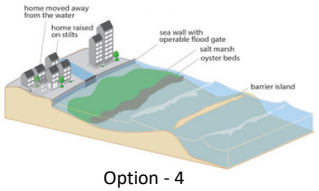
Option - 1



Option - 2



Option - 3

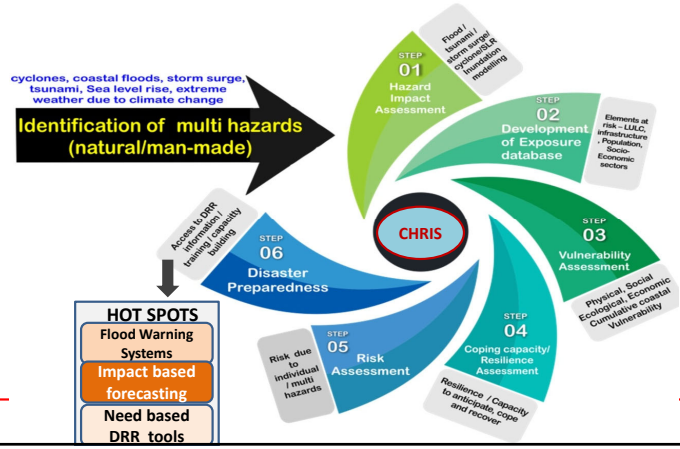


Option - 4

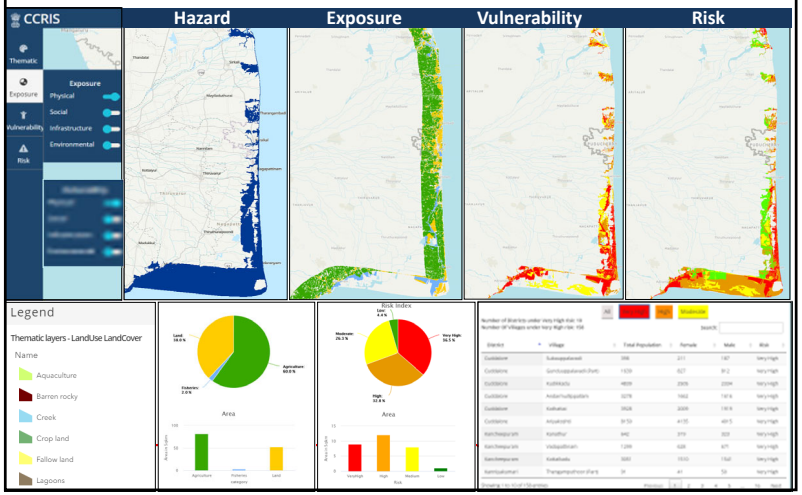
How to make investments ???

Climate Change and Coastal Hazards Risk Information System (CHRIS)

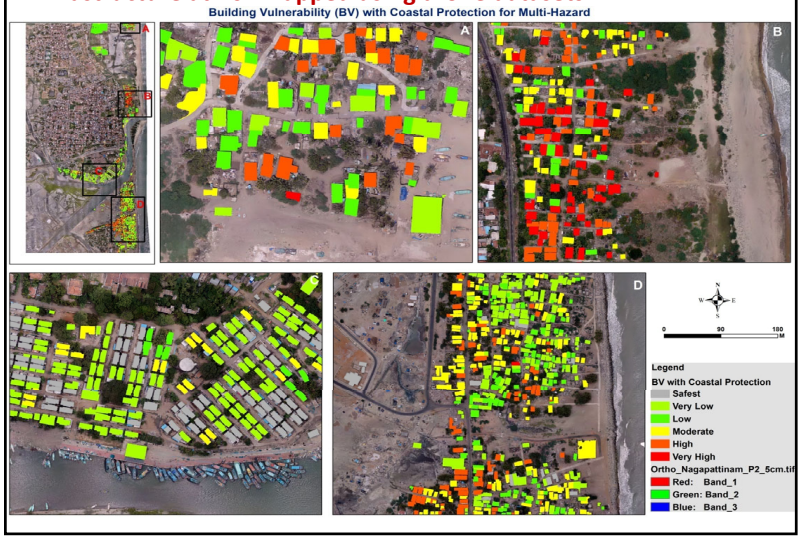
The Climate Change and Coastal hazards Risk Information System (CHRIS) being developed to provide access to usable disaster risk information and operational tools coastal hazards such as *cyclones, coastal floods, storm surge, tsunami, Sea level rise, extreme weather due to climate change.*



Climate Change Risk Information system for the Indian Coast – at state level

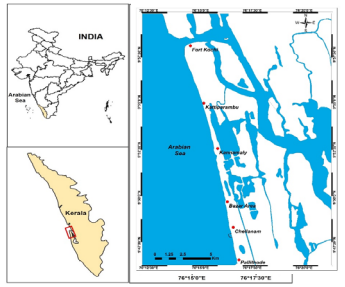


Climate Change Risk Information system for the Indian Coast – Infrastructure at risk mapped using drone datasets



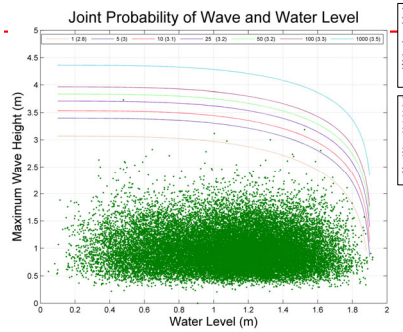
Coastal Erosion and Flood Issues: Chellanam Coast

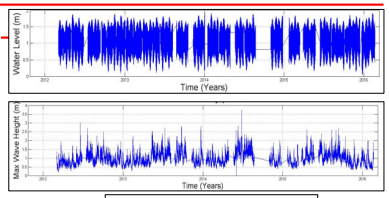
- Chellanam is a fishing village in Ernakulam District with more than 13,000 people and around 1,000 houses situated very close to the sea.
- It is narrow landform about 10 km and sand witched between Arabian sea on the west and backwaters to the east.
- Width varies from 150m and 1800m.
- Chellanam coast has been suffering with sea erosion and coastal Inundation.

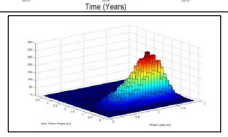




Joint Probability Analysis







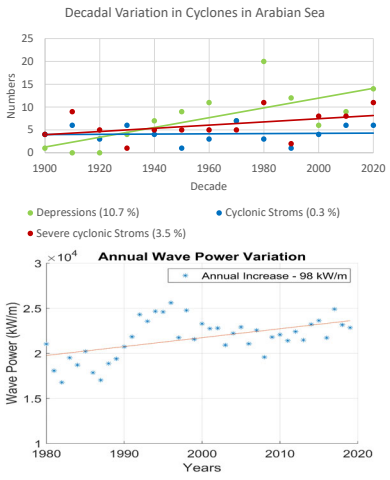
- Very Critical for design of Low crested Coastal Structures.

Return Period (Years)	Combined Water Level (m)	
	Independent Probability	Joint Probability
1	4.9	4.1
5	5.3	4.5
10	5.4	4.6
50	5.7	4.9
100	5.8	5.1
200	6.0	5.2

47

Changes in Wave Energy and Frequency of Cyclonic Events

- Decadal Analysis of Cyclones in Arabian Sea from 1890 to 2020 (Changes Per Annum)
  - ✓ Depressions – 1.07 %
  - ✓ Cyclonic Storm – 0.02 %
  - ✓ Severe Cyclonic Storm – 0.35 %
  - ✓ Overall – 1.44 % per year



- Analysis of Annual Wave Power from 1980 to 2020 at Chellanam Coast, Kerala
- Wave Power = E * C_G = f (H^2 , T)
  - ✓ Increase of 98 kW / m per Year
  - ✓ Increase by about 0.5 % per Year
- Understanding future trends is very essential for design of any Coastal Management Strategy

Estimation of Inundation due to Sea Level Rise on Coast

Simple inundation:

- Inundation is assumed to be the elevation contour corresponding to the sea level rise.

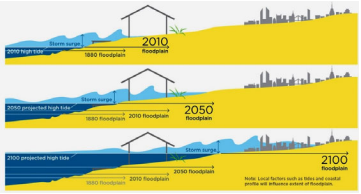
Bruun Rule:

- It assumes that the upper beach is eroded as the shore profile moves landward (Bruun, 1962).
- Shoreline retreats by 50 to 100 times SLR depending on the nearshore profile slope

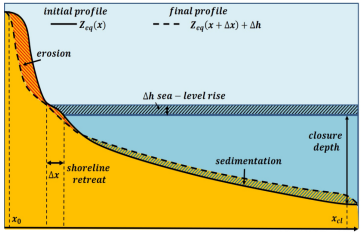
Both these methods has limitations but still being used because of their simplicity.

Numerical Models:

- Process based morphological models for reliable estimation of the area of inundation due to sea level rise.

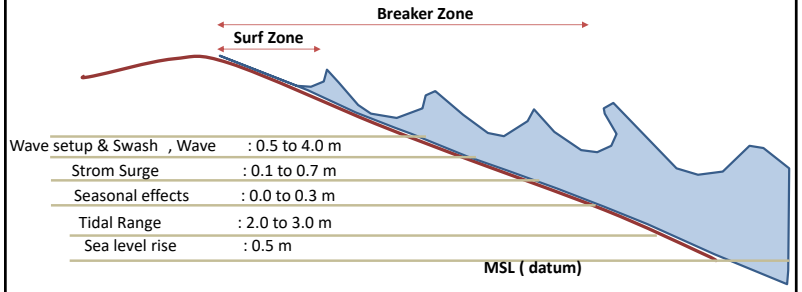


Change in Flood Plane



Change in Coastal Morphology

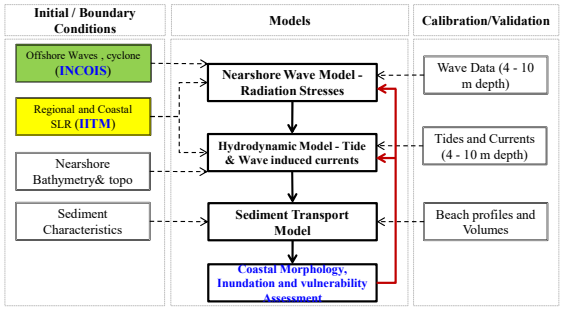
Combined effect of Sea Level rise on coast



Proposed Methodology Using Process Based

- A Process based Coastal Inundation and morphological model study will be carried out for reliable estimation of shoreline changes and inundation areas due to Sea Level Rise and Climate Change.

Coastal Inundation & Morphological Model -- Flow Chart
(Ranasinghe, 2016, Dastgheib *et al.*, 2016 and Chowdhury *et al.*, 2020)

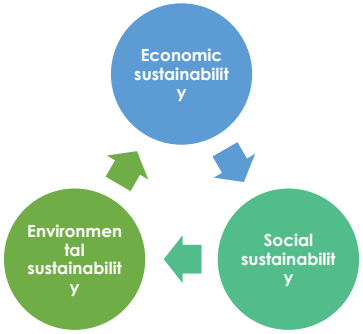


S.No	Location	Reason for Consideration of the sites
1	Mumbai, Maharashtra	Island City & financial capital of India subjected to frequent urban floods
2	Chellanam, Kerala	Subjected to extreme erosion & coastal flooding during cyclones & Monsoon
3	Pondicherry	Extreme eroding coast and protected by varied costal protection strategies.
4	Visakhapatnam	Strategic Location for Indian Navy subject to severe erosion in recent times.
5	Lakshadweep Islands	Low Elevated small Island subjected to erosion and flooding during cyclones.

Blue Economy : Opportunities and sustainable concern
Speaker: Dr. Uma Sankar Panda
Scientist-E, NCCR, Ministry of Earth Sciences, Govt. of India.
Date: 05.05.2022

Outline

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



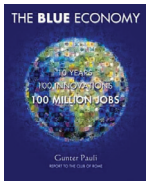
Blue Economy

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

The World Bank

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

Prof. Gunter Pauli



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

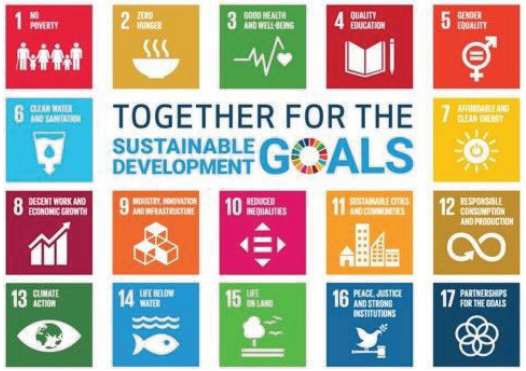
Blue Economy Concept

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

UN Sustainable Development Goals

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

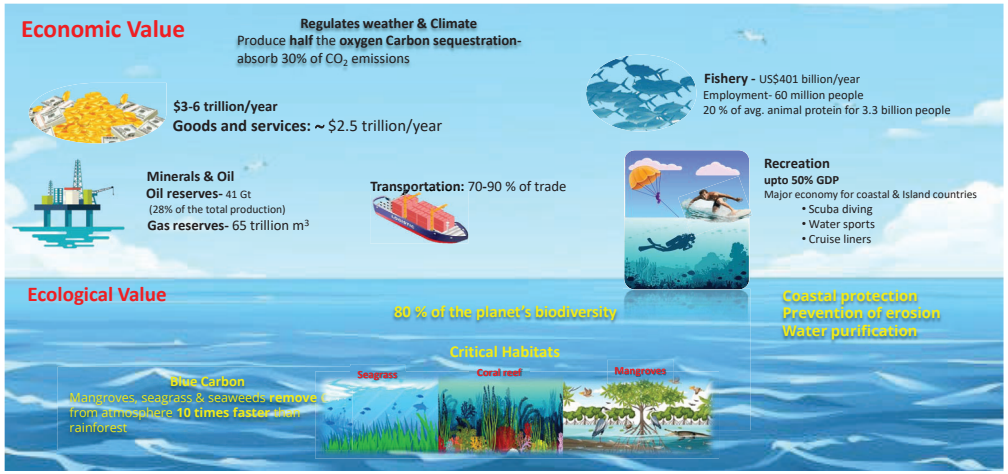
15 Years **17** Goals **169** Targets **230** Indicators



3 Pillars of SDG

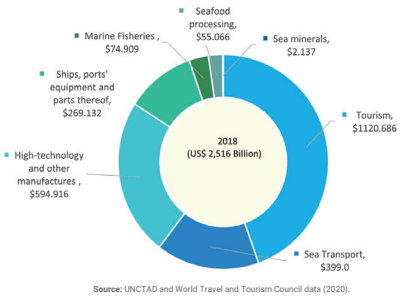
- Economic growth
- Social inclusion
- Environmental sustainability

THE OCEAN



The Blue Economy
>> *Economy of the future*

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



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

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

Sustainable Blue Economy Sector

- Harnessing renewable energy
- Tourism — Sustainable tourism
- Sustainable Fisheries & Aquaculture — Improved management, sustainable protection of key habitats (fisheries, aquaculture)
- Governance — Reduce pollutants, Protect & conserve marine life, Reduce conflict
- Smart shipping to reduce environmental impact
- Climate Regulation — Protect coastal communities

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

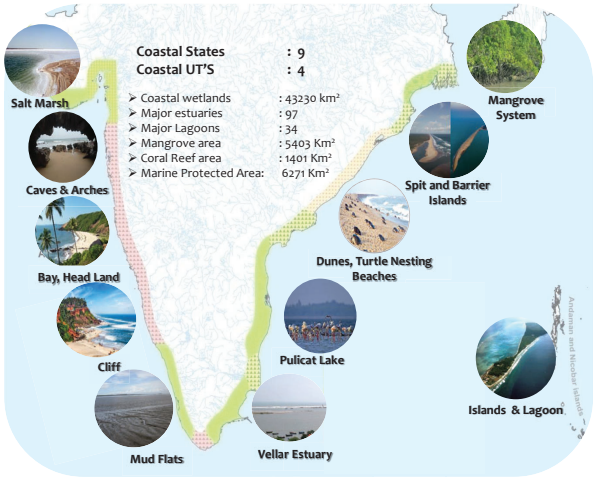
Blue economy !

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

Challenges to Ocean Economy

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

Coastal Systems : Benefits

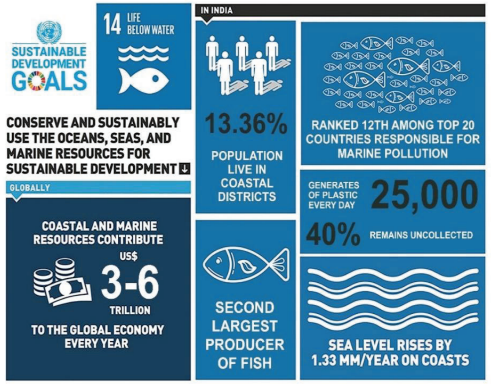


Challenges in India

Indian Marine System

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

Challenges

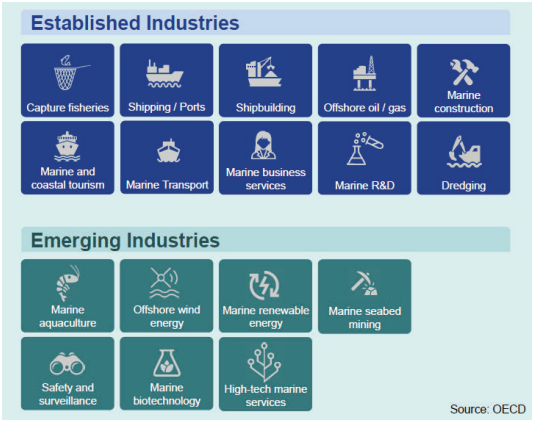


Source: United Nations in India

Issues and Problems → **Challenges and Opportunities**

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

Blue Economy – Potential Industrial Opportunities



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

Emerging Sectors

- **Tourism**
  - Beach tourism
  - Cruise ships
  - Blue Flag accreditation
- **Fisheries**
  - Recreational
  - Commercial
  - Mariculture
  - Cage culture
- **Conservation & environmental protection**
  - MPA
  - Goods and services
  - Amenity values
  - Ecosystem based services
- **Maritime transport & ports**
  - Maritime industry
  - International shipping
  - Port and harbour facilities
- **Offshore Petroleum**
  - Crude oil
  - Natural gas
- **Dredging & aggregate extraction**
  - Sand mining
  - Port dredging
  - Deep sea mining

Opportunities of Blue Economy with Changing climate and environment

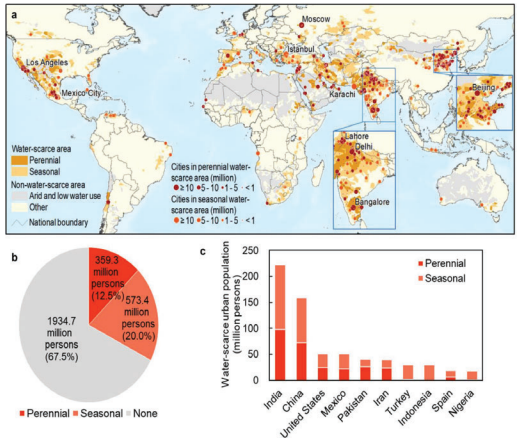
- **Water** – Desalination, dams etc.
- **Food** – PFZ, Biotechnology, culture etc.
- **Energy** – Wave and tidal, oil, Gas, etc.
- **Transport** – shipping, tourism
- **Resources** – Deep sea mining, critical habitat ecosystems
- **Pollution-** Green technologies, STPs, restoration etc.
- **Climate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

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

Sustainable concerns – SDGs

Water

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



Water

Sustainable Development Goals: Vision 2030

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

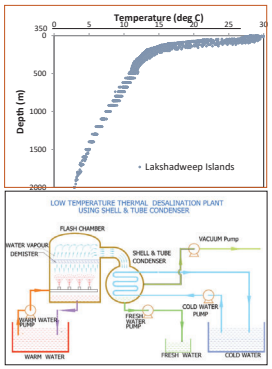
Desalination Methods- sectors

- Distillation
- Membrane
- Hybrid systems
- LTTD Technology

LTTD Principle – Technology demonstrated

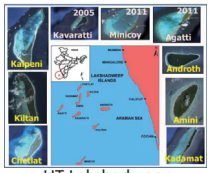
- The temperature difference is utilized to produce potable water by evaporating surface sea water at low pressures and condensing the resultant fresh vapor with cold water.

Innovative Technology : Low temperature Thermal Desalination

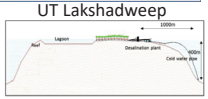


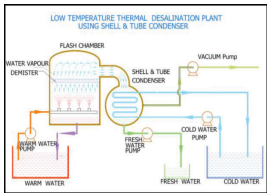
Desalination: Low Temperature Thermal Desalination for Remote Islands

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

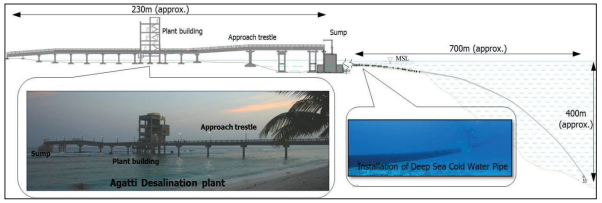


UT Lakshadweep





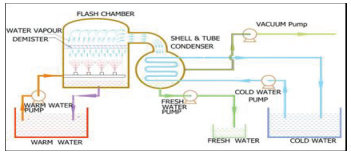
LTTD Process



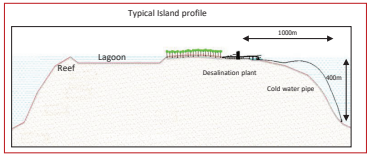
Plant Configuration

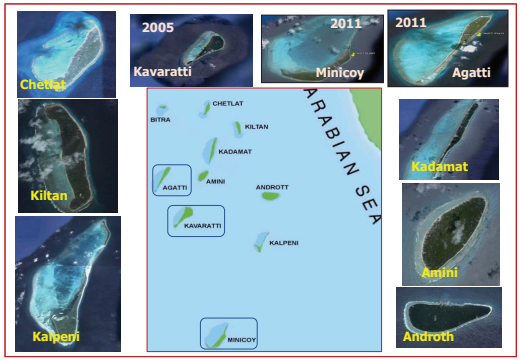
Establishment of Desalination Plants in 6 islands of UT Lakshadweep

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



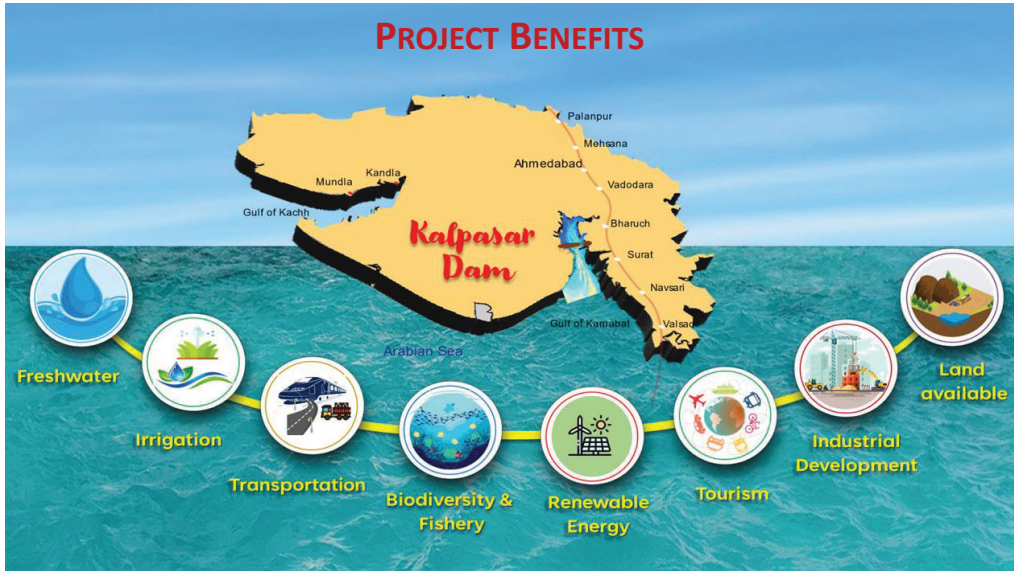
Schematic of LTTD concept





Kalpasar Dyke Project

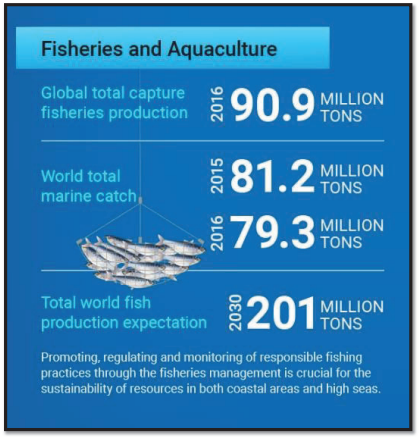
- Saurashtra of Gujarat is facing severe water scarcity.
- To overcome the problem Govt. of Gujarat intends to create fresh water reservoir by constructing a multipurpose dam across Gulf.
- Components of the Project
  - ✓ 30 km Earthen Dam with Spillways
  - ✓ Narmada diversion canal
  - ✓ Irrigation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



Food: Living Resources (*Fisheries & Aquaculture*)

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

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



Food: Living Resources

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

Open cage Culture

Mud Crab Culture

Aquaculture and MPA Employment Opportunities

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

Biotechnology

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

Electrofloculation of marine micro algae

Micro algal dry biomass (25 kg)

Oil and lutein extracted from algae

Drugs from sea

Courtesy: NIOT

Marine Biotechnology Research & Development

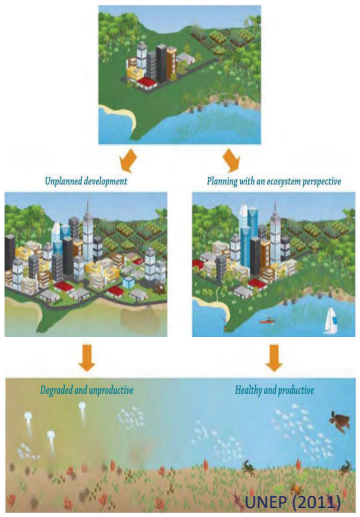
- Aquaculture, whereby new methodologies will help in:
  - selective breeding of species,
  - increasing sustainability of production,
  - preventive therapeutic measures,
  - use of zero-waste recirculation systems
- Marine biotechnology is related to:
  - the development of renewable energy products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

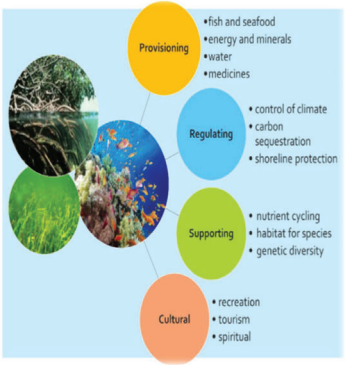
Maritime Education and Training/Circular Economy Employment Opportunities

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

Ecosystem-based approach

>> towards Sustainable Development of Coastal ecosystems and urban areas

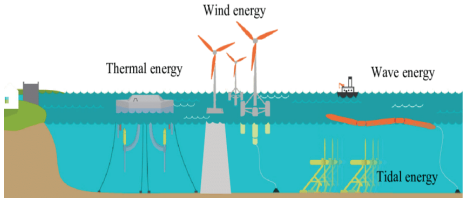




Energy : Renewable

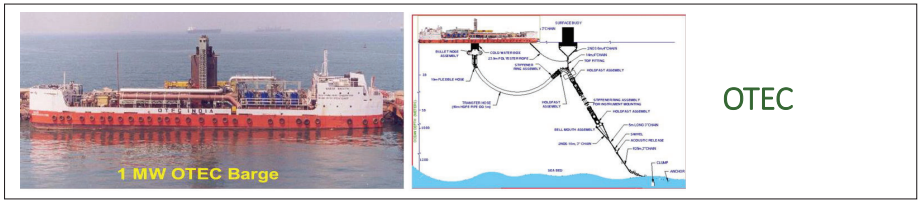
Sustainable Development Goals: Vision 2030

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



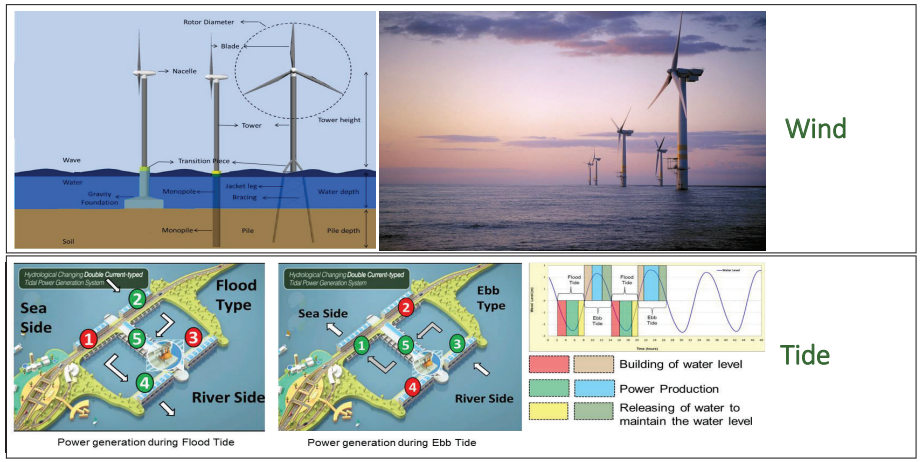
- The world population is expected to increase to an estimated 9 billion people in 2050,
- 1.5 times more
- Increase demands on fossil fuels
- **"blue energy - Ocean"**
  - wind,
  - wave,
  - tidal,
  - thermal,
  - biomass sources

Energy : Renewable



Courtesy: NIOT

Renewable Energy

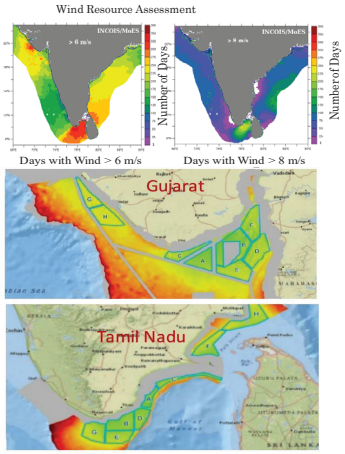


Offshore Wind Energy

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

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

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



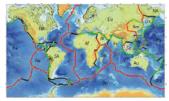
Minerals: Nonliving Resources

Sustainable Development Goals: Vision 2030

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

Minerals:

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



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

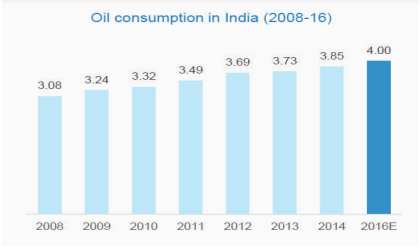
offshore drilling? / Deep Sea Mining

Oil and Gas : Nonliving Resources

Oil and gas - 37 % of total energy consumption.

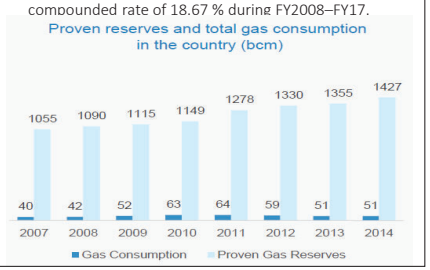
OIL

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



GAS

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



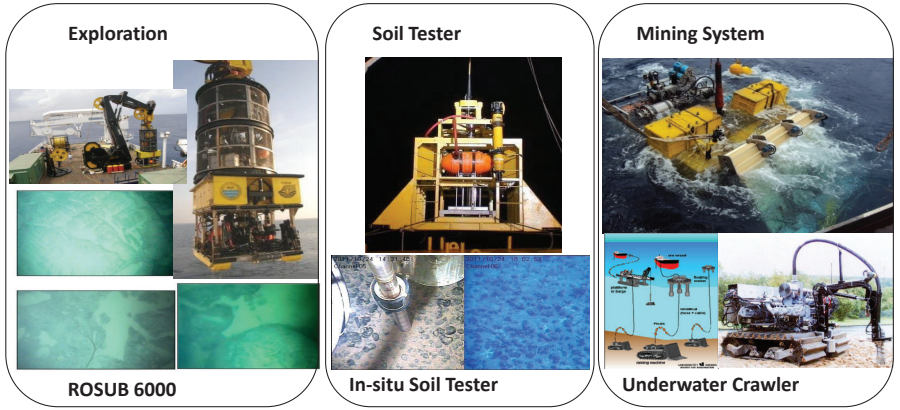
Deep Sea Mining Resources

Gas Hydrates

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

Courtesy: NIOT

Mining – Technological demonstration



Courtesy: NIOT

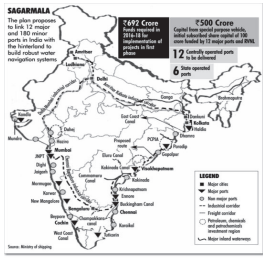
Transportation: Seaports & Shipping

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

Marine Transportation - India

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

Sagar mala – an opportunity development.



Tourism

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

Tourism

- Foreign tourist increasing at a rate of 7 % over 2005–15.
  - ✓ 2015 – USD 147.7 billion.
  - ✓ 2022 – USD 418.9 billion
- The country's big coastline is dotted with a number of attractive beaches.
- Improve infrastructure for activities like; Angling, Swimming, Water Skiing, Surfing, Scuba diving and Beach Front resorts
- Important to integrate principles of sustainable development and environmental protection

Tourism and Marine Renewable Energy/Offshore Employment Opportunities

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

Coastal Pollution

Pollution impacts

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

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

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

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

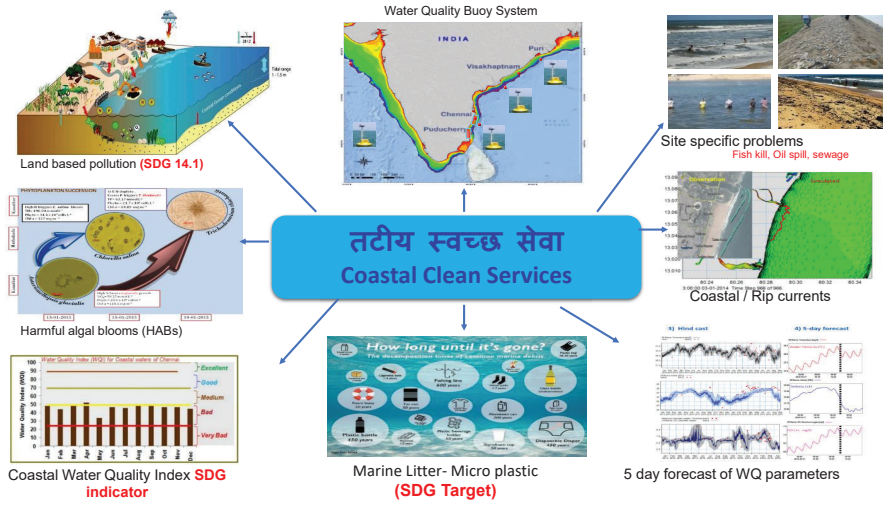
MARINE AND COASTAL POLLUTION

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

Source: WHO (2016)

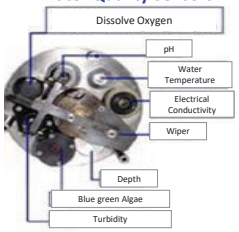
Action on Pollution can achieve multiple SDGs

Coastal Water Quality Monitoring and Prediction System



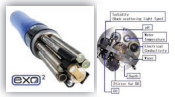
Coastal Water Quality Buoy – Realtime monitoring

Water Quality Sensors

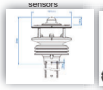


Sensors

Water Quality sensors YSI Exo-2 WQ Sonde



Metrological sensors



Current meter

Dashboard – Data display

Meteorological Sensors

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

Water Quality Sensors

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

Oceanographic Sensors

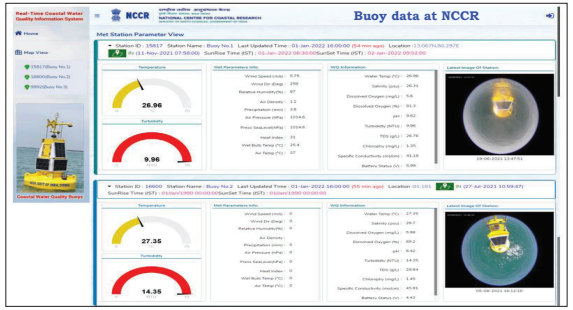
1. Current Speed; ±5m/s (1%)
2. Current Direction; 0 -359 (1°)
3. Wave Height; (±0.5cm)
4. Wave Period; (0.001s)
5. Wave Direction; 0-360° (±4°)

WQ Buoys – off Puducherry

Water Quality Buoy : Deployment & Data

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

Unveiling of Buoy

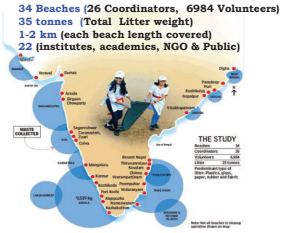


Chennai:
Location: 13.067191 N, 80.297576 E
Depth: 10m
Deployment On : 07 / 03/ 2021
Data (10min) : NCCR , Sate government
Meteorology, Water quality

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

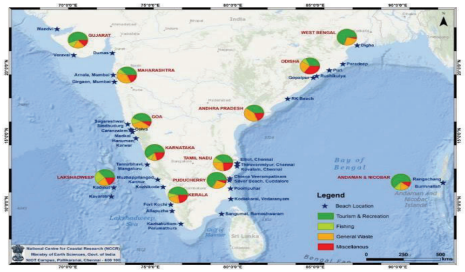
Marine Litter and Microplastics

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



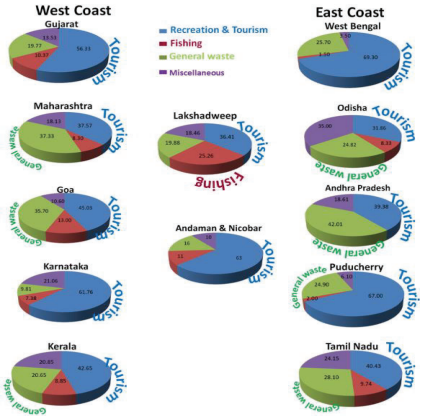
Marine Litter & Microplastics

Coastal Cleanup Day



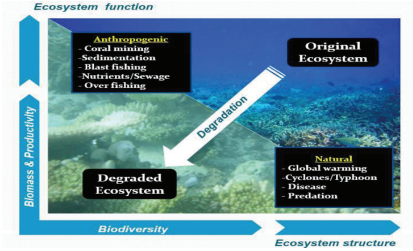
- **34 Beaches, 26 Coordinators, 6,984 Volunteers (ICG, Schools, College, Institutes, NGO & Public)**
- **Total litter : 34.993 tonnes (Plastics & Glass)**
- **Major source: Recreation & Tourism, Fishing**

State-wise composition of Beach Litter



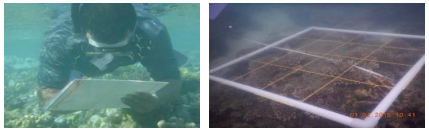
Restoration of coral reefs at Gulf of Mannar

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



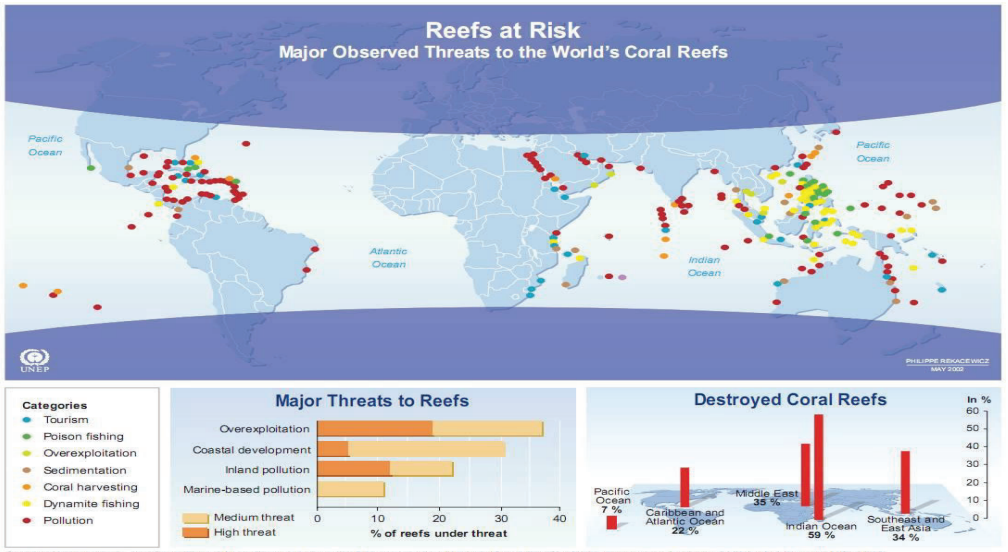
Coral Reef Ecosystems in India
- Gulf of Mannar
- Lakshadweep Islands
- Malvan, Maharashtra
- Andaman & Nicobar
- Gulf of Kutch

Monitoring – Status of coral reefs



Bleaching – a major threat to coral ecosystem

Restoration



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

Climate Change

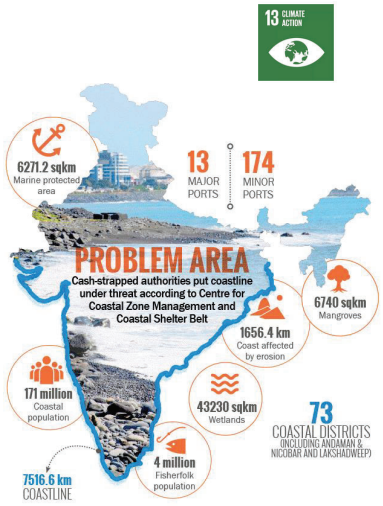
Sustainable Development Goals: Vision 2030

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

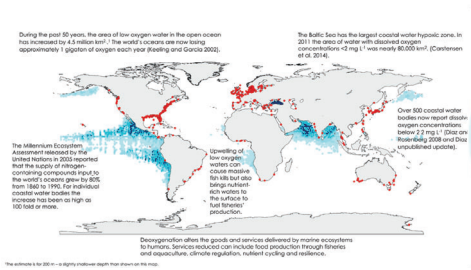
Threats to the Coastal Zone

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

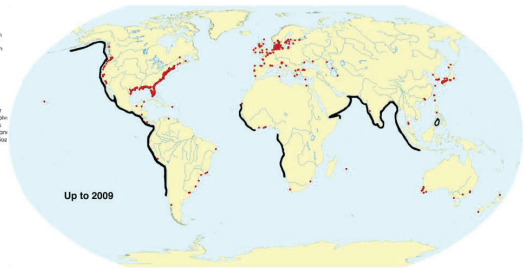
➢ Coastal and Marine Pollutions - land based, oil spill etc.
➢ Coastal Security



Oxygen Minimum Zones and Coastal Hypoxia Zones



OMZs (blue) and areas with coastal hypoxia (red) in the world's ocean
(Isensee et al., 2015; Breitburg et al., 2018; including oxygen effects from Keeling and Garcia, 2002; Diaz and Rosenberg, 2008; Carstensen et al., 2014).



- **550 Hypoxic Areas**
- **60 Hypoxic Areas in recovery**
- **250 Eutrophic Areas in Danger of Hypoxia**
- **OMZ Touching 1,150,000 km² of Seabed**

Helly & Levin 2004
Diaz et al. 2010

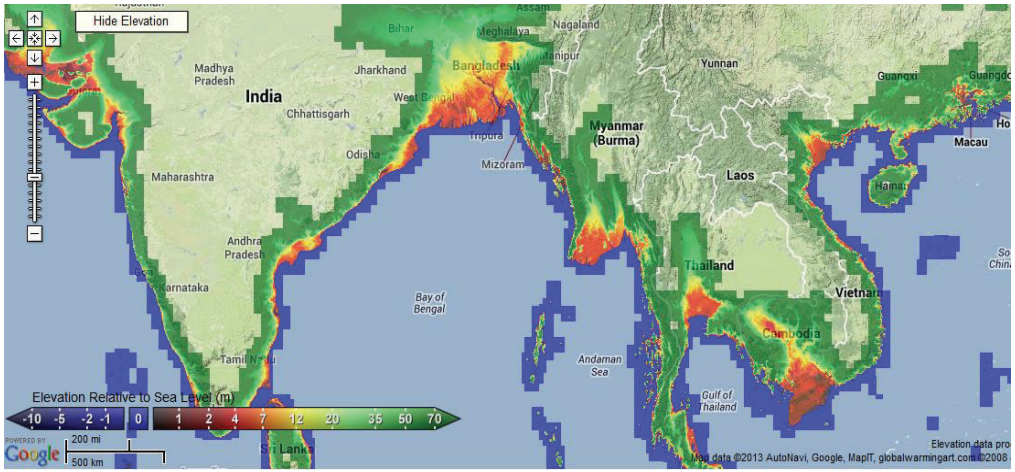
Coastal Hazards

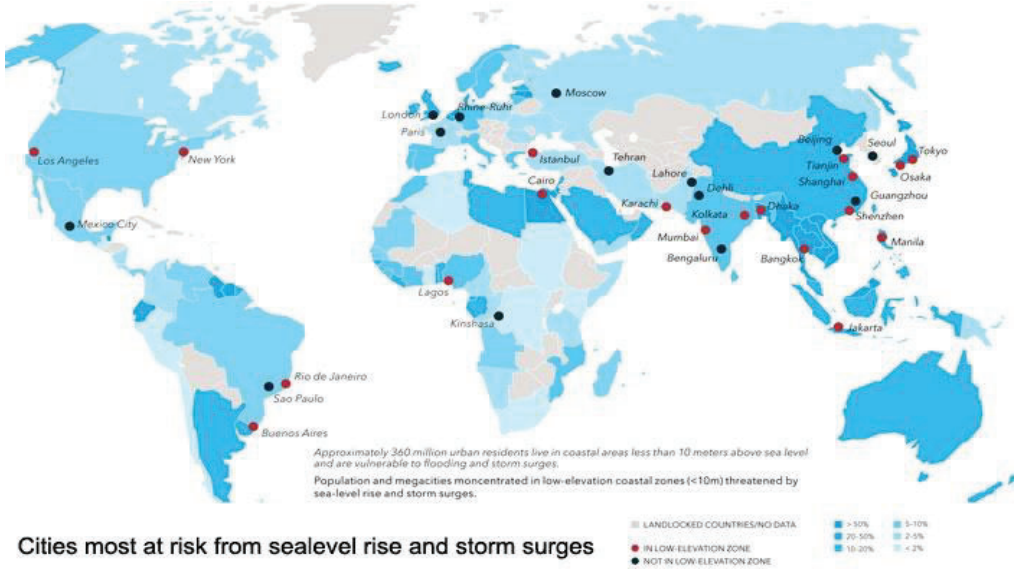
Coastal hazards are natural and human-made hazards that occur at the interface between the ocean and the shoreline. Coastal hazards are categorized as rapid-onset (fast moving) or slow-onset hazards

Rapid-Onset Hazards
Storms
Flooding
Storm Surge
Tsunamis

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

Sea Level Change in Southeast Asia

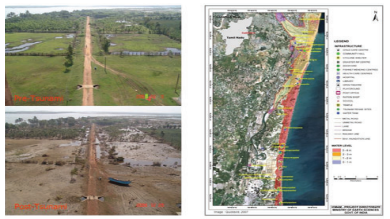




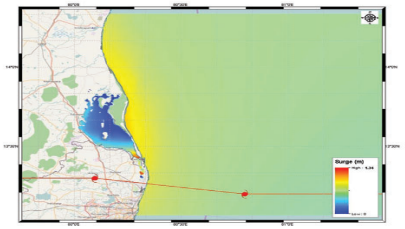
Cities most at risk from sealevel rise and storm surges

Coastal inundation

Tsunami



Strom Surge

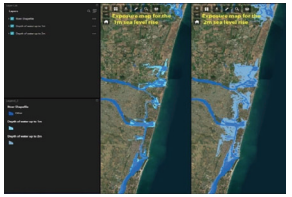


Urban Flood

Chennai
1 Dec 2015 : 494mm in 24 hours,

Mumbai
26 July 2005 : 944mm in 24 hours,

Sea Level Rise



Integrated Flood Warning System

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

Developed and made Operational

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

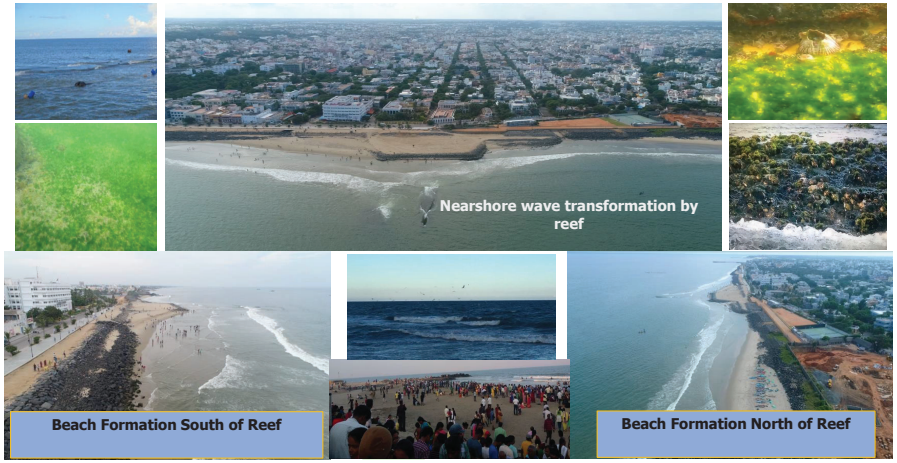
In the Pipeline

- iFLOWS-Kolkata

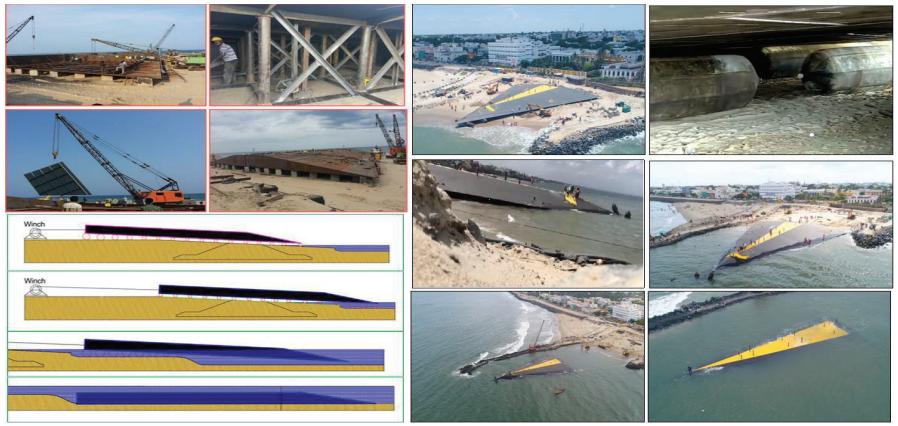
A collaboration of MoES Institutes (IMD, NCMRWF, IITM, NCCR)

Erosion along Pondicherry coast

Beach Restoration along Pondicherry coast



Major Challenge Launching Wedge Reef



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

60

Puducherry- Beach Restoration

61

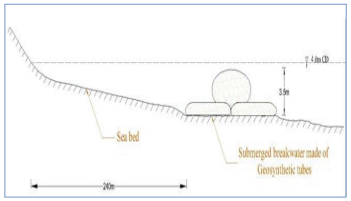
Status of Puducherry beach- Before and After nourishment

Before

After

Kadalur Periyakuppam- Erosion

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



Kadalur Periyakuppam-Beach Restoration

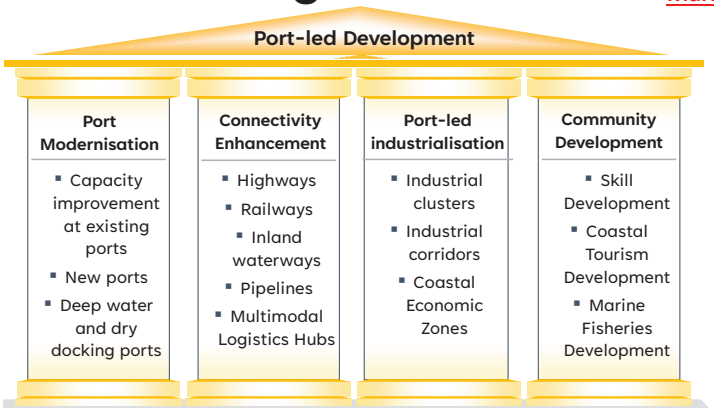
Developments initiated by India

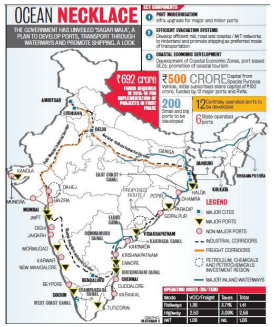
- The Sagarmala Project
- O-SMART
- Deep Ocean Mission
- Integrated Coastal Zone Management (ICZM)
- Coastal Economic Zones (CEZ)
- Marine Spatial Planning (MSP)
- National Fisheries Policy

for promoting 'Blue Growth Initiative'

Sagar Mala

Maritime India Vision 2030





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

Deep Ocean Mission

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

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

Marine Spatial Planning (MSP)

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

India – Planning Procedures and Policies

LAND

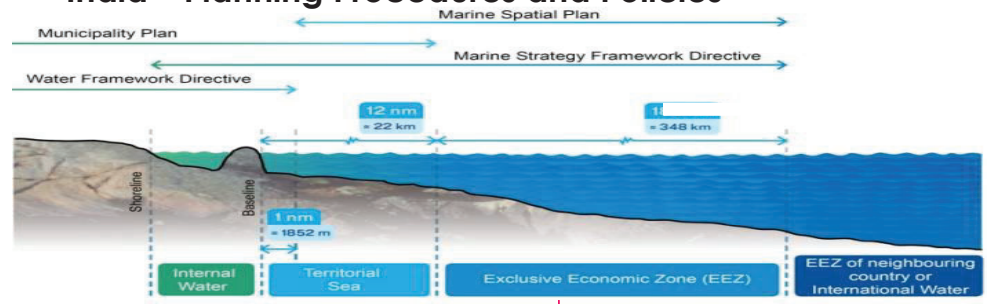
Landuse Planning - Central Government prepares Model Acts, Policies / programmes and Guidelines for the benefit of the State Governments

COAST

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

Marine Spatial Planning

India – Planning Procedures and Policies



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

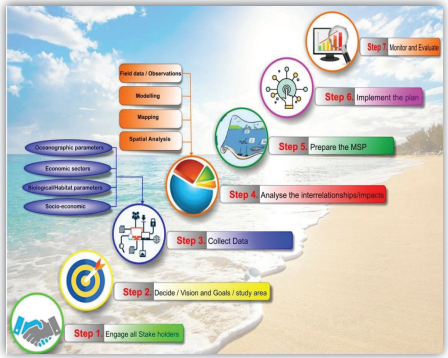
ICZM Plannning - Environment and Forest

ICZM is a subset of MSP

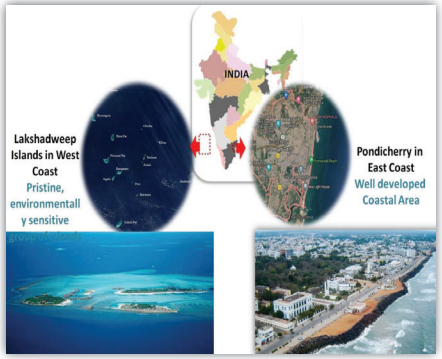
Marine Spatial Planning

Marine Spatial Planning – Integrated Ocean Management

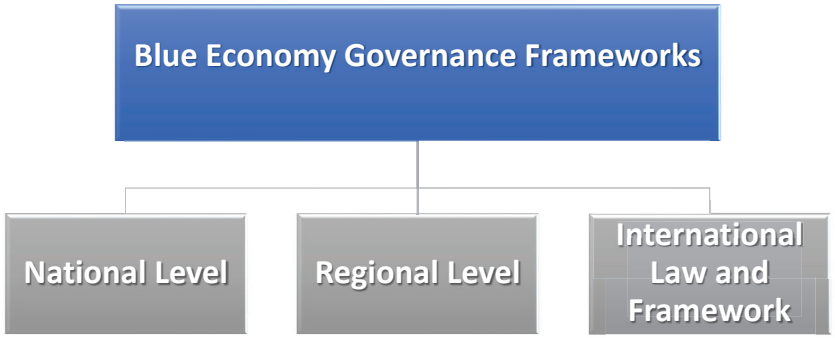
MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in coastal and marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process.



Workflow in Marine Spatial Planning



Pilot Areas : Puducherry and Lakshadweep



National Level

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

Regional Level

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

International Law and Framework

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

Global Agreements that Regulate the use of Oceans

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

Twelve key provisions:

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

Moving Forward

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

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

A sustainable Blue Economy -

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

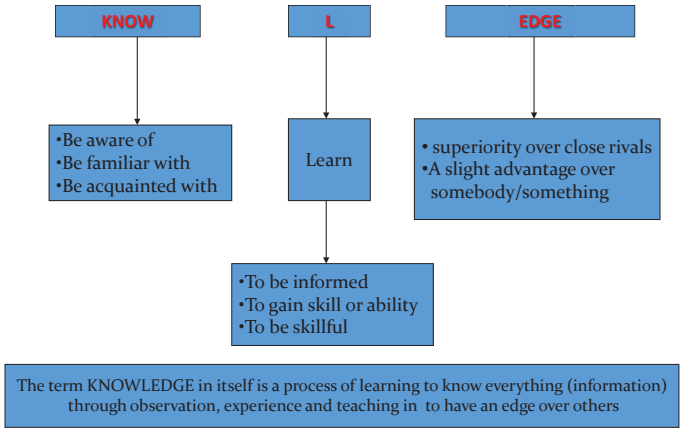
Knowledge Management in Climate Change
Speaker :Dr P K Bhattacharya
Associate Director & ENVIS Coordinator, TERI.
Date : 05.05.2022.

Knowledge Management in Climate Change

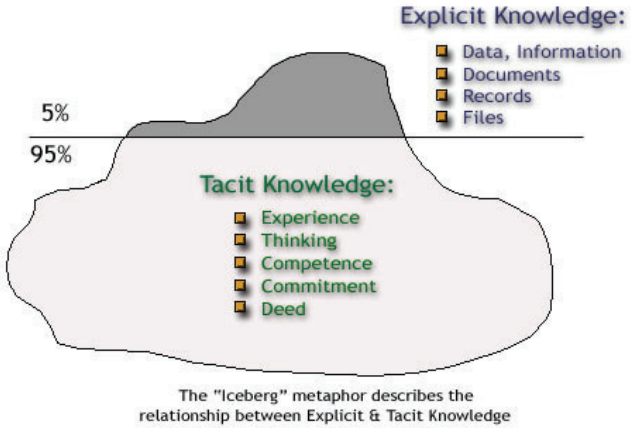
Dr P K Bhattacharya
Associate Director & ENVIS Coordinator, TERI

teri Creating Innovative Solutions for a Sustainable Future

Decoding KNOW…L….EDGE

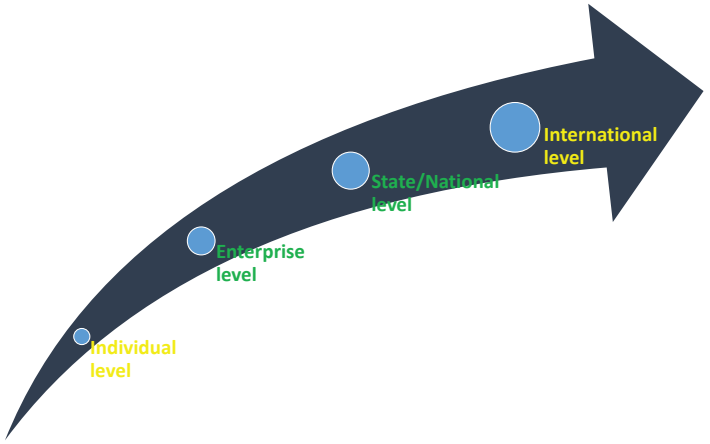


Knowledge Iceberg



The "Iceberg" metaphor describes the relationship between Explicit & Tacit Knowledge

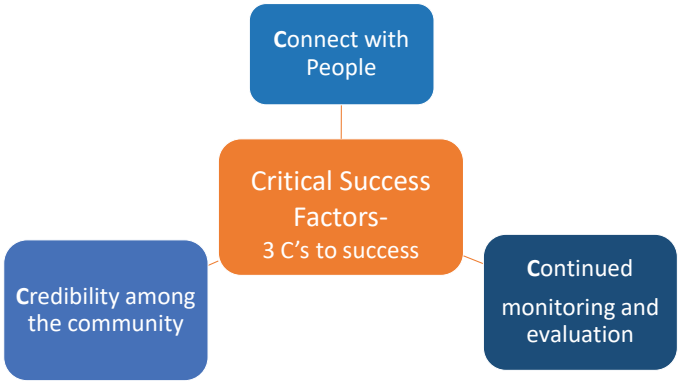
Knowledge Management Types



New “My KM.in “

Integration with Social Media & Analytics

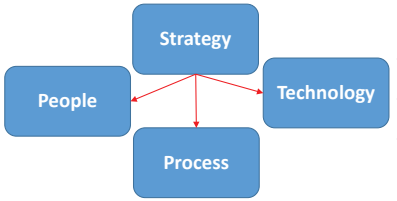
Critical Success Factors



Transformational KM Strategy

- Which factors are crucial for research that can be addressed through KM?
- Which knowledge resource adds most value, and what investments are required to realize this value
- What are the highest priority initiatives

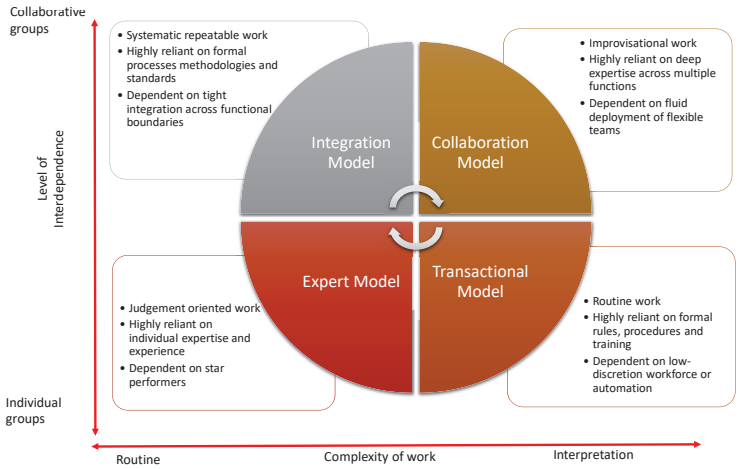
- How do you create a culture
- Which people need to be empowered to contribute the right knowledge
- Are priorities aligned with measurement



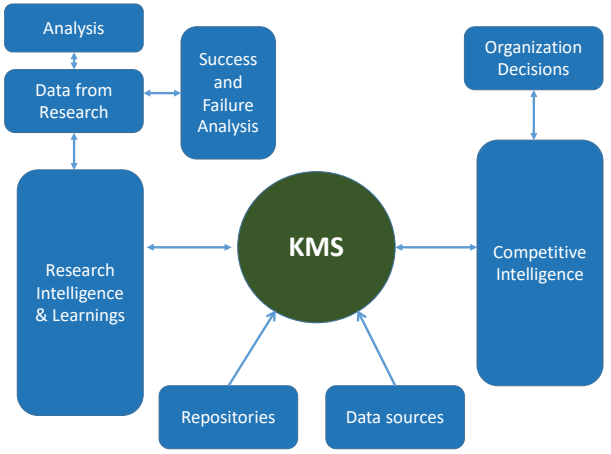
- What tools are currently in place?
- What tools are needed to enable the environment
- How do you fill the gap

- Area the right processes in place to:
  - Capture, refine and create knowledge
  - Disseminate, share and apply knowledge to deliver research/business value

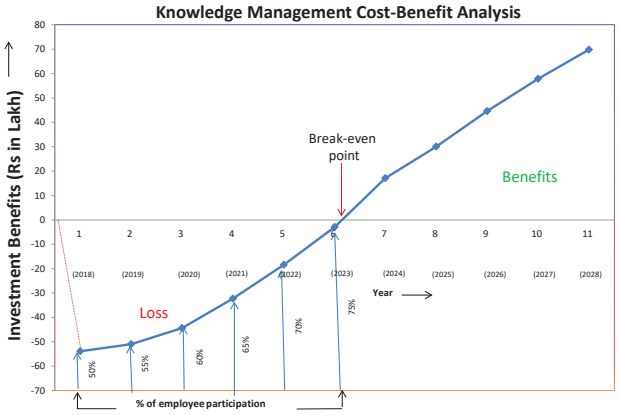
Knowledge Management Framework: Work Models



Sustainable Competitive Advantage

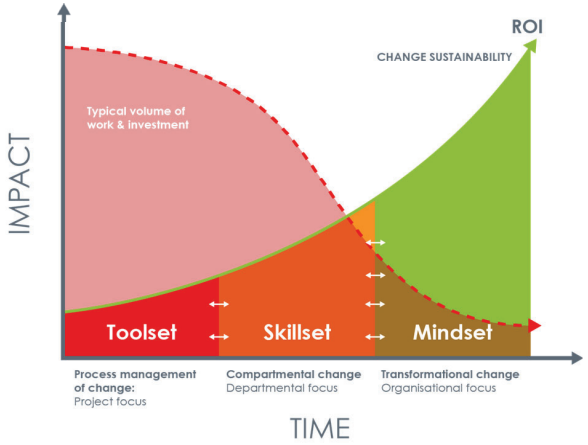


Knowledge Management RoI Benefits



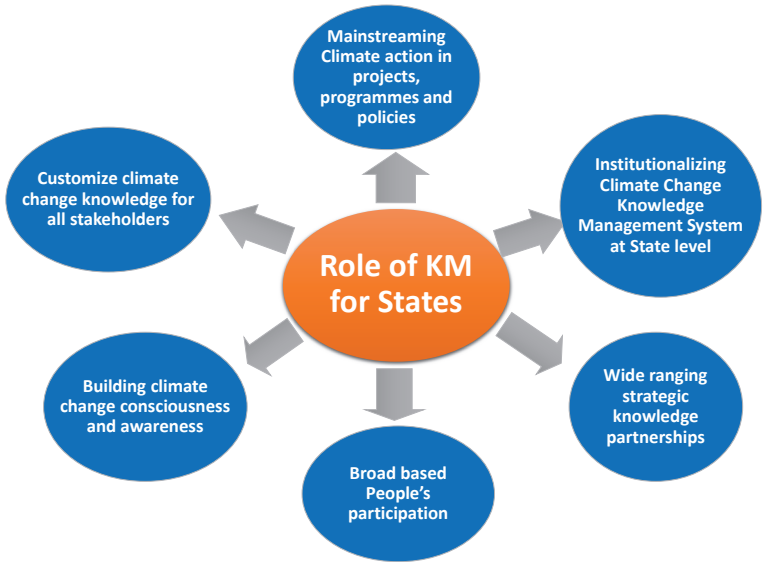
- All knowledge items available for consultation as required
- Organization memory retained
- Work duplication minimized
- Saves time for productive work
- Collaborative work possible
- Knowledge driven value added services creation are possible through derived competitive advantages
- Evidence based decision making leads to error minimization at community level

Knowledge Management Strategy
(Impact Measurement)



Value of Knowledge Management in Climate Change

- Knowledge Management facilitates climate change best practices and examines barriers to use of knowledge for climate change mitigation, adaptation and disaster risk reduction
- Immediate benefits:
  - Knowledge professionals and researchers to improve practices and come together as a community to solve a local/global issue
  - Data scientists to leverage KM and artificial intelligence (AI) technologies to build and analyze large datasets to support climate action
  - Donors, to contribute towards significant societal benefits made possible through better KM driven assessment and its contribution towards more informed decision-making



Key Activities of Climate Change KM

- Education and Training
- Resource Development
- Networks and Strategic Partnerships
- Engaging Communities
- Knowledge Portal
- Communication and Outreach

Education and Training

Low levels of awareness and limited understanding of climate change issues is an impediment for implementing adaptation measures

- Organize and capture proceedings of technical sessions, workshops, dialogues on Climate Change
- Develop education and training resource material

Target Group: Research professionals, Policy makers, Communities, Children and Youth

Purpose

- Build capacity of all interested stakeholders and encourage public participation for devising adequate response measures for Climate Change
- Open lines of communication and build trust and ownership for the climate change activities

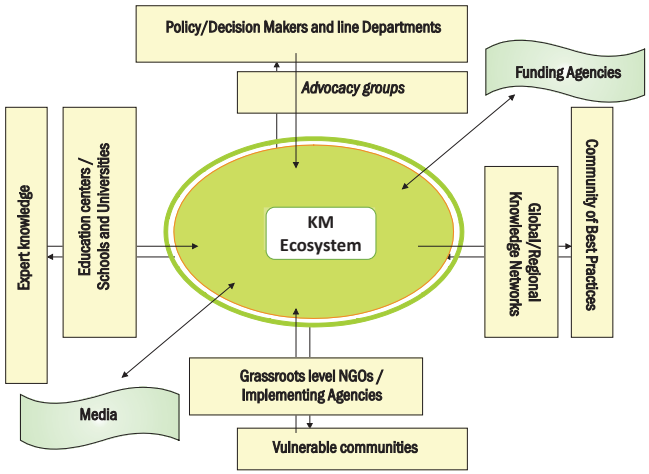
Knowledge Resource Development

Inadequacy of information may lead to declining stakeholder interest, and may not be possible to generate all the resources at a single source

- Employing innovative ways to engage various sources of knowledge by
  - collaborating with different partner organizations and stakeholders in sourcing and generating new knowledge catering to user needs
  - motivating, facilitating and coordinating newer research relevant to the State
- KM should ensure **Quality**; **Quantity**; **Reliability** and **Accuracy** of the knowledge resources

- Collecting research studies and scientific assessments including: *Research studies to develop climate scenarios for the State*
- Compilation of latest scientific studies and reports on Climate Change
- Climate Change Policies and latest developments
- Inventory of experts and organizations who are working in different areas/ themes
- Information about best practices and FAQs
- Policy briefs specific to the State
- Audio/Video clips on climate change

Networks and Strategic Partnerships in State



Scope of KM work
- Identify knowledge needs and gaps
- Stakeholder mapping
- Inventory of good practices

Building Networks
- Inventory of relevant forums/knowledge networks with a brief description of their topical focus
- Networks could be theme specific engaging policy makers, scientists and members from the civil society or specific to user groups e.g network of Children and Youth
- Networks will be facilitated by a moderator

Clear rules and guidelines
- Clear roles and terms of engagement
- Identification of common rules and mechanisms for knowledge sharing and transfer
- Clear guidelines for conflict resolution and an exit strategy

Incentives
- Identify local champions who will recognized and awarded
- The incentives can be financial awards or non-financial which are reputational in nature
- Credit based incentive structure

Climate Change KM in Practice: TERI Cases

Role of TERI ENVIS Resource Partner

Established in 1984 under ENVIS Programme of MoEFCC, Government of India

- **Location:** Knowledge Resource Centre, TERI, New Delhi
- **Operational:** since July 1984
- **Expertise areas:** Renewable Energy and Climate Change
- **Mode of activities:** Research, Surveys, and Trainings/Workshops, GSDP, NES
- **Major features:** GSDP, Research outputs in Renewable energy, Sustainable development, climate change, Online databases
- **Contact us:** www.terienvis.nic.in

- Conducting Green skill Development
- Contributing to National Environment Survey
- Engaged in Community-driven Environmentally Sustainable Village Programme
- Identifying & bridging knowledge gap on RE & climate change research
- Information dissemination through communication tools to support Research and Policy

www.terienvis.nic.in

Major Components

- Case Studies
- Technologies
- Statistics
- GSDP
- Databases
  - ✓R & D Organization
  - ✓Article
  - ✓Experts
  - ✓Ph.D Thesis
  - ✓Environment& Climate Change Abstracts

Green Skill Development Programme (GSDP)

Sustain and Enhance Technical Knowledge in Solar Energy Systems

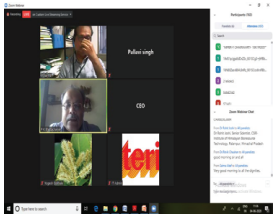
- 18 GSDP trainings conducted in different parts of India
- 7 Ongoing GSDP trainings
- Trained over 780 students; 50% students are earning livelihood

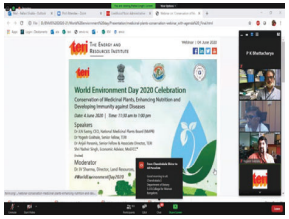
25

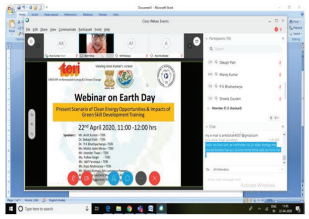
Field Exposure Visits

Solar Installation

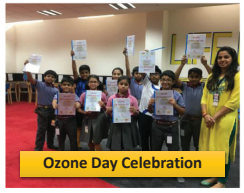
Recent Webinars







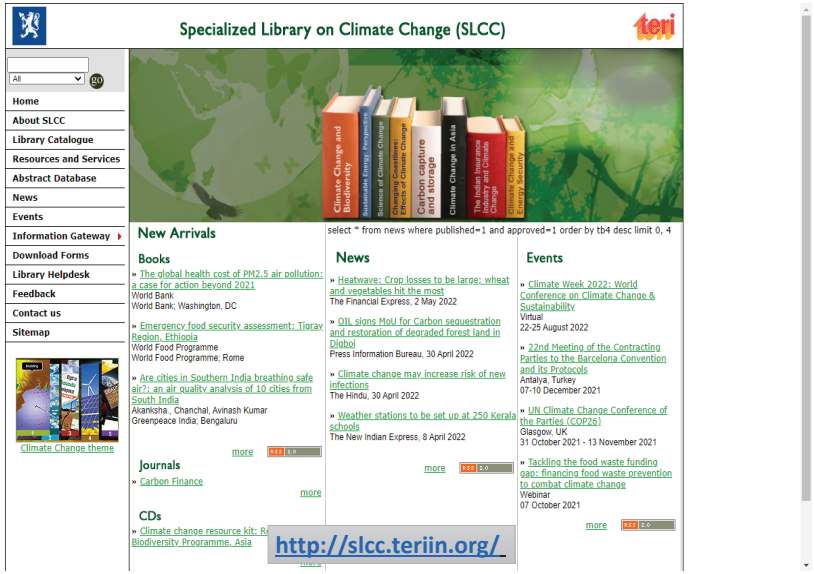
Stakeholder's outreach



Promotion & Outreach

- Promotion of ENVIS through webinars, annual seminar in different parts of India
- GSDP programmes & livelihood generation at different parts of India
- Success Stories of GSDP trainees in MoEFCC Portal
- Promotion of Webinar through MoEFCC twitter handle

- Aggressive promotion through local & online media, community level awareness generation, e-mails of publications, social media campaign etc
- Promotion through online & offline brochures, posters, leaflets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» OIL signs MoU for Carbon sequestration and restoration of degraded forest land in Digboi
Press Information Bureau, 30 April 2022
» Climate change may increase risk of new infections
The Hindu, 30 April 2022
» Weather stations to be set up at 250 Kerala schools
The New Indian Express, 8 April 2022
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Events
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Virtual
22-25 August 2022
» 22nd Meeting of the Contracting Parties to the Barcelona Convention and its Protocols
Antalya, Turkey
07-10 December 2021
» UN Climate Change Conference of the Parties (COP26)
Glasgow, UK
31 October 2021 - 13 November 2021
» Tackling the food waste funding gap: financing food waste prevention to combat climate change
Webinar
07 October 2021
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Climate Change theme
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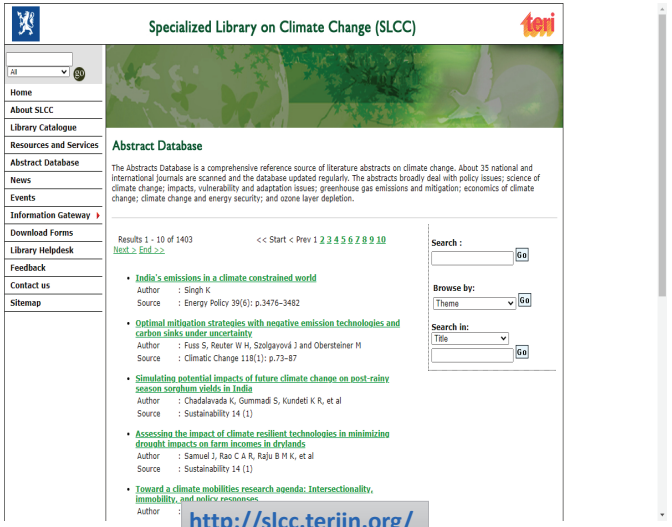
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India's emissions in a climate constrained world
Author : Singh K
Source : Energy Policy 39(6): p.3476–3482
Optimal mitigation strategies with negative emission technologies and carbon sinks under uncertainty
Author : Fuss S, Reuter W H, Szolgayová J and Obersteiner M
Source : Climatic Change 118(1): p.73–87
Simulating potential impacts of future climate change on post-rainy season sorghum yields in India
Author : Chadalavada K, Gummadi S, Kundeti K R, et al
Source : Sustainability 14 (1)
Assessing the impact of climate resilient technologies in minimizing drought impacts on farm incomes in drylands
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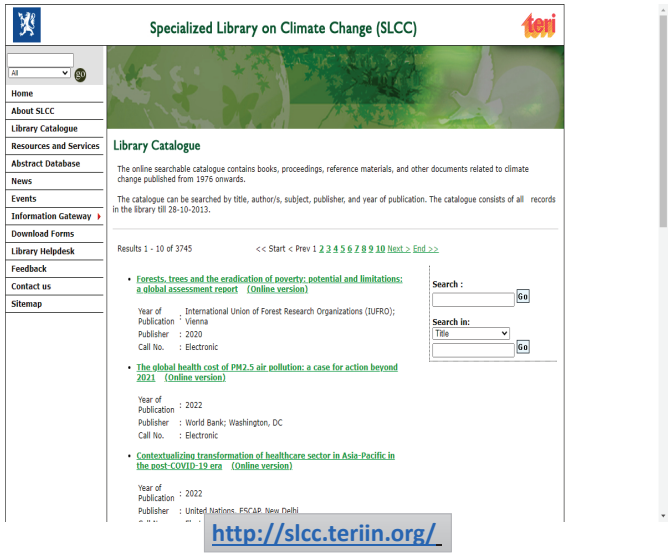
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The online searchable catalogue contains books, proceedings, reference materials, and other documents related to climate change published from 1976 onwards.
The catalogue can be searched by title, author/s, subject, publisher, and year of publication. The catalogue consists of all records in the library till 28-10-2013.
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Call No. : Electronic
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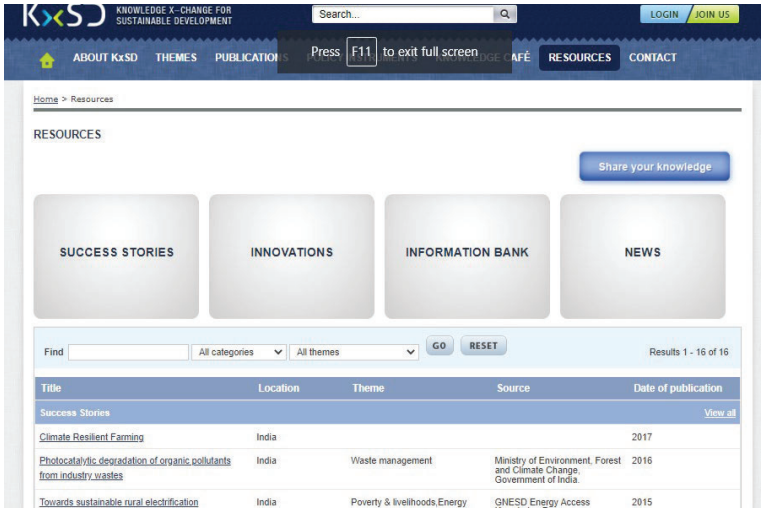

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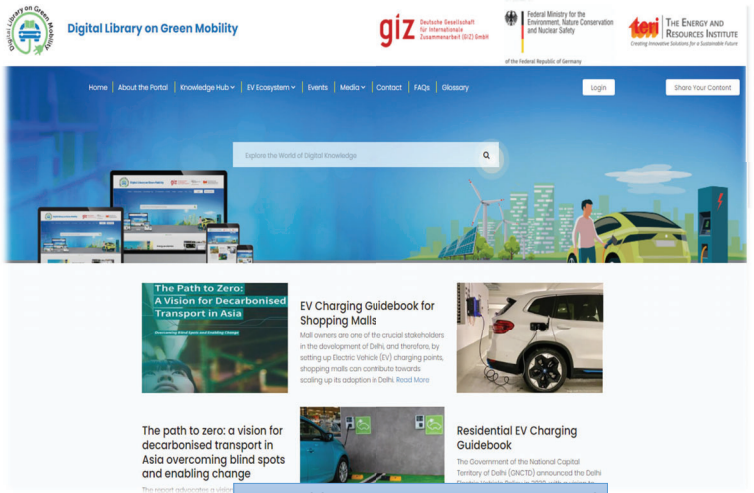

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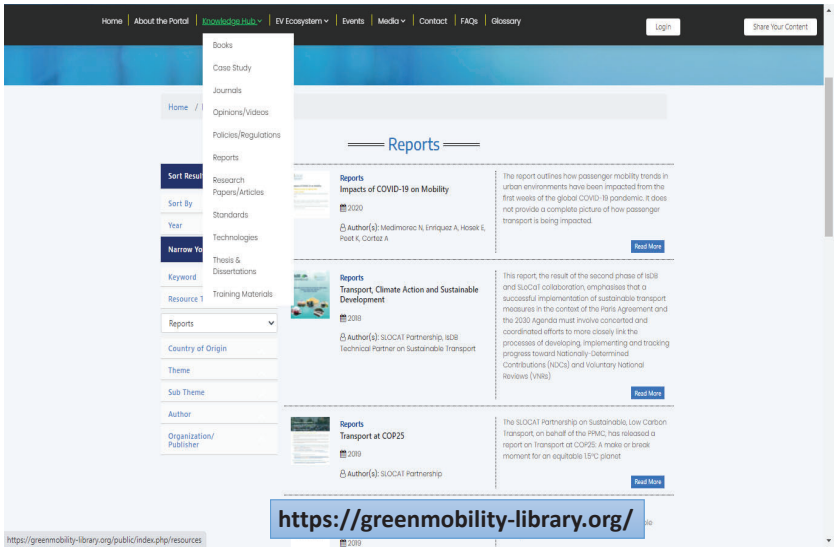

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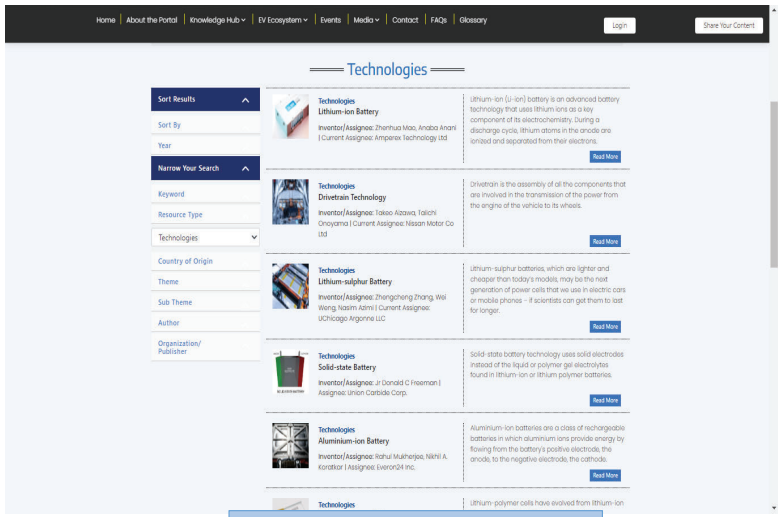

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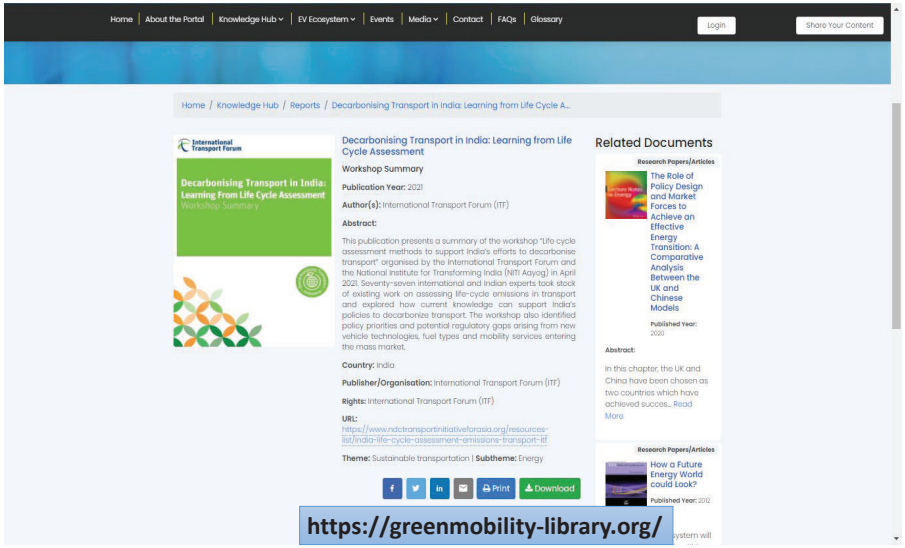
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Workshop Summary
Publication Year: 2021
Author(s): International Transport Forum (ITF)
Abstract:
This publication presents a summary of the workshop "Life cycle assessment methods to support India's efforts to decarbonise transport" organised by the International Transport Forum and the National Institute for Transforming India (NITI Aayog) in April 2021. Seventy-seven international and Indian experts took stock of existing work on assessing life-cycle emissions in transport and explored how current knowledge can support India's policies to decarbonize transport. The workshop also identified policy priorities and potential regulatory gaps arising from new vehicle technologies, fuel types and mobility services entering the mass market.
Country: India
Publisher/Organisation: International Transport Forum (ITF)
Rights: International Transport Forum (ITF)
URL:
https://www.ndctransportinitiativeforasia.org/resources-list/india-life-cycle-assessment-emissions-transport-itf
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Puducherry ENVIS Hub - Status of Environment & its Related Issues
Speaker: Mr. P. Vipin Babu, Scientist (PPCC)/ENVIS Coordinator.
Date: 05.05.2022.

Workshop on Integrating Climate Action in the Development Planning of Puducherry Union Territory

PUDUCHERRY ENVIS HUB
Status of Environment & its Related Issues

Date : 05th & 06th May, 2022

Presented by
P. Vipin Babu, Scientist (PPCC)/ENVIS Coordinator

About ENVIS

❖Environmental Information System (ENVIS) is a Centrally Sponsored Scheme (CSS) funded by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India, New Delhi.

❖Focus: To provide environmental information to the decision makers, policy planners, scientists and engineers, research workers, etc. all over the country.

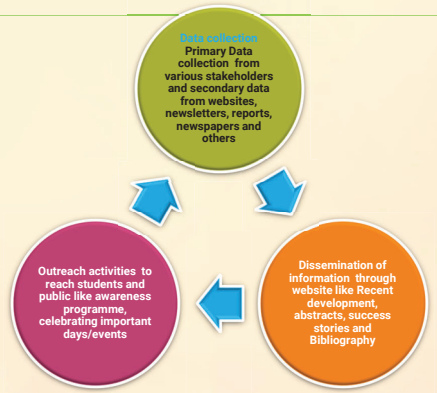
❖ENVIS was conceived as a distributed information network with the subject-specific centres to carry out the mandates and to provide the relevant and timely information to all concerned.

ENVIS Network

Total Number of ENVIS Centres: 66 ENVIS centres
State ENVIS Hub – 31 Nos.
Institutional Resource Partners – 26 Nos.
NGOs Resource Partners – 9 Nos.

About Puducherry ENVIS Hub

- Puducherry Envis Hub functioning from 22nd September, 2005.
- ENVIS centre, Puducherry mainly focuses on special reference to "Status of Environment and Related Issues".



Objectives of Puducherry ENVIS Hub

- **Green Skill Development Programme (GSDP)**
- **Knowledge Products and Infographics**
- **Stakeholder Meeting**
- **SoER preparation**
- **Patchi Mobile app**
- **Web based database** on the State of Environment and related issues
- **Community-driven Environmentally Sustainable Village Programme (CESVP)**
- **National Environmental Survey-GRID Based Resource Information & Decesion Support Systems (NES-GRIDSS)**
- **Environment related Awareness Programmes**

Green Skill Development Programme (GSDP)

The Green Skill Development Programme (GSDP) of the Ministry of Environment, Forest and Climate Change (MoEF&CC) is an initiative for skill development in the environment and forest sector to enable India's youth to get gainful employment and/or self-employment.

The common norms issued by Ministry of Skill Development & Entrepreneurship (MSDE) inter alia, states that the

3-fold requirement has to be met, namely,

i. Domain Specific demand

ii. Skill Training for a minimum period (including practical/on the job training)

iii. Employment oriented Outcome

- All skill development courses to comply with National Skills Qualification Framework (NSQF) of National Skill Development Agency (NSDA) under MSDE.
- Skill training largely focus on technical skills. Training in softer skill sets is not predominant – this is a major requirement of the environment sector.

GSDP Proposals for 2022-23

1. Pollution Monitors: Air and Water pollution -1 Batch per Year
2. Para-Taxonomy including People Biodiversity Register – 1 Batch

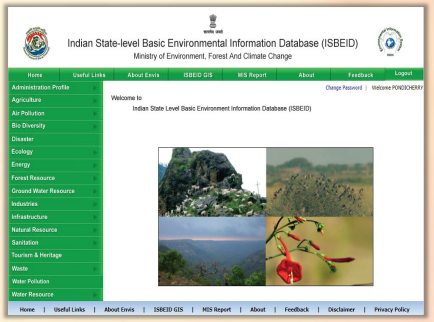
Green Skill Development Programme (GSDP)

- Puducherry Envis conducted certificate course in "Pollution Monitors: Air and Water Pollution" under GSDP. So far, **3 batches** has been conducted.
- **2018 – 2019** - Training Period 38 working days (11th September to 26th October 2018, 260 hours). 19 trainees were participated.
- **2019 – 2020** - Training Period 30 working days (17th February to 21st March, 2020). 27 trainees were participated.
- **2020 -2021** - Training Period 33 working days (10th February to 19th March, 2021). 30 trainees were participated.
- The training module included theoretical, practical, field visits, hands-on training and assignments.
- Training was given by various Experts from various Government Departments, Universities, Institution and NGO's.
- Course completion Report for the year 2018 – 2019, 2019 – 2020 & 2020 - 2021 submitted to the Envis Secretariat.
- The complete details of GSDP Course can be view at: https://sites.google.com/view/gsdp-envis-puducherry/home

Photoclips of GSDP Programme 2018 -2021

Status of data updation in the Indian State Basic Environmental Information Database (ISBEID) Portal

- ISBEID is a web - enabled software developed by the Ministry of Environment and Forests, Government of India under the Environmental Information System [ENVIS].
- The ISBEID software has 17 modules (link to the modules) and will be implemented by all the States/UT ENVIS Centres.
- Puducherry ENVIS Hub updated data in the ISBEID Portal for the U.T. of Puducherry till 2021.



http://isbeid.gov.in/Home_old.aspx

Issues in collection of data/ information from line Departments of State Governments or any other issues.

1. Hardship for getting Environmental Data for ISBEID from Line Departments even after several communication addressed to the Departments.

17 modules

- Administration profile
- Agriculture
- Air Pollution
- Bio Diversity
- Disaster
- Ecology
- Energy
- Forest Resource
- Ground Water Resource
- Industries
- Infrastructures
- Natural Resource
- Sanitation
- Tourism & Heritage
- Waste
- Water Pollution
- Water Resource

Grid-based Decision Support System (GRIDSS) – for Sustainable Management of Natural Resources

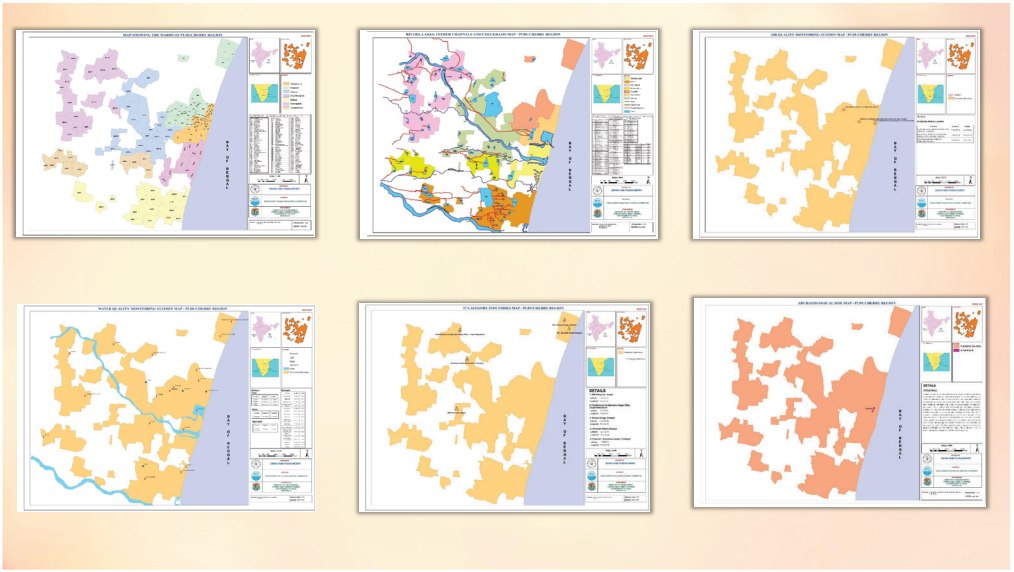
Grid-based Decision Support System - (GRIDSS)

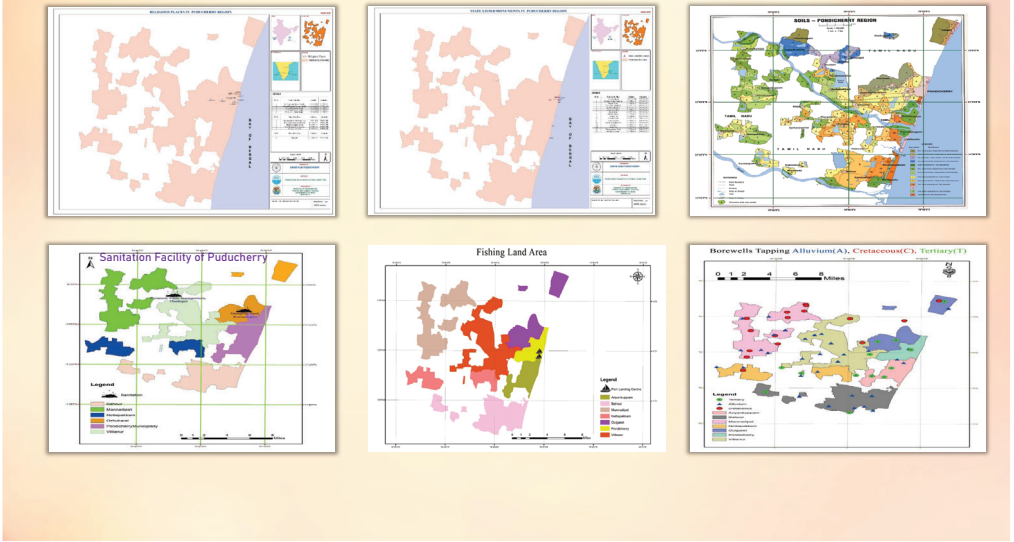
- The National Environmental Survey will be conducted at the district level on a quinquennial basis.
- Districts will be divided into grids of 9 km x 9 km, or any suitable grid depending on the requirement.
- Based on physiological/land use conditions, a sample of grids would be taken and data collected by questionnaires and other methods.
- To avoid duplication of efforts, data/information/ maps available with relevant government departments will be used.
- An Advisory Committee, comprising both in-house and external experts, will identify the environmental parameters to be surveyed.

Grid-based Decision Support System - (GRIDSS)

District : Puducherry
Completed : 18 Maps

- Water Bodies in Puducherry.
- National Air quality Monitoring Programme (**NAMP**)
- National Water Monitoring Programme (**NWMP**)
- Puducherry Commune Boundaries.
- 17 Categories of Industries in Puducherry Region.
- Archaeology Site Map of Puducherry
- Lighthouse in Puducherry.
- Mangroves in Puducherry Region.
- Sand Dunes in Puducherry Region.
- ETP in Puducherry Region
- STP in Puducherry Region
- Hot spots of Pollution in coastal area.
- Heritage Sites in Puducherry Region.
- Religious Sites in Puducherry Region.
- State Listed Monuments in Puducherry Region.
- Soil Types in Puducherry.
- Sanitation Facility of Puducherry.
- Fish Landing Area in Puducherry.
- Bore wells Tapping in Puducherry.





Value Added Knowledge Products Release

Puppetry Video Released on 02.07.2021

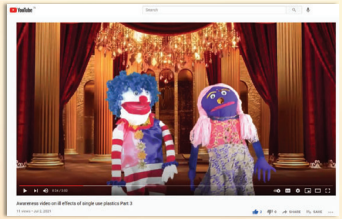
On the occasion of International Plastic Bag Free Day, 2021, Awareness Video on 'Ill effects of Single Use Plastics' has been released on 02.07.2021 by the Hon'ble Chief Minister, Government of Puducherry in the presence of Hon'ble Minister Mr. Lakshminarayanan, Smt. Smitha. R, I.A.S., Chairperson, Puducherry Pollution Control Committee (PPCC), Dr. S. Dinesh Kannan, IFS, Member Secretary, PPCC and other officials of PPCC, DST&E, ENVIS Puducherry Team.

This videos emphasize the ill effects and alternative products of single use plastics.

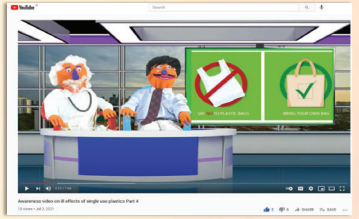
Awareness video on "ill-effects of single use plastics"

https://youtu.be/uRn_RSOXPiY

https://youtu.be/2bb1FZOk9Cc

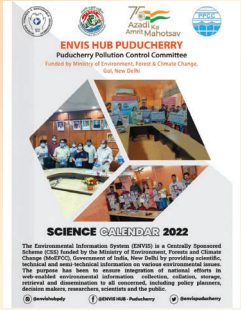


https://youtu.be/n8hCawAtr4I



https://youtu.be/JGfuyNm-sY

Monthly & Yearly E-Science Calendar Release



This calendar will emphasis on the importance of highlighted days in the respective month for carrying out necessary Environment, Science and Technology related activities/ celebration / events.

Outreach Programmes

Turtle Sculpture from Plastics Waste at Eden Beach, Chinnaveerampattinam, Puducherry

- Puducherry ENVIS Hub, Puducherry Pollution Control Committee in association with Vannidhasan High School, Seliamedu, Puducherry, Terre and Eden beach Team created the Turtle Sculpture at Eden Beach, Chinnaveerampattinam, Puducherry using waste plastic materials obtained from the seashore.
- The turtle structure shows that the harm we do to life in the oceans with our plastic-consuming lifestyles and also to raise awareness about the damage done by plastic materials to marine life.

Vigyan Sarvatre Pujyate – *'Science & Technology Festival'*

ENVIS Hub of Puducherry Pollution Control Committee, Puducherry participated in the Vigyan Sarvatre Pujyate – 'Science & Technology Festival' organized by the Department of Science, Technology and Environment and Puducherry Council for Science and Technology by displaying a stall at the Science Expo from 22.02.2022 to 28.02.2022 to highlight the activities of the ENVIS Team conducted at Dr. Abdul Kalam Science Centre & Planetarium, Puducherry. ENVIS publications viz., Calendars, Books, Posters etc., were distributed to the public during the said occasion apart from increasing with students, teachers, faculties etc., for their suggestions/views. ENVIS Hub team was also part of the various competitions held during the Science & Technology Festival.

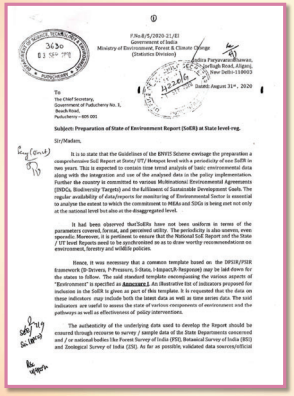
Hon'ble Lt Governor , Hon'ble Chief Minister and Speaker of Puducherry visited the ENVIS Hub stall on the occasion of Science and Technology festival - Azadi ka Amrit Mahotsav: Vigyan Sarvatra Pujyate

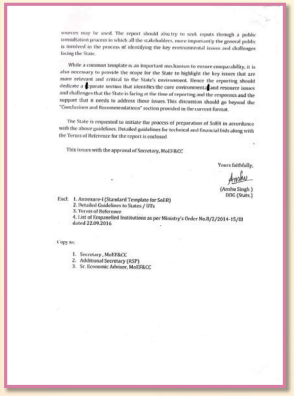
Chief Secretary, Government of Puducherry visited the ENVIS Hub stall

State of Environment Report

State of Environment Report, 2020

The State of Environment Report of the Puducherry State-2021 will be a comprehensive document (study, research and editorial inputs) covering aspects like Forest, Wildlife, Biodiversity & Conservation, Pollution, Agriculture, Health and Climate Change etc., along with its recommendations for corrective measures.





The Steering Committee was constituted on 09.12.2020

Proposal for the preparation of SoER, 2020 sent to Statistics Division, MoEF&CC, GoI, New Delhi on 08.02.2022.

Capacity Building Programmes

Capacity Building Programme

Mr. S. Jagan Kumar, Information Officer and Mr. S. Dhinesh, Information Technology Officer from Puducherry Envis Hub attended hands on experience on 'Spatial and Temporal GIS Mapping on Vector Borne Diseases' on 28.09.2021 and 29.09.2021 at ICMR-VCRC, Puducherry.

Online Certificate Course on Mobile App. Development (Android with Kotlin)

Information Technology Officer from Puducherry ENVIS Hub attended 3 weekend online Certificate Course on Mobile App. Development (Android with Kotlin) conducted by Ministry of Micro, Small and Medium Enterprises Technology Development Centre, Chennai.

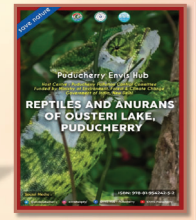
ENVIS Publications

Publication 2021 – 2022

Newsletters	3
Books	3
Posters	58
Pamphlets	30
SUP Awareness Videos	4
Animation Videos	4
Calendar (Yearly & Monthly Science Calendar)	2

Puducherry ENVIS Hub publications can be view at:
https://dste.py.gov.in/Envispdy/Newsletter.html

Birds of Puducherry – Volume- II



Reptiles and Anurans of Ousteri Lake, Puducherry

Biodiversity Assessment in the Mangrove Forest of Karaikal District, Puducherry, Union Territory

2005 to Till date Publication of ENVIS HUB PUDUCHERRY

Newsletters	50
Books	4
Mobile App.	1
Posters	125
Pamphlets	58
Stickers	15
Science Calendar(Yearly & Monthly)	8
Videos	10
Animation Videos	3
Articles (Biodiversity conservation)	1
Write up(Biodiversity conservation)	3
Abstract	1

https://dste.py.gov.in/Envispdy/Newsletter.html

Road Map for F.Y. 2022-23

New Initiative Planned As Per Assigned Subject Area

1. Biodiversity Assessment at Bahour Lake, Puducherry.
2. Distribution Mapping.
3. Survey projects.
4. Creation of Data bank on Puducherry Environment.
5. Facilitating employment opportunities for the GSDP students.
6. Utilisation of services of the GSDP students in the mapping and other data collection i.e Noise survey, Monitoring etc.
7. Self financing GSDP courses.

Follow us on:

https://www.facebook.com/envishubpdy/

https://www.youtube.com/channel/UCo__5E1KGnPiETPWavoZ-8w

https://www.instagram.com/envishubpdy/

https://twitter.com/envispuducherry

0413 - 2201256

envis.pon@nic.in

https://dste.py.gov.in/envispdy/

Thank you

Addressing U.T. of Puducherry Cappacity Building Needs and Knowledge Management
Speaker : Mr. K. Kalamegam
Environmental Engineer, DSTE, Puducherry.
Date : 05.05.2022.

Workshop on Integrating Climate Action in Development Planning of Puducherry Union Territory – 05-06th May 2022

Addressing U.T. of Puducherry Capacity Building Needs and Knowledge Management

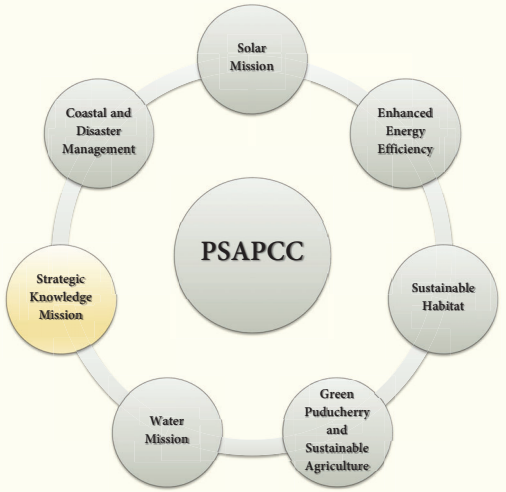
सत्यमेव जयते

GOVERNMENT OF PUDUCHERRY
DEPARTMENT OF SCIENCE,TECHNOLOGY AND ENVIRONMENT
PUDUCHERRY CLIMATE CHANGE CELL

ONE OF THE EIGHT MISSIONS OF U.T OF PUDUCHERRY STATE ACTION PLAN ON CLIMATE CHANGE (PSAPCC)

Mission on Strategic Knowledge on Climate Change

(support mission to other missions)



Strategic Knowledge Mission

- Mission recognizes that Knowledge creation, management, dissemination and exchange will be critical and central to the successful implementation of the SAPCC
- Mission seeks to build a vibrant and dynamic knowledge management system on climate change issues in the UT, that would inform, plan and support local actions for responding effectively to Climate Change Adaptation and Mitigation with involvement of expert contributions and stakeholder inputs.

Focus of the Mission

- Build the capacity of key government departments and agencies to understand climate change concerns and integrate climate change mitigation and adaptation actions in developmental planning and policies.
- Build the capacity of key government departments and agencies on accessing the various climate funds.
- Strengthening institutions for climate change capacity building and knowledge management
- Building Network of Climate Change Knowledge Institutions.
- Develop a comprehensive knowledge management portal on climate change related issues and disseminate information in systematic manner.
- Awareness Programs and Training to the Government agencies, NGOs, Students and public on Climate Change concerns and strategies.
- Establishing a Climate Change Cell in the UT to create awareness, monitor progress and coordinate among various agencies to share knowledge and implement the state action plan for combating climate change.

PUDUCHERRY CLIMATE CHANGE CELL

- In Puducherry Union Territory, various mitigations and adaptation actions and initiatives have already been undertaken by various agencies.
- Different level of knowledge exists with various institutions on climate change mitigation and adaptation on different subjects and sectors.
- There is a need to integrate this scattered knowledge for planning future actions.
- It is, therefore, important to have a center where all the available knowledge and information on climate change can be pooled together so that the users along with the government bodies can effectively make use of such climate related information and products for mainstreaming climate change in development planning and policies.
- Keeping this in view, Puducherry Climate Change Cell (PCCC) has been established as a central repository of information and knowledge products on climate change.
- PCCC also acts as support agency in formulation, implementation and monitoring of the State Action Plan on Climate Change.

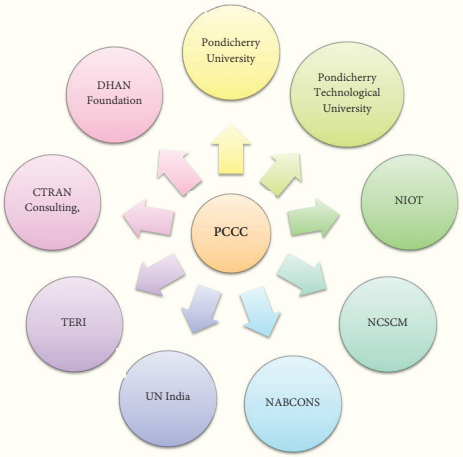
PUDUCHERRY CLIMATE CHANGE CELL

PCCC is established in the Department of Science, Technology and Environment, Puducherry with the support of **DST, GoI** under **National Mission on Strategic Knowledge for Climate Change (NMSKCC)**

सत्यमेव जयते
Department of Science & Technology
Govt. of India

CORE FUNCTIONS OF PUDUCHERRY CLIMATE CHANGE CELL

OUR KNOWLEDGE PARTNERS

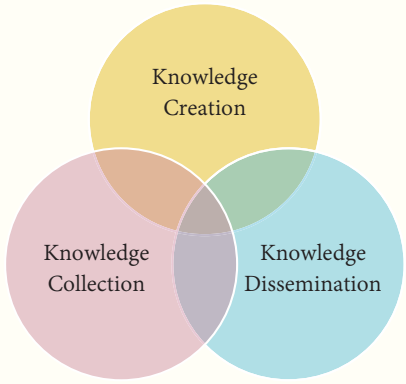


CLIMATE CHANGE KNOWLEDGE MANAGEMENT

Climate Change Knowledge Management

- Address the issues pertaining to the assimilation and access of relevant up-to-date data on climate and climate change
- Create Knowledge Repository and Enhancing Knowledge Environment there by Bridging the Gap
- Improving Knowledge Access &Transfer; Managing Knowledge as an Asset
- Strengthening the R&D Capacity in Climate Change field
- Mainstreaming Climate Change concerns in the policies and programmes

KNOWLEDGE MANAGEMENT ACTIVITIES



Knowledge Creation – Research Papers

Three Research Papers has been published

- Case study of GHG reduction and sustainable solutions in a Chemical Industry with reference to the climate change action plan of the Puducherry region, India, Dwarakanath Madahva Rao, et al., Journal of Applied Science and Engineering Methodology, 2016.
- Sector-wise GHG Inventorization for Union Territory of Puducherry with Special Reference to Agriculture – Phase I, Rao D.M, et al., International Journal of Tropical Agriculture, 2016.
- A Review on Studies performed to Assess the Impact of Climate Change and Anthropogenic Activities on the Coastal Ecosystem at Puducherry, India, Smitha. R, et al., International Knowledge Press, 2019.

Two Research Papers under review

- Trend Analysis of Air Quality in Puducherry Region in the South Eastern Coast of India
- Heat Wave analysis for the region of Puducherry and Karaikal in the U.T. of Puducherry

Knowledge Creation – Reports / Monographs

Knowledge Creation – Reports / Monographs

- Climate Profile of U.T. of Puducherry
  - **District wise observed climate change** (temperature, rainfall and its extremities) during the past decades 1976 -2020 using IMD data
  - **District wise future climate scenarios-** Downscaling and modelling high resolution future plausible climate change for Puducherry the latest Representative Concentration Pathways under AR5 Scenario (TERI)
- Climate Change Vulnerability Assessment
  - **District wise climate change vulnerability assessment** using the common framework developed by DST, GoI and Swiss Agency of Development and Cooperation (SDC) Project
  - Sectoral climate change **vulnerability assessment** viz., agriculture, forestry and biodiversity, coastal, energy, suitable habitat and water sectors (TERI)
- Long term trend analysis of Air Quality in Puducherry (2010 – 2020)
- Heat Wave Analysis for region of Puducherry and Karaikal in the U.T. of Puducherry (2000 – 2020),

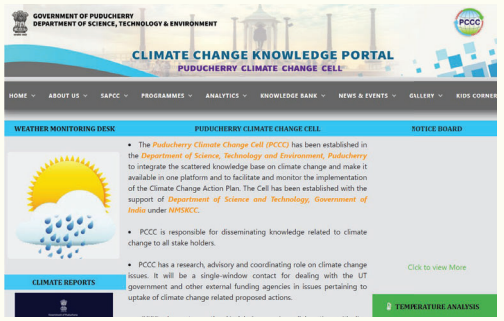
Knowledge Collection

- Data Bank and a knowledge repository for storing and retrieving climate change information at the UT level to be useful to all stakeholders
  - Collection of knowledge resources
  - Case studies on climate change mitigation and adaptation best practices
  - Weather Monitoring Station established with support of DST, GoI and data is uploaded in PCCC website
  - Meteorological data from 1976 obtained from IMD
  - Inventory of all the tanks and ponds completed.
- Establishing Networks and strategic partnerships with institutions and agencies

Knowledge Dissemination

Climate Change Knowledge Portal launched on October 31, 2018 with various data sets like

- Important environmental statistics of the region,
- Climate trend analytics
- Vulnerability analysis
- GHG Inventory
- SAPCC related information
- Weather monitoring desk
- Climate change projects and programs undertaken
- Reports and research papers published at regional, national and international level
- Current news and articles
- Policy matters



https://dste.py.gov.in/PCCC/

CAPACITY BUILDING

Individual level	Institutional level	Systemic level
• Climate Change education for School students • Climate Change awareness program for General Public • Training Program on Waste Management, Water Conservation • Climate resilient Agriculture practices, Solar energy to concerned stakeholders • Awareness through mass media, pamphlets, etc.	• Training / Workshops / Webinars on main streaming Climate Change, Project formulation, Funding Mechanisms, etc. for Government Departments and Agencies • Strengthening capacity of PPCC for collecting baseline data on Air and Water Quality & Weather conditions • Network of Knowledge Institutions and Developing Knowledge Products • Web based Knowledge Portal	• Preparation of Revised SAPCC • Monitoring and Evaluation framework for SAPCC implementation • Other Policy interventions and revisions • Formulation and Implementation of Climate Change Mitigation and Adaptation projects

Climate Change Awareness Programme for School Students

Puducherry Climate Change Cell is conducting Climate Change Awareness Programmes for the school students from 9th to 12th standard. About 12 schools are covered every month.

Climate Change Awareness Programme for School Students

Objectives:

- To create awareness on Climate Change causes, impacts, mitigation & adaptation actions
- Encourage changes in their attitudes and behavior to enable them to act in bringing up a Climate sustainable environment.
- To introduce them with the idea of "green good deeds" to be practiced by individuals and "Green Protocol" to be followed by schools.

➢ 128 programs have been conducted so far **reaching out to a total of 10455 students in Puducherry.**

Capacity Building Programme for tank users and farmers

- Twenty Capacity Building Programme was conducted under the NAFCC project "Integrated Surface water management through Rejuvenation of 25 tanks and 32 village ponds for Climate Change Adaptation in Puducherry".

Workshop on "Climate Change Strategies and Finance Mechanisms"

- Conducted at Karaikal for Government officials, academicians and NGO's.
- Designed to share information about best practices and climate change funds and help government agencies build capacity to access the existing pool of climate change finance from various sources.
- Brain storming session conducted at the end of the training to identify suitable project proposals for Karaikal region for funding under NAFCC / GCF schemes.

Climate Change Webinar Series

13 Webinars were organised as a part of the **Climate Change Webinar Series** for various key stakeholders viz. Government officials, Academicians, Students, NGOs and General Public:

- Mainstreaming Climate Change into Development Policies and Strategies
- Implementation of INDCs: Advancing Mitigation and Adaptation Actions for Climate Change
- Climate Change: Net Zero Emission Pathways
- Water Mission: System to Monitor and Evaluate Performance and Socio-Economic Impacts of Water Resource Management Projects
- Climate Modelling and Climate Change Projection for the U.T. of Puducherry
- Climate Change Vulnerability Assessment for the U.T. of Puducherry
- Climate Change and Biodiversity
- CO_2 Sequestration and Climate Mitigation – An Industrial Orientation
- Community - Based Adaptation to Climate Change through Nature based Solution for Coastal Zones in India
- Earth Day: Restore our Earth
- Climate Change Finance Mechanism
- Carbon Credit Mechanism

Training Programs

- **108 Training Programmes** have been conducted in association with various agencies on climate change related topics with **5331 participants.**

Rejuvenation of Tanks and Ponds in the region of Puducherry under NAFCC

- PCCC is the PMU for implementing the "Integrated Surface Water Management through rejuvenation of Tanks and Ponds for Climate Change Adaptation in U.T. of Puducherry" implemented under NAFCC funding.
- 49 Irrigation Tanks and 186 Village Ponds are being rejuvenated and one mini lake is newly formed under the project for climate proofing of water sector.

SAPCC

- PCCC is presently preparing the revised SAPCC for U.T. of Puducherry in synergy with the goals of India's Nationally Determined Contributions (NDC) submitted under Paris Agreement and other recent scientific assessments and projections on global warming; vulnerability; and impacts
- PCCC works in association with 18 Government Departments and Agencies for the revision of SAPCC.
- The draft SAPCC 2.0 is expected to be ready by June, 2022.

Thanks…

Climate Change and Human Health Risk and Responses
Speaker: Dr. T. Mahalakshmy
Additional Professor, Department of Preventive and Social Medicine, JIPMER.
Date : 05.05.2022

Climate Change and Human Health

Risk and Responses

Additional Professor, Dept of Preventive and Social Medicine, JIPMER, Puducherry

www.menti.com

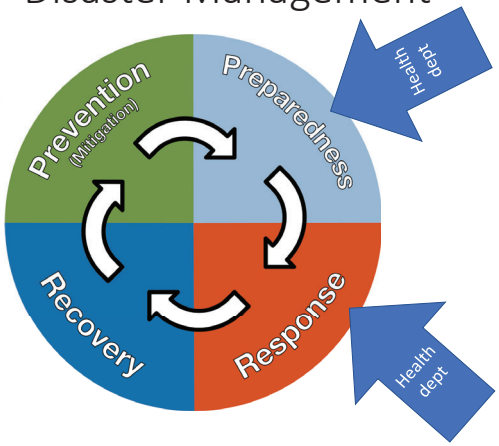
3829 0333

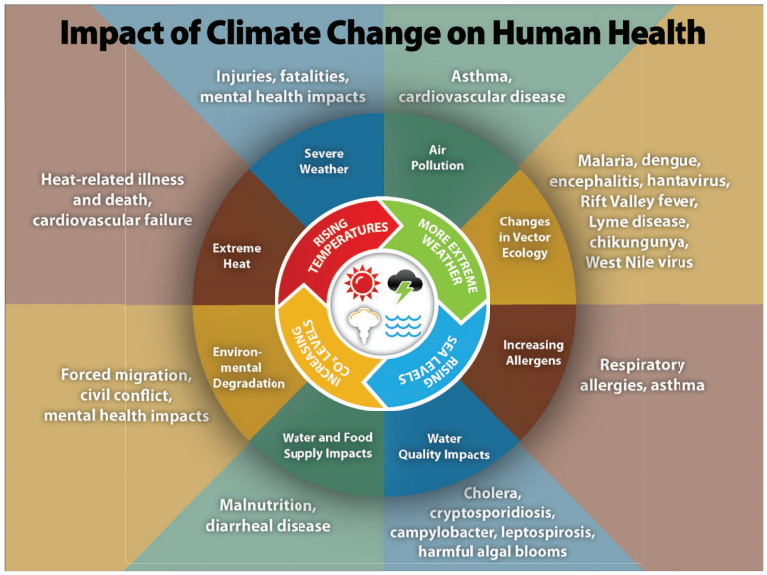
https://www.mentimeter.com/app/presentation/bf97cc697dd1e0065a90e9a110cbd5d6/bc36f81da1b1

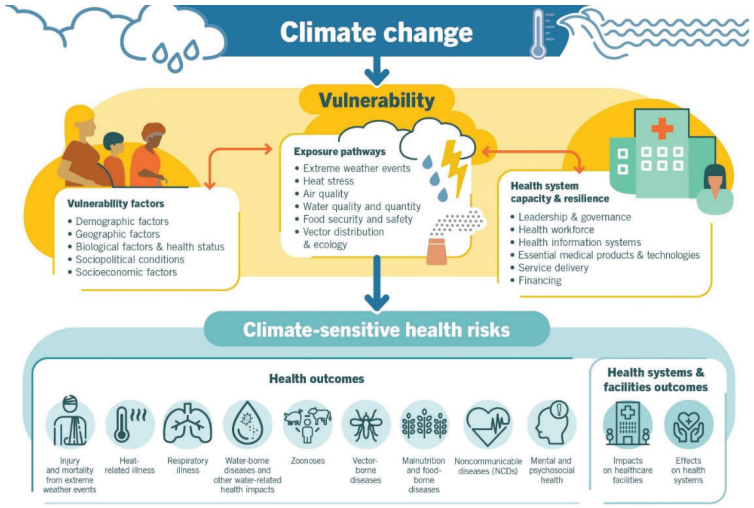
Video – short break

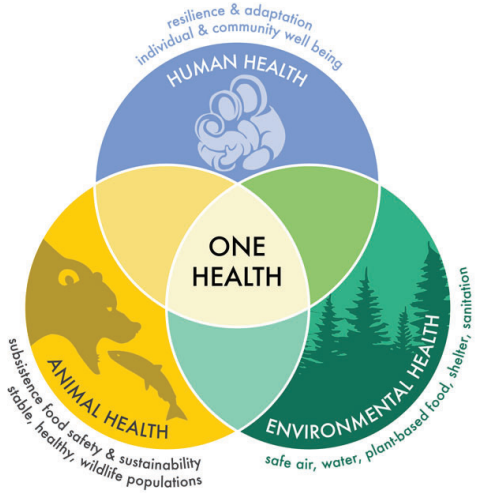
https://www.mentimeter.com/app/presentation/bf97cc697dd1e0065a90e9a110cbd5d6/bc36f81da1b1

Disaster Management









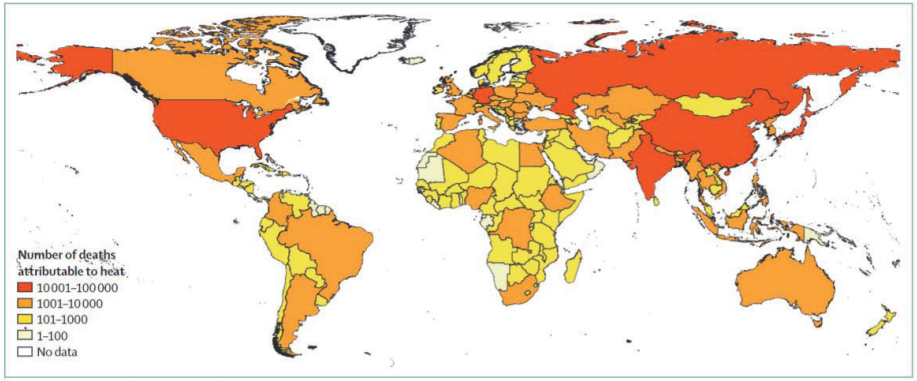
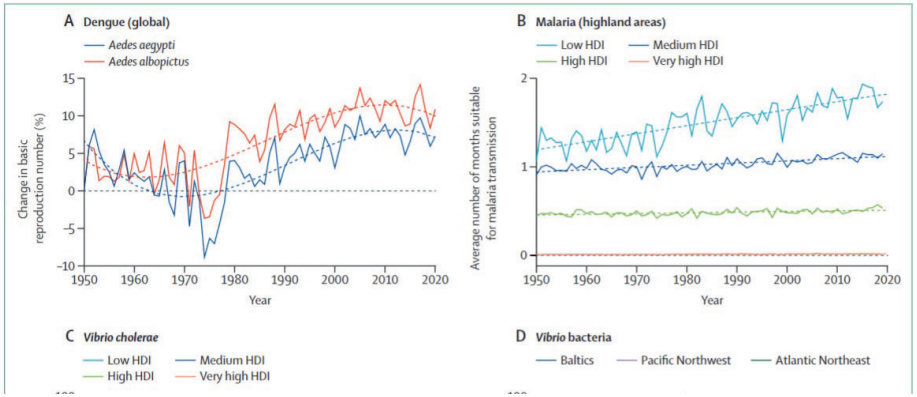
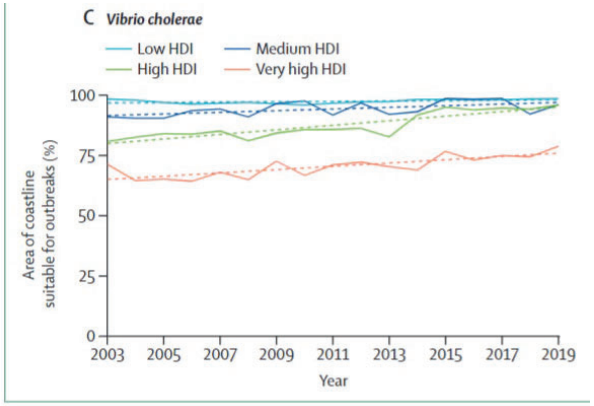


Figure 5: Heat-related deaths of people older than 65 years in each country in 2019





Heat and sentiments

- During heat waves
  More negative tweets

National Programme on Climate Change & Human Health (NPCCHH)

Centre of Excellence

1. National Institute of Malaria Research - Vector Borne Disease
2. PGIMER - Illnesses due to Air Pollution
3. V.P. Chest Institute (VPCI) – allergic dieases
4. NIMHANS – mental health
5. National Institute of Cholera and Enteric Diseases - Water borne Diseases
6. National Institute of Nutrition – Nutrition related illness
7. All India Institute of Medical Sciences – Cardio Pulmonary Diseases
8. National Institute of Disaster Management (NIDM) – Disaster
9. Indian Institute of Public Health (IIPH) – heat stress
10. National Institute of Occupational Health – Occupational health
11. Nutrition Foundation of India – food borne illness

General

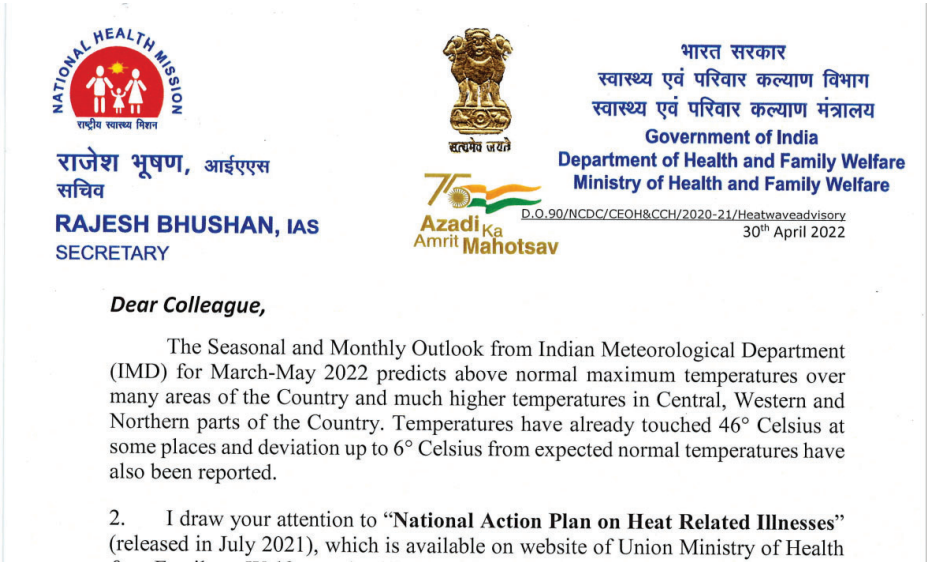
1. Public Health Foundation of India – green health system
2. International Institute of Health Management Res – vulnerability assessment
3. The Energy and Resources Institute (TERI) – health information system
4. North Eastern Indira Gandhi Regional Institute Medical Sciences (NEIGRIMS) – Hill regions climate sensitive diseases

Jawaharlal Institute of Postgraduate Medical Education & Research (**JIPMER**) – Costal Climate sensitive diseases

Awareness & Behaviour modification of general population or impact, illnesses, prevention and adaptive measures for climate sensitive illnesses

Health Education material

videos, posters



राजेश भूषण, आईएएस
सचिव
RAJESH BHUSHAN, IAS
SECRETARY

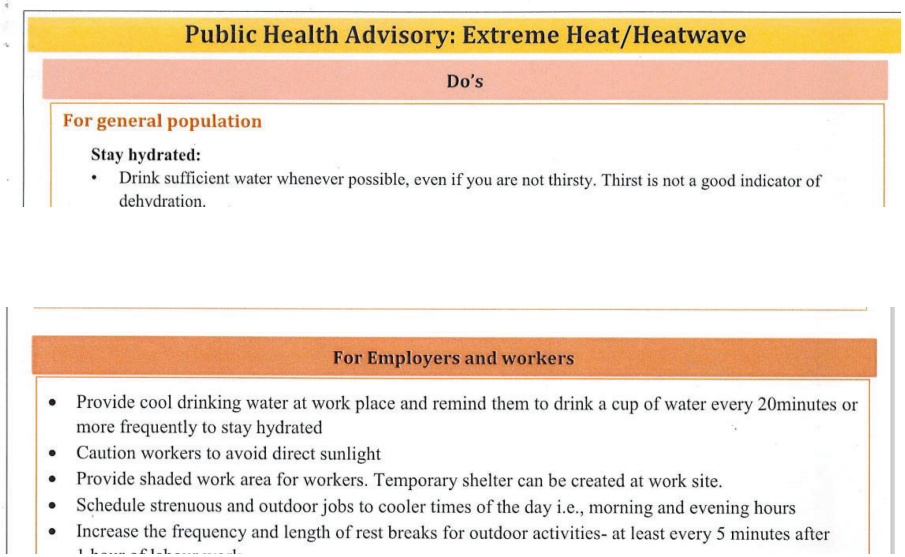
भारत सरकार
स्वास्थ्य एवं परिवार कल्याण विभाग
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
Government of India
Department of Health and Family Welfare
Ministry of Health and Family Welfare

D.O.90/NCDC/CEOH&CCH/2020-21/Heatwaveadvisory
30th April 2022

Dear Colleague,

The Seasonal and Monthly Outlook from Indian Meteorological Department (IMD) for March-May 2022 predicts above normal maximum temperatures over many areas of the Country and much higher temperatures in Central, Western and Northern parts of the Country. Temperatures have already touched 46° Celsius at some places and deviation up to 6° Celsius from expected normal temperatures have also been reported.

2. I draw your attention to "**National Action Plan on Heat Related Illnesses**" (released in July 2021), which is available on website of Union Ministry of Health



Public Health Advisory: Extreme Heat/Heatwave

Do's

For general population

Stay hydrated:

- Drink sufficient water whenever possible, even if you are not thirsty. Thirst is not a good indicator of dehydration.

For Employers and workers

- Provide cool drinking water at work place and remind them to drink a cup of water every 20minutes or more frequently to stay hydrated
- Caution workers to avoid direct sunlight
- Provide shaded work area for workers. Temporary shelter can be created at work site.
- Schedule strenuous and outdoor jobs to cooler times of the day i.e., morning and evening hours
- Increase the frequency and length of rest breaks for outdoor activities- at least every 5 minutes after

Train healthcare personnel and equipped institutes/ organization towards achievement of climate resilient healthcare services and infrastructure at district level in each state

Module for Medical Officer, ASHA, ANM and other para-medical staff

- Activity based
- Easy for dissemination
- Power point presentations
- Voice over video
- Training of trainers by the CoE

Integrated monitoring system for collection and analysis of health related data with meteorological parameters, environmental, socio-economic and occupational factors

Evidence–based support to policy makers, programme planners and related stakeholders

Research

Funds for it

Indicators

- Direct indicators

Panel 1: **Working group indicator**

Climate change impacts, exposures, and vulnerabilities

1.1: health and heat
- 1.1.1: vulnerability to extremes of heat
- 1.1.2: exposure of vulnerable populations to heatwaves
- 1.1.3: heat and physical activity
- 1.1.4: change in labour capacity
- 1.1.5: heat and sentiment
- 1.1.6: heat-related mortality

1.2: health and extreme weather events
- 1.2.1: wildfires
- 1.2.2: drought
- 1.2.3: lethality of extreme weather events

1.3: climate-sensitive infectious diseases
- 1.3.1: climate suitability for infectious disease transmission
- 1.3.2: vulnerability to mosquito-borne diseases

1.4: food security and undernutrition
- 1.4.1: terrestrial food security and undernutrition
- 1.4.2: marine food security and undernutrition

1.5: migration, displacement, and rising sea levels

Summary

- How is human health affected?
- What is being done?

Date: 06.05.2022

Acknowledgements

- Smitha. R, I.A.S., Secretary to Government, Department of Science, Technology & Environment, Government of Puducherry
- K. Kalamegam, Environmental Engineer, Department of Science, Technology & Environment, Government of Puducherry
- Prof. S. Mohan, Vice-Chancellor, Puducherry Technological University
- Workshop Organizers (PCCC, TERI, …)

Chicago, USA

Sustainable Engineering Research Laboratory (SERL)
Geotechnical and Geoenvironmental Engineering Laboratory (GAGEL)

Directed by Prof. Krishna R. Reddy, University of Illinois at Chicago, kreddy@uic.edu

Environmental Remediation of Soils, Sediments, Groundwater and Stormwater

- In-situ remediation technologies
- Mixed and emerging contaminants
- Heterogeneous and low permeability subsurface environments
- New development or optimization of technologies:
  - Electrokinetic/electrochemical remediation
  - Air sparging/bio-sparging
  - Chemical oxidation
  - Chemical reduction by nanoparticles
  - Bioremediation/phytoremediation
  - Stabilization/solidification
  - Active and passive containment barriers
  - Integrated technologies
- Green, sustainable and resilient remediation

Waste Management and Landfill Engineering

- Beneficial use of waste and recycled materials
- Anaerobic digestion/composting
- Mechanical stability and chemical containment of landfills (coupled processes/modeling)
- Sustainable landfill liner and cover systems
- Biocovers
- Bioreactor landfills

Life Cycle Assessment and Sustainable & Resilient Engineering

- Sustainability analytics: Quantifying sustainability
  - LCA, SLCA, SSEM, QUALICS
- Sustainable engineering materials
  - Scrap tires versus sand as drainage material in landfill covers and liners
  - Biochar versus compost as landfill cover material
- Sustainable infrastructure
  - Foundations (e.g., piles versus caissons)
  - Earth-retaining systems (e.g., Reinforced cantilever retaining wall versus mechanically stabilized wall)
  - Ground improvement (e.g., lime treatment versus organic amendment)
- Sustainable waste management
  - Landfilling versus incineration
- Sustainable environmental remediation
- Resiliency framework & applications

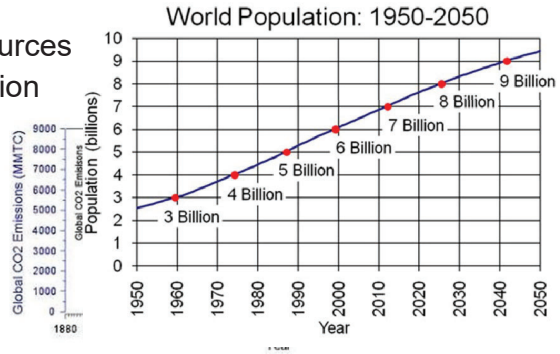
Civil Engineering/Geotechnical Engineering

- Site investigations
- Structural foundations
- Earth-retaining structures
- Dams and levees
- Ground improvement techniques
- Geomechanics
- Geotechnical earthquake engineering

http://gagel.lab.uic.edu/

Grand Challenges in the 21st Century?

- Global climate change and consequent extreme events (sea level rise, floods, droughts, wild fires,…)
  - Impacts to current and future generations
- Exploding population growth and consequent impacts
  - Depletion of natural resources
  - Increased waste generation
  - Increased pollution
  - Damage to ecosystem
  - Loss of biodiversity
  - Urban sprawl
  - Economic disparities
  - Social injustice



Sustainable Development?

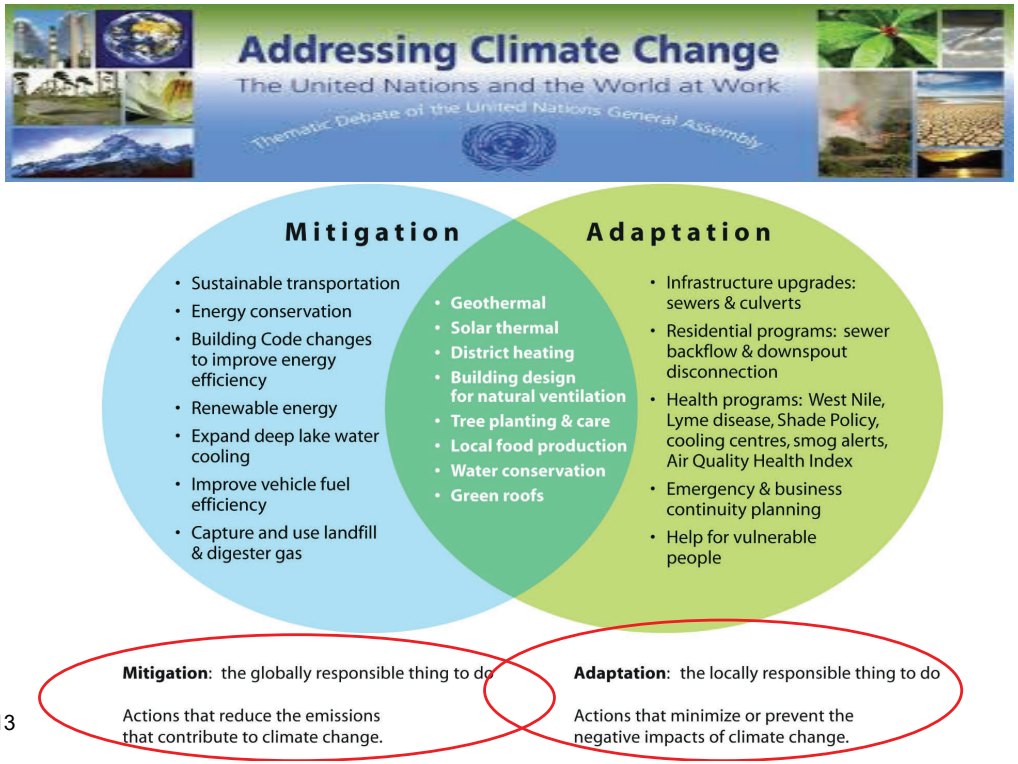
"…development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

World Commission on Environment and Development report (UN, 1987) entitled, *Our Common Future* (also known as the *Brundtland Report*)

2030 UN Sustainable Development Goals?

17 Goals with 169 Targets (All Interlinked!)

How are we going to achieve these ambitious goals?



Climate Impacts Are Intensifying?

- Sustained changes in average temperatures
- Increased heavy precipitation events
- Increased coastal flooding
- Increased intensity of storm surge
- Sea level rise
- Increased wildfire severity

Coastal Erosion Due to Increased Storm Severity

Bishop (2020)

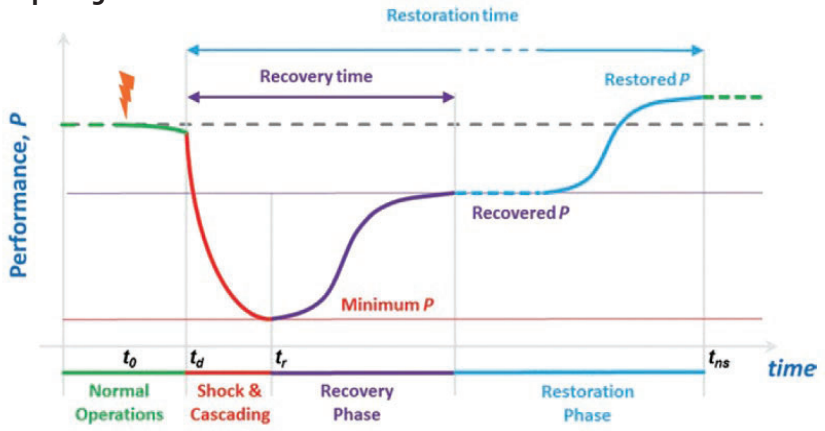
Residential Flooding Following Hurricane Harvey

Residential flooding in the Timarron Park area of The Woodlands, TX, following Hurricane Harvey

Bishop (2020)

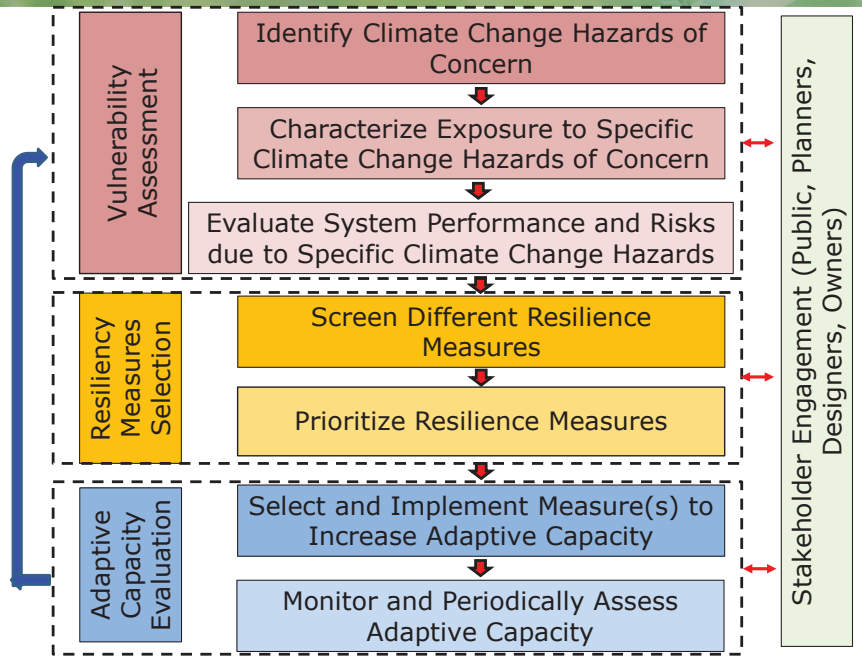
Need Climate Adaptation (Resilience)

- Ability to cope, adapt, and grow in the face of foreseeable climate and extreme weather impacts that may occur over the life cycle of project



Source: Sansavini 2016

Climate Resilient Design Framework
Adaptive Management Methodology(Reddy et al. 2021)



Data Sources and Tools

- National Oceanic and Atmospheric Administration (NOAA) resources such as *Digital Coast* and *Sea Level Trends.*
- National Weather Service resources such as *National Storm Surge Hazard Maps* and *Sea, Lake, and Overland Surges from Hurricanes (SLOSH).*
- Modeling that uses predictive weather and climate data, through use of conventional software or commercially available risk assessment software for engineered systems.
- Developing site-specific maps and matrices that can aid decision-making.

Resilient Design: Building Foundation

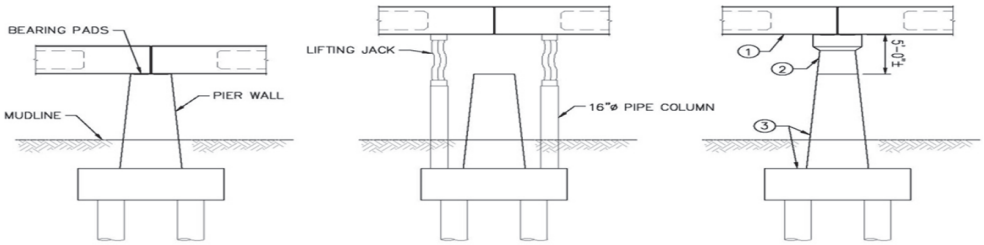
Resilient Design: Building Foundation

Resilient Design: Rail Corridor

LOSSAN (Los Angeles to San Diego) Rail Corridor follows the sea coast and crosses low-lying areas on trestles.

Resilient Design: Rail Corridor

Used Moffat and Nichol concept of precast piers and caps to allow insertion of additional pier segments if needed to adapt to flooding hazard.



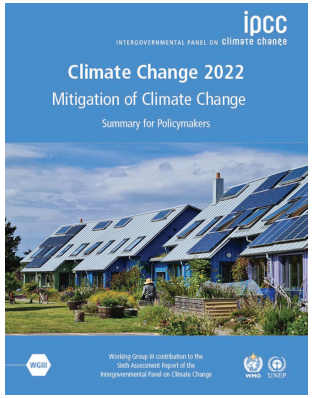
Richard Dial, Bruce Smith and Gheorghe Rosca, Jr., "Evaluating Sustainability and Resilience in Infrastructure: Envision™, SANDAG and the LOSSAN Rail Corridor" Proceedings of the 2014 International Conference on Sustainable Infrastructure, American Society of Civil Engineers, pp 164-174.

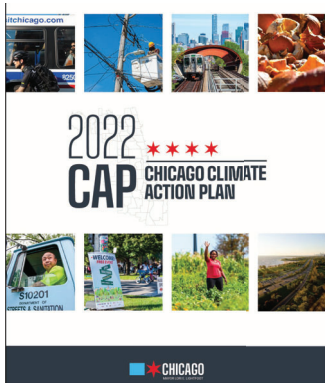
Resilient Design: Landfill Cover

- Resilience of a covered landfill at the Davisville Naval Construction Battalion Center Superfund site, in Rhode Island, is strengthened by an armored base to prevent erosion.
- Intertidal wetlands and a seawall work together below the base to reduce wave energy during storm surge from the adjacent Allen Harbor.

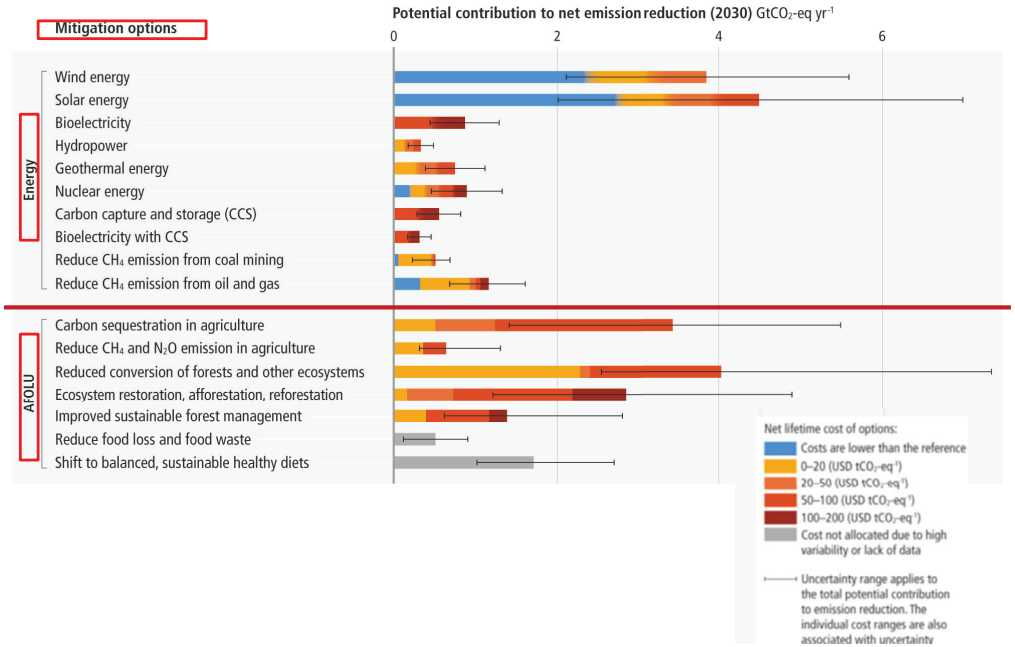
Preferred Option: Climate Mitigation?

- Adaptation or resiliency options will be challenging and will be limited, if GHGs (climate change) continues to increase!
- We should prefer reducing GHGs that are the root cause of climate change (climate mitigation)

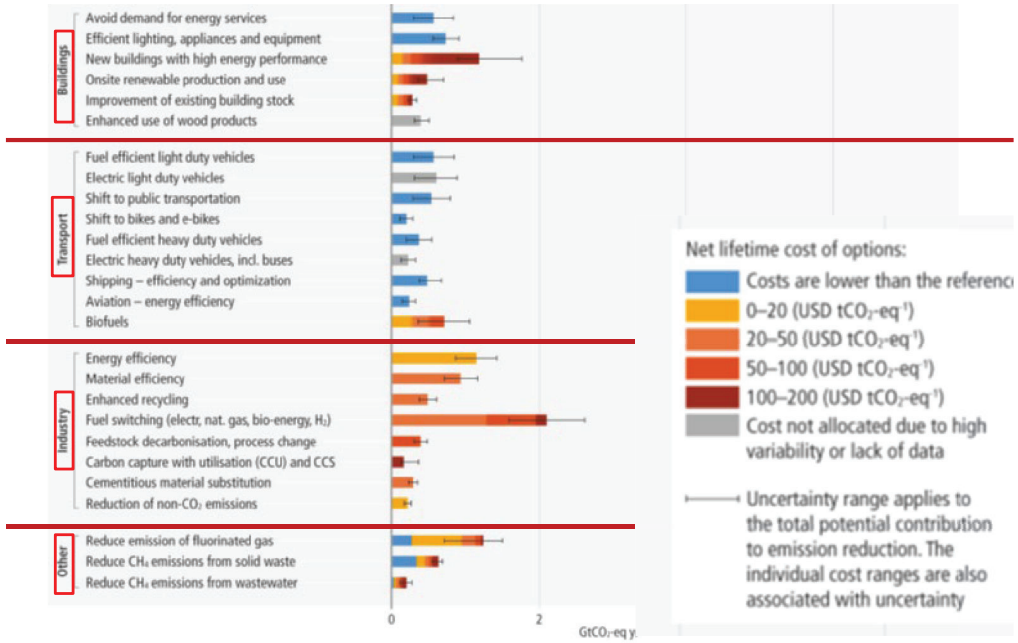




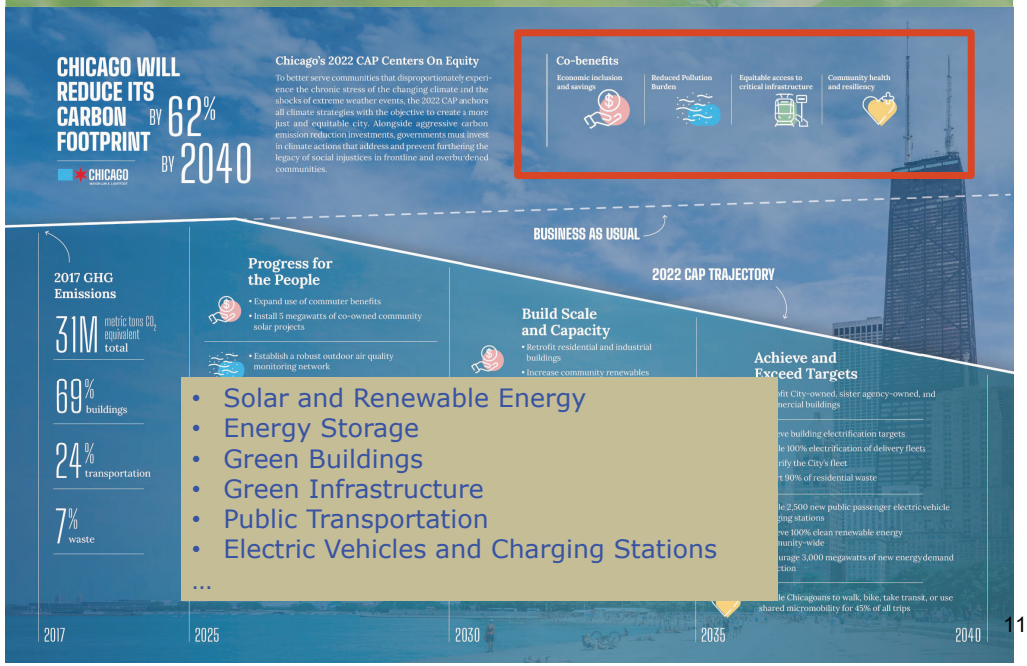
IPCC: Mitigation Options and Costs



IPCC: Mitigation Options and Costs



Chicago: 2022 Climate Action Plan (CAP)



Sustainability Versus Resilience

Sustainability is the capacity for:

– Ensuring economic prosperity

– Protecting ecological resources

– Enhancing societal well being

continuity **fitness**

Resilience is the capacity for:

– Overcoming unexpected crises

– Adapting to turbulent change

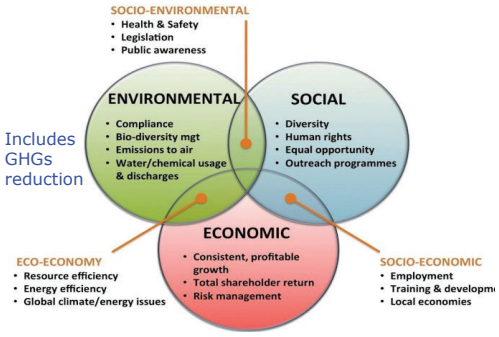
– Flourishing in a chaotic world

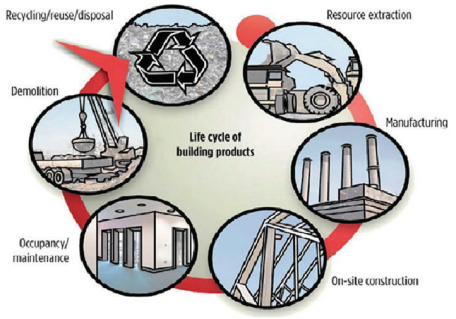
Co-Benefits: UN SDGs

17 Goals with 169 Targets (All Interlinked)

Integrating Sustainability?

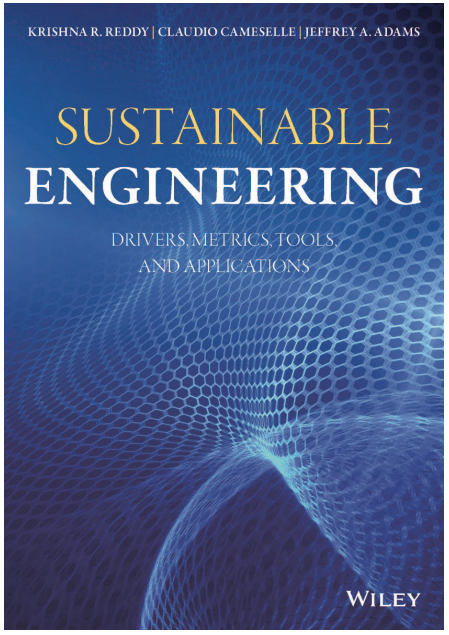
- Select climate adaptation and mitigation choices considering broader <u>environmental, economic, and social dimensions based on the life cycle</u>





Sustainable Choices: Environmentally friendly, economically viable, and socially acceptable through entire life cycle!

Useful Reference



Sustainable Engineering: Drivers, Metrics, Tools, and Applications

Krishna R. Reddy
Claudio Cameselle
Jeffrey A. Adams

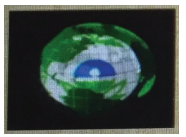
ISBN: 978-1-119-49393-8

2019

John Wiley & Sons

Scale of Sustainability Projects

- Global Scale (e.g. Global CO_2 budgeting)
- National Scale (e.g., Energy)
- Regional Scale (e.g., Watershed)
- Business or Institutional Scale (e.g., Eco-industrial park)
- Sustainable Technologies Scale (e.g., Sustainable materials, designs, products and systems)





Integrating Sustainability: Envision™ Rating System

64 sustainability and resilience indicators

Quality Of Life — 14 Credits

WELLBEING
- QL1.1 Improve Community Quality of Life
- QL1.2 Enhance Public Health & Safety
- QL1.3 Improve Construction Safety
- QL1.4 Minimize Noise & Vibration
- QL1.5 Minimize Light Pollution
- QL1.6 Minimize Construction Impacts

MOBILITY
- QL2.1 Improve Community Mobility & Access
- QL2.2 Encourage Sustainable Transportation
- QL2.3 Improve Access & Wayfinding

COMMUNITY
- QL2.1 Advance Equity & Social Justice
- QL2.2 Preserve Historic & Cultural Resources
- QL2.3 Enhance Views & Local Character
- QL2.4 Enhance Public Space & Amenities

QL0.0 Innovate or Exceed Credit Requirements

Leadership — 12 Credits

COLLABORATION
- LD1.1 Provide Effective Leadership & Commitment
- LD1.2 Foster Collaboration & Teamwork
- LD1.3 Provide for Stakeholder Involvement
- LD1.4 Pursue Byproduct Synergies

PLANNING
- LD2.1 Establish a Sustainability Management Plan
- LD2.2 Plan for Sustainable Communities
- LD2.3 Plan for Long-Term Monitoring & Maintenance
- LD2.4 Plan for End-of-Life

ECONOMY
- LD3.1 Stimulate Economic Prosperity & Development
- LD3.2 Develop Local Skills & Capabilities
- LD3.3 Conduct a Life-Cycle Economic Evaluation

LD0.0 Innovate or Exceed Credit Requirements

Resource Allocation — 14 Credits

MATERIALS
- RA1.1 Support Sustainable Procurement Practices
- RA1.2 Use Recycled Materials
- RA1.3 Reduce Operational Waste
- RA1.4 Reduce Construction Waste
- RA1.5 Balance Earthwork On Site

ENERGY
- RA2.1 Reduce Operational Energy Consumption
- RA2.2 Reduce Construction Energy Consumption
- RA2.3 Use Renewable Energy
- RA2.4 Commission & Monitor Energy Systems

WATER
- RA3.1 Preserve Water Resources
- RA3.2 Reduce Operational Water Consumption
- RA3.3 Reduce Construction Water Consumption
- RA3.4 Monitor Water Systems

RA0.0 Innovate or Exceed Credit Requirements

Natural World — 14 Credits

SITING
- NW1.1 Preserve Sites of High Ecological Value
- NW1.2 Provide Wetland & Surface Water Buffers
- NW1.3 Preserve Prime Farmland
- NW1.4 Preserve Undeveloped Land

CONSERVATION
- NW2.1 Reclaim Brownfields
- NW2.2 Manage Stormwater
- NW2.3 Reduce Pesticide & Fertilizer Impacts
- NW2.4 Protect Surface & Groundwater Quality

ECOLOGY
- NW3.1 Enhance Functional Habitats
- NW3.2 Enhance Wetland & Surface Water Functions
- NW3.3 Maintain Floodplain Functions
- NW3.4 Control Invasive Species
- NW3.5 Protect Soil Health

NW0.0 Innovate or Exceed Credit Requirements

Climate and Resilience — 10 Credits

EMISSIONS
- CR1.1 Reduce Net Embodied Carbon
- CR1.2 Reduce Greenhouse Gas Emissions
- CR1.3 Reduce Air Pollutant Emissions

RESILIENCE
- CR2.1 Avoid Unsuitable Development
- CR2.2 Assess Climate Change Vulnerability
- CR2.3 Evaluate Risk & Resilience
- CR2.4 Establish Resilience Goals and Strategies
- CR2.5 Maximize Resilience
- CR2.6 Improve Infrastructure Integration

CR0.0 Innovate or Exceed Credit Requirements

ENVISION™

Source: Institute for Sustainable Infrastructure (ISI)

Envision Application Example

Envision Application Example

SUN VALLEY PARK DRAIN AND INFILTRATION SYSTEM

Envision Award Rating Criteria

- **Quality of Life:** Enhance Public Health & Safety, Enhance Public Space
- **Leadership:** Foster Collaboration & Teamwork, Plan for Long-Term Monitoring & Maintenance
- **Resource Allocation:** Protect Fresh Water Availability
- **Natural World:** Manage Stormwater, Prevent Groundwater Contamination
- **Climate and Risk:** Prepare for Long-Term Adaptability, Prepare for Short-Term Hazards


Construction of 1.7 acre infiltration chambers which are 5


Underground infiltration chambers at


Installation of water treatment system at Sun Valley Park


AFTER: Park space above infiltration basins at Sun Valley Park

Envision Application Example

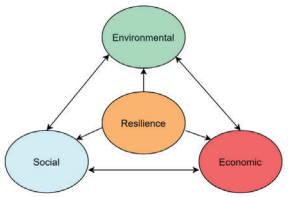
Sun Valley Watershed Management Plan

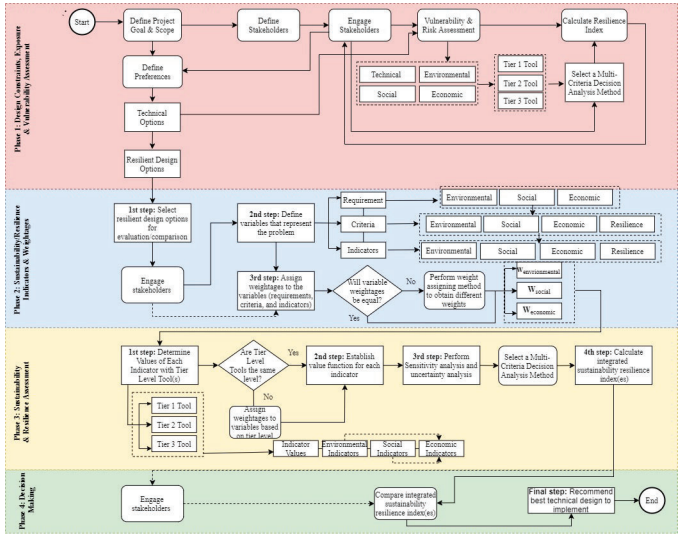
Envision Rating Results

Final Score = 67%

Integrating Sustainability: TQUALICSR Framework (Reddy et al. 2021)

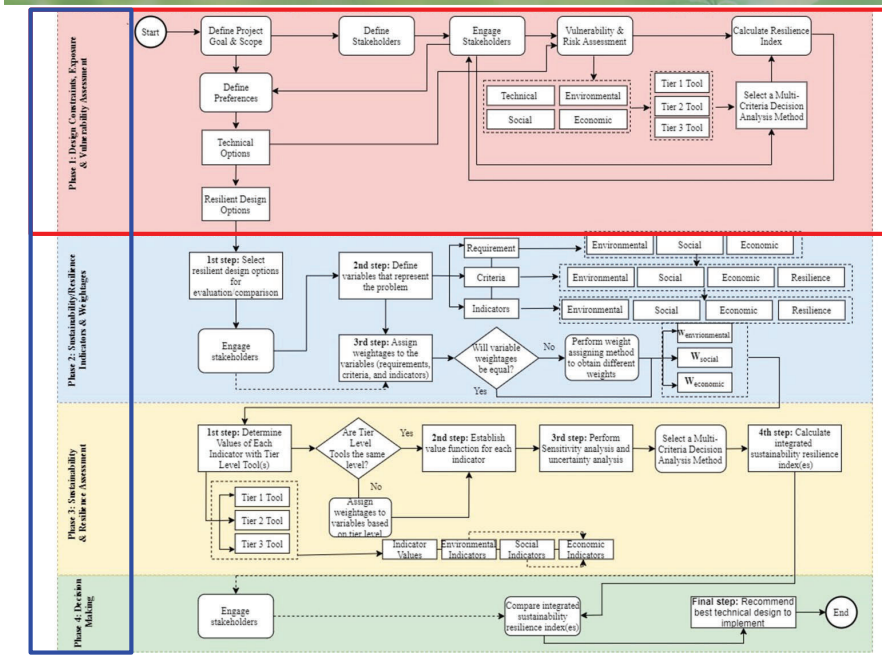
- Integration of technical, resiliency, and sustainability
- Applicability to various life cycle stages of an engineering project of any size
- Flexible, tier-based selection of tools



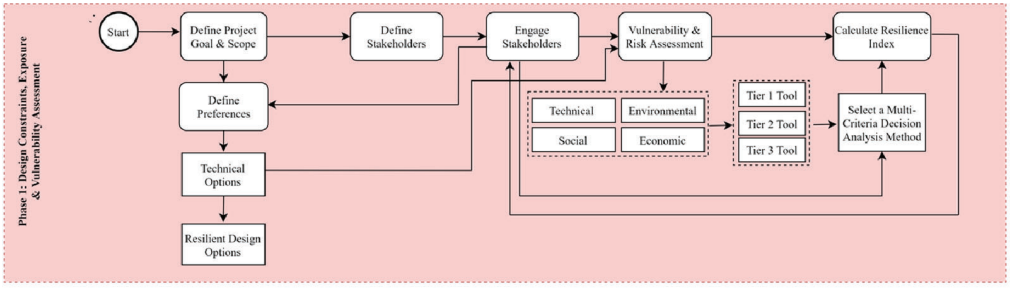


Reddy, K.R., Robles, J.R., Carneiro, S.A.V., and Chetri, J.K. (2021). **Tiered Quantitative Assessment of Life Cycle Sustainability and Resilience (TQUALICSR)**: Framework for Design of Engineering Projects, In *Advances in Sustainable Materials and Resilient Infrastructure*, Springer Nature.

TQUALICSR Framework



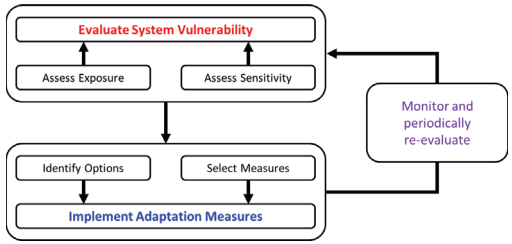
Phase 1: Design Constraints, Vulnerability/Risk & Resilience Index



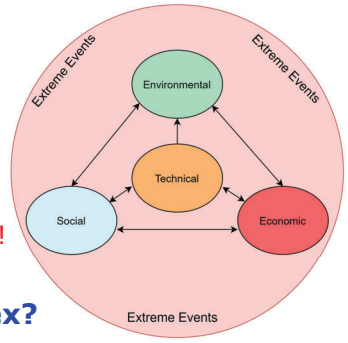
- Provides a structured flow to include more than technical considerations early in the design process
- Help identify resilience goals, constraints, and indicators in an informed manner

Phase 1

- Resilient Design Options
  - Potential technical designs based on:
    - ✓ Vulnerability/risk assessment
    - ✓ Adaptive measures



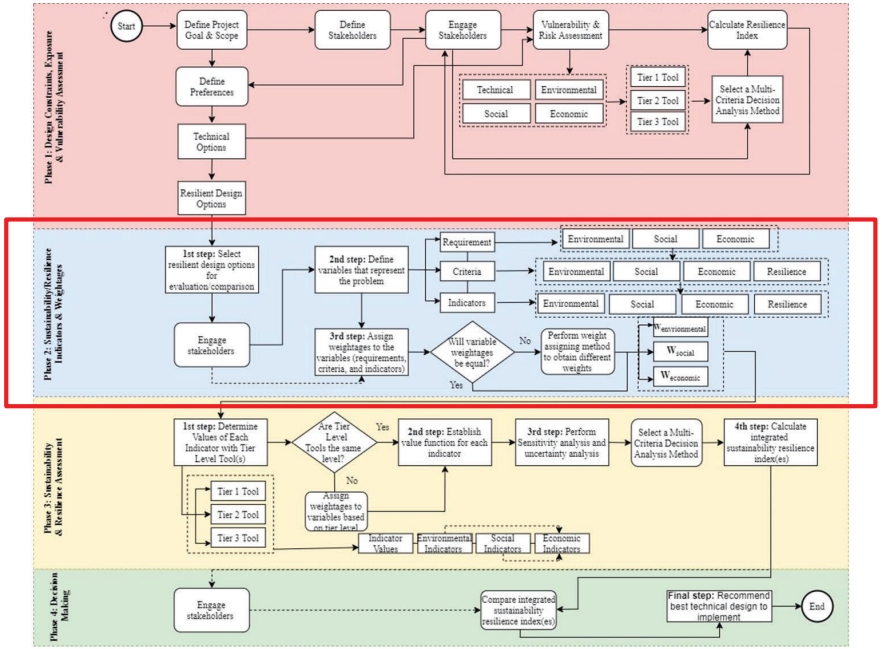
- Hazard-Resilience Indicators and Metrics
  - Technical
  - Environmental
  - Economic
  - Social



Interdependent!

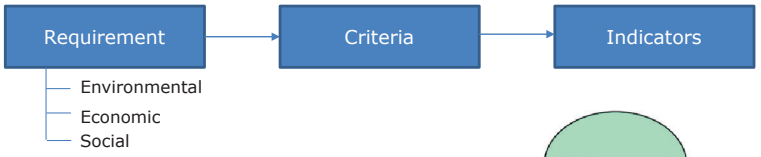
Resilience Index?

TQUALICSR Framework

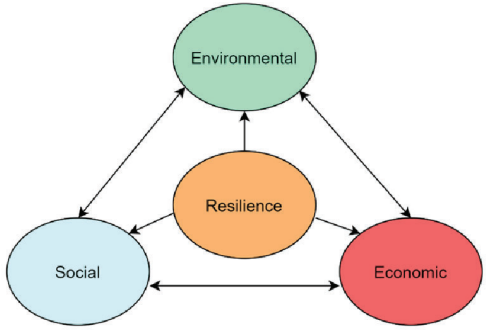


Phase 2

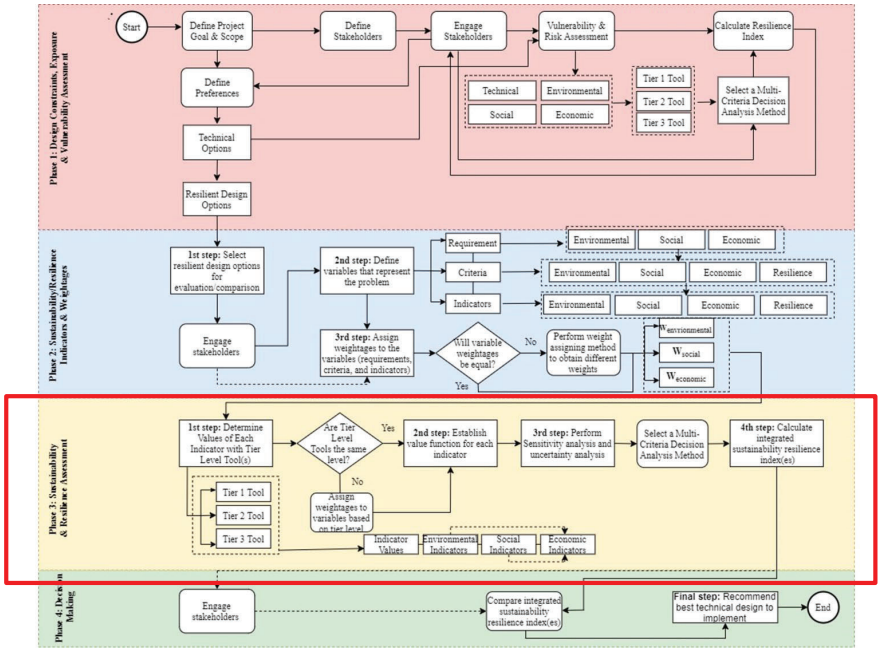
Define Qualitative and Quantitative Sustainability and Resilience Variables (Indicators)



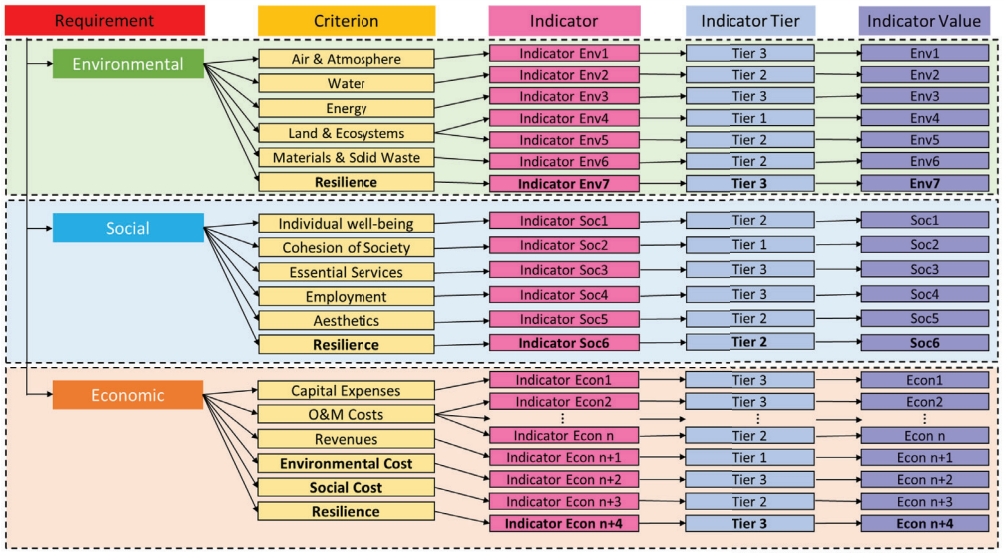
Considers **interconnections** between the three dimensions of sustainability and resilience



TQUALICSR Framework



Phase 3: Integrated Sustainability Resilience Assessment



Phase 3

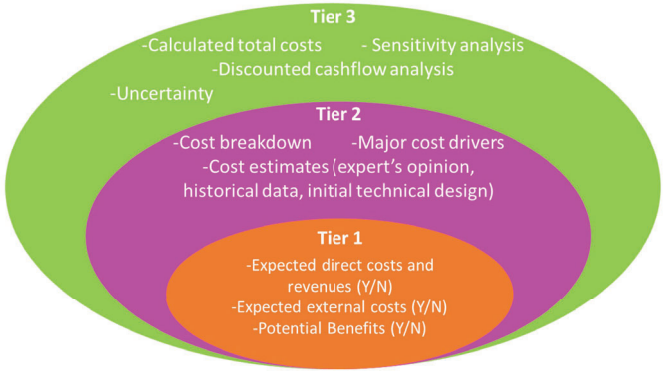
Quantify Sustainability Indicators

- Qualitative or Quantitative
- Need flexible approach
- How to quantify indicators numerically?
- Proposed use of tiered tools
  - Tier 1: Qualitative (BMPs)
  - Tier 2: Semi-quantitative (Ratings)
  - Tier 3: Quantitative

Tiered Assessment: Advantages

- Considers the amount and type of data, information, and tools **available to the user**
- Rankings based on the degree of **quantitative nature**, **time required**, and **accuracy** involved

Economic Indictors and Metrics



Phase 3

Calculate Sustainable Resilience Index (SRI)

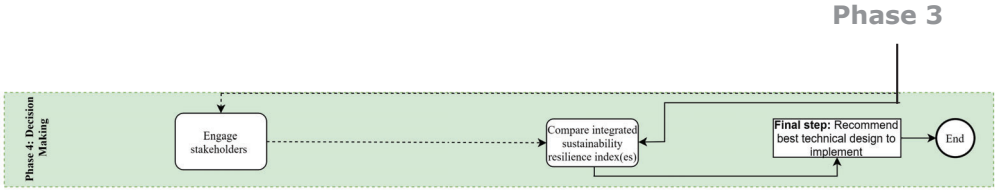
- Derived based on Multi-Criteria Decision Analysis results
- Normalized indicator values obtained from the value function (V_{ind}) are multiplied by their respective weights (W_{ind}) assigned in Phase 2

$$V_{cri} = \sum W_{ind} \times V_{ind}$$

$$V_{req} = \sum W_{cri} \times V_{cri}$$

$$V_{final}(SRI) = \sum W_{req} \times V_{req}$$

Phase 4: Decision Making



- Participatory and comprehensive review of the designs before a choice is selected
- Multiple stakeholders' views are recommended to be considered
- Analysis of the calculated integrated sustainability resilience indicators
- The "best" option may be subjected to external project considerations:
  - Budget restrictions
  - Social acceptance
  - Stakeholders' preference

Case Study: UIC Geothermal System

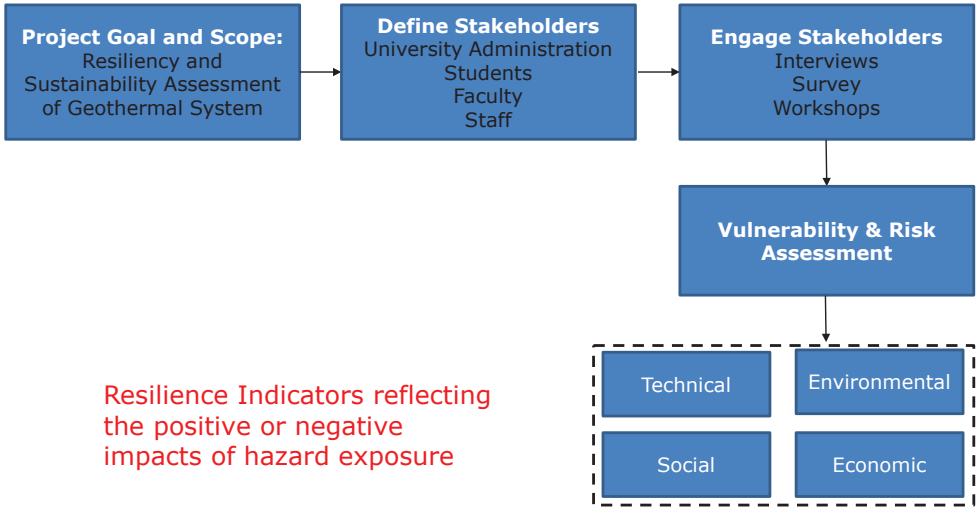
- UIC has geothermal heating and cooling system inside Grant, Lincoln, and Douglas Halls.
- Goal: 50% savings in energy consumption and almost zero carbon emissions.
- Constant indoor temperature of 73 degrees runs throughout the year.

Conventional Heating and Cooling System

- Conventional system includes a direct electric heating and cooling or burned fossil fuels to convert to heat or oil HVAC (Heating, Ventilation, and Air Conditioning) systems.
- Compared to geothermal system, conventional system tends to consume more fossil fuel

TQUALICSR Framework Application

Phase I: Design Constraints, Vulnerability and Risk Assessment & Resilience Indicators



Resilience Indicators reflecting the positive or negative impacts of hazard exposure

Phase 1: Resilience Indicators & Metrics

Hazard Exposure: Extreme Heat

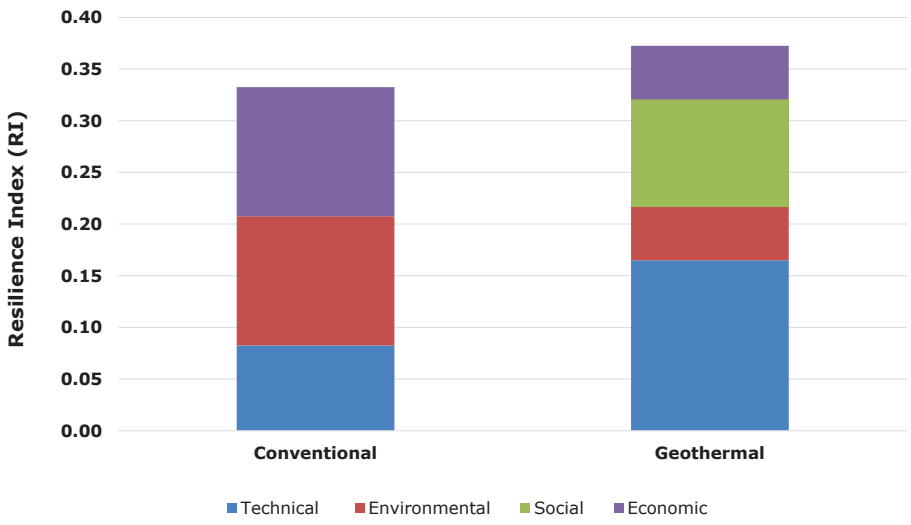
Criteria	W criteria - %	Indicators	W indicator - %	Indicator value	
				Conventional	Geothermal
Technical	25	Not meeting the energy demand	33	2	3
		Equipment malfunction	33	3	4
		Damage to equipment/infrastructure/utilities	33	4	2
Environmental	25	Air circulation issues	50	2	4
		Sanitation/Water supply	50	3	2
Social	25	Occupant discomfort	33.33	4	3
		Negative effect on student learning	33.33	4	3
		Negative health issues	33.33	1	3
Economic	25	Emergency/Backup energy supply	50	3	4
		Emergency repairs	50	4	3

Requirement	W requirement - %	Criteria	W criteria - %	Indicators	W indicator - %	Indicator value		Tendency	X^{min}	X_{max}	Value Indicator		Value Indicator * Windicator		V criteria		V criteria * W criteria		V requirement		V final = V requirement * W requirement	
						Conventional	Geothermal				Conventional	Geothermal	Conventional	Geothermal	Conventional	Geothermal	Conventional	Geothermal	Conventional	Geothermal	Conventional	Geothermal
Resilience	100.00	Technical	25	Not meeting the energy demand	33	2	3	Decrease	2	3	1.00	0.00	0.33	0.00	0.66	0.33	0.17	0.08	0.50	0.33	0.50	0.33
				Equipment malfunction	33	3	4	Decrease	3	4	1.00	0.00	0.33	0.00								
				Damage to equipment/infrastructure/utilities	33	4	2	Decrease	2	4	0.00	1.00	0.00	0.33								
		Environmental	25	Air circulation issues	50	2	4	Decrease	2	4	1.00	0.00	0.50	0.00	0.50	0.50	0.13	0.13				
				Sanitation/Water supply	50	3	2	Decrease	2	3	0.00	1.00	0.00	0.50								
		Social	25	Occupant discomfort	33.33	4	3	Decrease	3	4	0.00	0.42	0.00	0.14	0.33	0.28	0.08	0.07				
				Negative effect on student learning	33.33	4	3	Decrease	3	4	0.00	0.42	0.00	0.14								
				Negative health issues	33.33	1	3	Decrease	1	3	1.00	0.00	0.33	0.00								
		Economic	25	Emergency/Backup energy supply	50	3	4	Decrease	3	4	1.00	0.00	0.50	0.00	0.50	0.21	0.13	0.05				
				Emergency repairs	50	4	3	Decrease	3	4	0.00	0.42	0.00	0.21								

MCDA

Resilience Index

Phase 1: Resilience Index

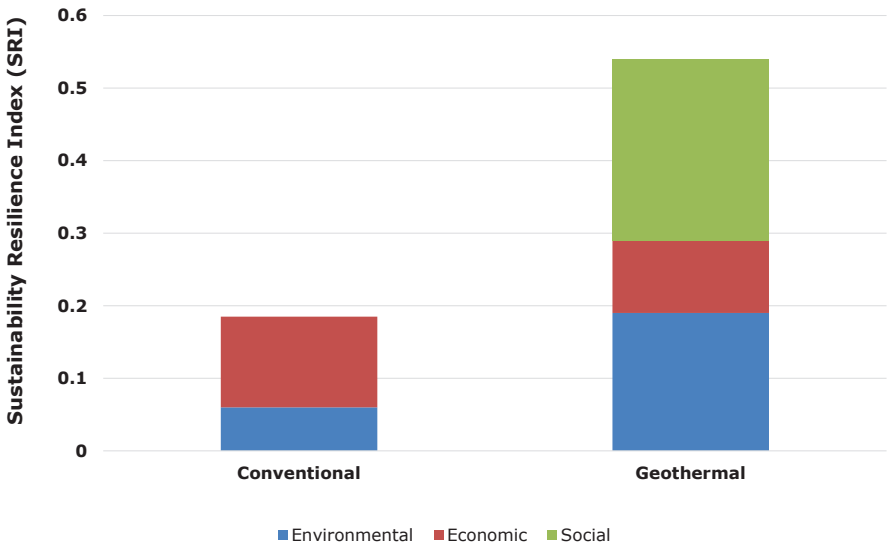


Based on this assessment, the technical design can be modified to make the system more resilient!

Phase 2: Sustainability Indicators and Weightages

Requirement	Weightage (Wrequirement - %)	Criteria	W criteria - %	Indicators	W indicador - %
Environmental	25%	Air	25%	Global Warming (kg CO2 eq)	17%
				Ozone depletion (kg CFC-11 eq)	17%
				Smog Formation (kg O3 eq)	17%
				Carcinogens (CTUh)	17%
				Non Carcinogens (CTUh)	17%
				Respitatory Effects (kg PM2.5 eq)	17%
		Water Usage & Imapacts	25%	Acidification (kg SO2 eq)	50%
				Eutrophication (kg N eq)	50%
		Land & Ecosystems	25%	Natural resource/Fossil Fuel depletion (MJ surplus)	50%
				Ecotoxicity	50%
		Resilience	25%	Release of harmful chemicals under breakdown	50%
				Reduced access to the system	50%
Economic	25%	Direct Cost	50%	Raw Materials (USD)	33%
				Transportation (USD)	33%
				Labor (USD)	33%
		Indirect Costs	20%	Stepwise Monetisation (USD)	100%
		Social Costs	20%	Social Cost of CO_2	100%
		Resilience	10%	Financial Security	100%
Social	25%	Public Survey	30%	Social-Individual	25%
				Social-Institutional	25%
				Social-Economic	25%
				Social-Environmental	25%
		Group SSEM	50%	Social-Individual	25%
				Social-Institutional	25%
				Social-Economic	25%
				Social-Environmental	25%
		Resilience	20%	Assistance to individuals	50%
				Access to alternative power	50%

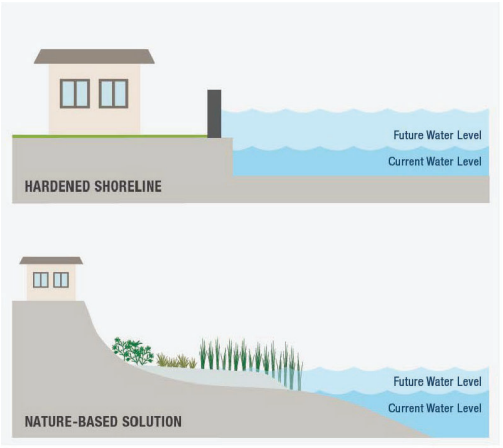
Phase 3: Sustainable Resiliency Index

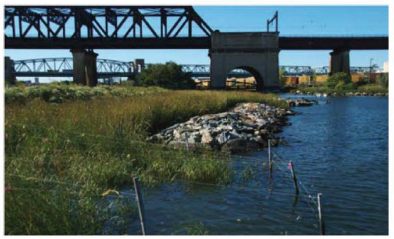


Phase 4: Decision Making

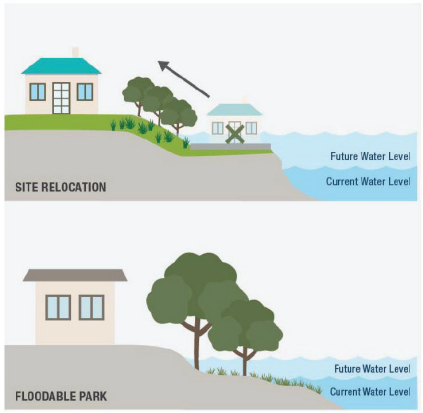
- Budget restrictions?
- Social acceptance?
- Stakeholders' preference?

Resilient and Sustainable Design: Flood/Surge Protection



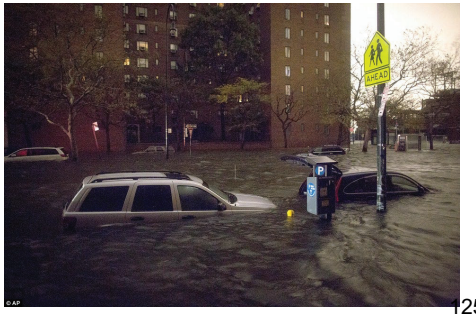


Resilient and Sustainable Design: Flood/Surge Protection



NYC Parks Design and Planning for Flood Resiliency

Hurricane Sandy (2012): New York



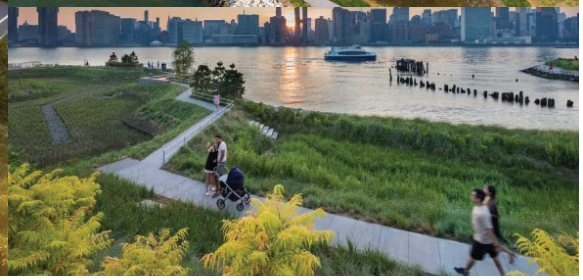
Resilient and Sustainable Design

Resilient and Sustainable Design

Resilient and Sustainable Design

Resilient and Sustainable Design

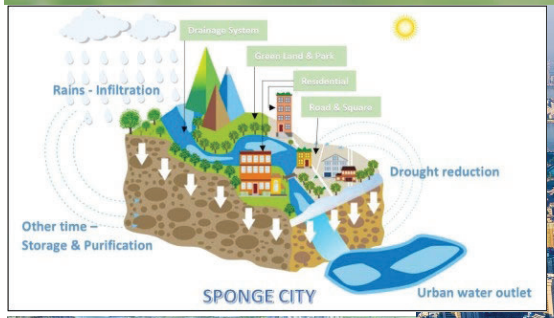
NY Hunter's Point South Park to Address Rising Tides



Green Infrastructure Tackling Floods

ABC Waters Site in Singapore (ABC=Active, Beautiful, and Clean)

Sponge Cities



Water Park with Stormwater Storage

New innovative water square combines leisure and storm water storage in Rotterdam, the Netherlands

Take-Home Messages

- To cope with the negative impacts of climate change, climate adaptation (resiliency) options should be recommended based on adaptive management methodology (non-stationarity? Uncertainty? Unknown Unknowns?)
- In the long-run, climate mitigation (control of greenhouse gas emissions) options are needed to minimize/prevent climate change hazards. Select options that are impactful and can provide co-benefits!
- Consider sustainability (broader environmental, economic and social issues) in selecting climate adaptation and mitigation options (to promote sustainable development)
- Use integrated resilience and sustainability assessment tools (e.g., Envision, TQUALICSR) that provide structured approach to develop optimal solutions!
- Promote nature-based engineering solutions that have potential to be both resilient and sustainable!

Contact/Additional Information

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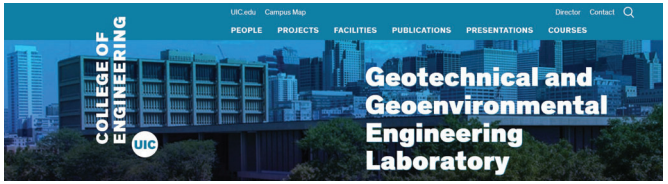


gagel.lab.uic.edu

THANK YOU

QUESTIONS ?

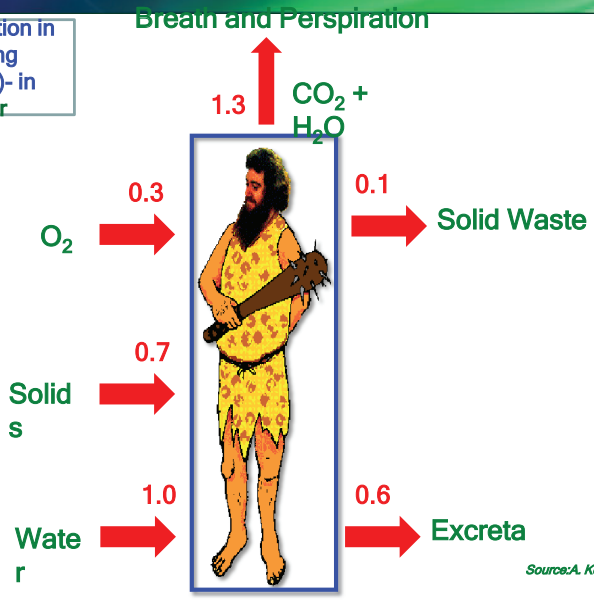
Effective waste management leading to circular economy

Suneel Pandey

6th May 2022

Minimalistic Consumption = Less Waste Output

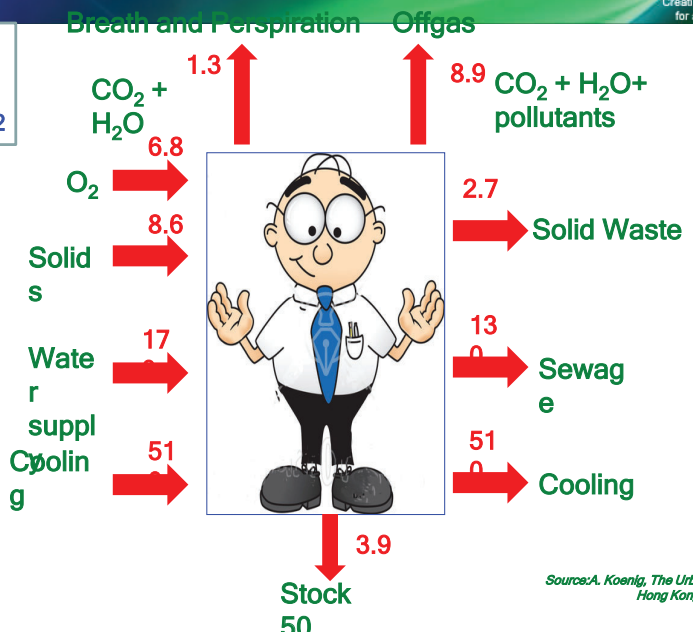
Material Consumption in Neolithic Hong Kong Person (1992 B.C.)- in tonnes/person-year



Source:A. Koenig, The Urban Metabolism of Hong Kong

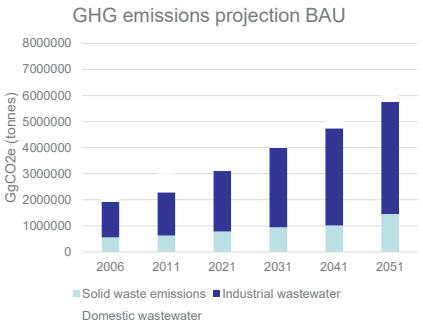
More Consumption = More Waste Output

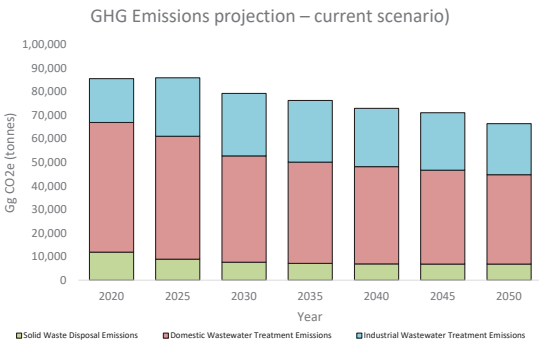
Material Consumption of modern Hong Kong man (1992 A.D); tonnes/person-year



Source:A. Koenig, The Urban Metabolism of Hong Kong

GHG Emissions for Waste Sector in India



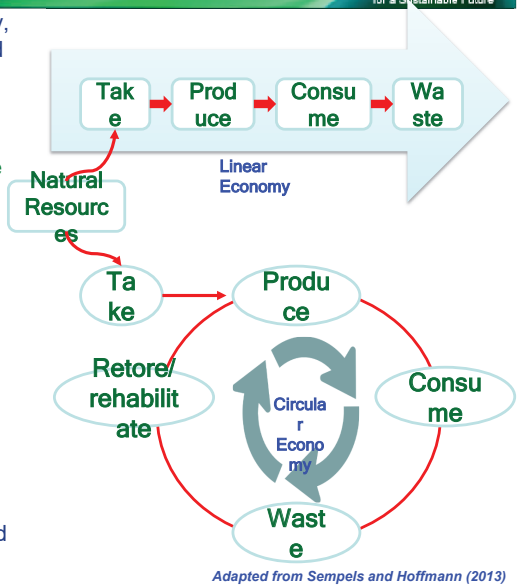


TERI estimates based on IPCC;
Reduction largely due to recent Government Initiatives

GHG: Greenhouse Gas Emissions

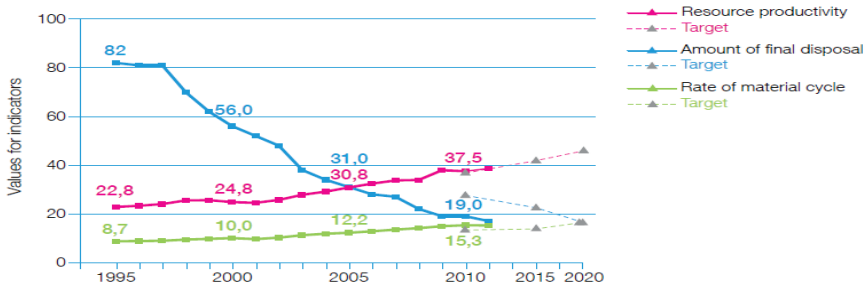
Defining the Circular Economy

- A close loop of material flow in an economy, based on a circular concept was introduced by Pearce and Turner in 1990
- CE refers to restorative system through a careful management of materials flows
- "CE is designed to efficiently recirculate the raw material and used to produce goods through
  - **Product-life extension;**
  - **Eco-design;**
  - **Long-life goods;**
  - **Reconditioning, reuse activities;**
  - **Renting service system instead of owning product;**
  - **Waste prevention**
  - **Industrial Symbiosis**
- CEfocuses on three objectives; economy (accelerate growth), social (job creation and employment) and environment (reduce pollution and GHG emission).



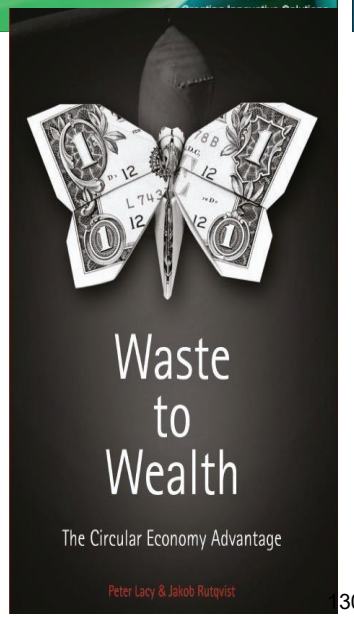
Adapted from Sempels and Hoffmann (2013)

Enhancing Resource Recovery – Case of Japan



Circular Economy Potential

- According to the Waste to Wealth from Accenture Strategy (NYSE: ACN) research, the CE could generate US$ 4.5 trillion of additional economic output by 2030
- Various circular business models will help decouple economic growth and natural resource consumption while driving greater competitiveness



https://newsroom.accenture.com/news/the-circular-economy-could-unlock-4-5-trillion-of-economic-growth-finds-new-book-by-accenture.htm

Circular Economy: New Business Models

1. Product Transformation: if not the entire products be reconditioned in their entirety but certain components that carry a high value, and with the right design and remanufacturing capabilities, they can be put together to form new products

Example: Mobile phone containing precious metals

2. Sharing Platform: is centered on the sharing of products and assets that have a low ownership or use rate

Examples: sharing transportation (Lyft, RelayRides, BlaBlaCar), lodging (Airbnb), and neighbors helping neighbors (TaskRabbit, NeighborGoods)

3. Resource Recycling: Recycling the waste produced in product's supply chain and use as secondary raw materials (ex. Coca Cola recycling their PET bottles)

http://www.greenbiz.com/article/5-business-models-put-circular-economy-work

http://www.fastcoexist.com/1681904/5-business-models-that-are-driving-the-circular-economy

Recycling and Job Creation…

Dumping 10,000 tons of waste in a landfill 6 Jobs

recycling Of 10,000 tons of waste 36 Jobs

Recycling generates more jobs (at higher income levels) than other forms of waste management

http://www.all-recycling-facts.com/recycling-benefits.html

World's Recycling Industry and Market

- Approximately 1.6 million people worldwide are active in the recycling industry
- Together, they handle more than 600 million tonnes of recyclables every year
- Annual turnover of more than $200 billion, similar to the GDP of countries such as Portugal, Colombia and Malaysia
- About 10% of this amount is spent on new technologies, R&D that contribute to creating high-skilled jobs and making recycling more efficient and environmentally sound
- Recycled Materials supply 40% of the global raw material needs

"Bureau of International Recycling" http://www.bir.org/industry/

10

Waste is Wealth: Billion Dollar WM Companies

- Businesses everywhere generate trash, but trash also generates new businesses

VEOLIA ENVIRONMENTAL SERVICES

Market Cap $10.9 Billion (as of May 2015)

#723 Global 2000

Forbes 2015 Global 2000 Top Companies

SUEZ environnement

€ 14.324 Billion (2014)

WM WASTE MANAGEMENT

Waste Management Market Cap $19.49 billion (As of May 2014)

Fortune 500 Companies

FORTUNE 500

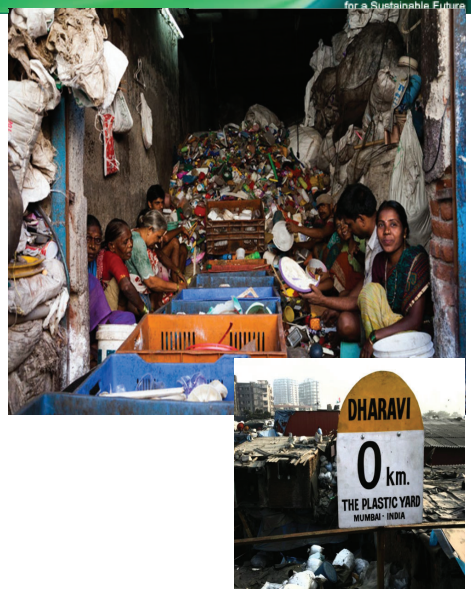
131

13

India's Dharavi Recycling Slumdog Entrepreneurs

- Dharavi- Asia's largest slums is now labelled as the recycling centre of India with an estimated 15,000 single room factories, employing around a quarter of a million people and turning over a staggering £700 million ($US 1 billion) each year
- Over 80% of Mumbai's waste is given a new lease of life by recyclers
- Wages in Dhavari are in range of 3,000 to 15,000 rupees per month

http://www.sustainablebusinesstoolkit.com/dharavi-indias-recycling-slumdog-entrepreneurs/



Some Indian examples

Example 1: PET waste pre-processing

The earlier in the process foreign substances are removed, and the more thoroughly this is done, the more efficient the process is.

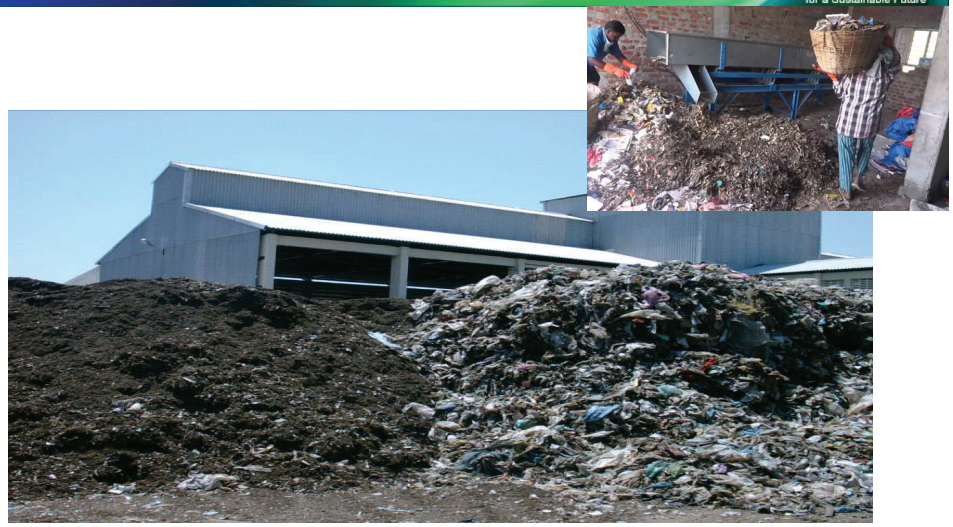
Polyethylene terephthalate

Possible commercial products from PET waste

Ganesha Ecosphere

Do you know that Indian cricket team' uniform, made by Nike, is produced from recycled PET bottle

Example 2: Refuse derived fuel co-processing in cement kilns



Advantages of co-processing

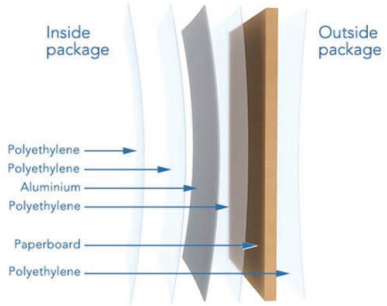
- High flame temperature (1500°C) – ensures complete destruction of harmful pollutants
- High residence time >5 sec in oxygen rich atmosphere - ensures complete destruction of organic compounds including dioxins and Furan
- Total neutralization of acid gases, SOx and HCl - by the active lime in the kiln load
- The biggest advantage is that co-processing leaves no residue to be land-filled.

Example 3: Use of plastic in road making

The implementation of plastics in roads also opens a new option for recycling post consumer plastics

Example 4: Tetra Pak PCC Recycling

- Tetra Pak cartons are primarily made from paper. 75% of the Tetra Pak carton is made from paperboard, 20% of polyethylene and 5% of aluminum.



Reprocessed product

Landfill free cities

Benefits
- Reduction in uncontrolled methane emission
- Reduction in landfill fires
- Minimizing waste to landfills
- Resource recovery from waste
- Creation of green jobs

- In fact, filled up dumpsites need to be characterised for combustibles including plastics, rags, leather, etc.
- These can be mined and used for RDF preparation while organic degradable portion can be composted and inerts can be used in construction
- This would free up valuable space which can be used for developing integrated waste management project

Thank you

Climate Resilient Waste Management

Speaker: Mr. S.Sudalai, Assistant Professor, Centre for Pollution Control and Environmental Engineering, Pondicherry University

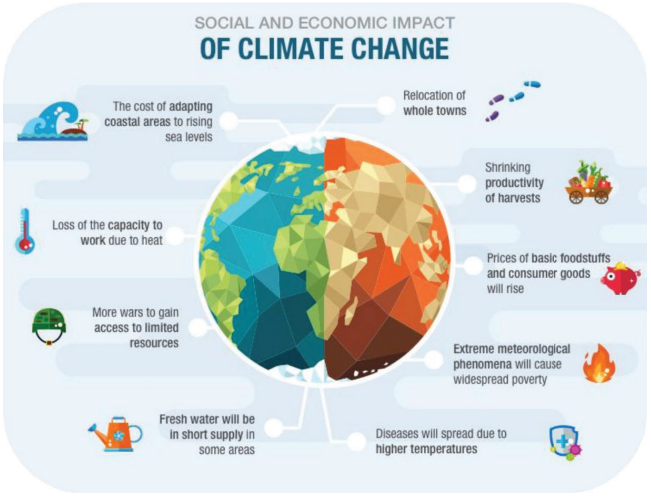
Date : 06.05.2022

Climate Resilient Waste Management

Thoughts by

S.Sudalai
Assistant Professor, Centre for Pollution Control and Environmental Engineering, Pondicherry University

Sudalai.S, CPCEE,PU

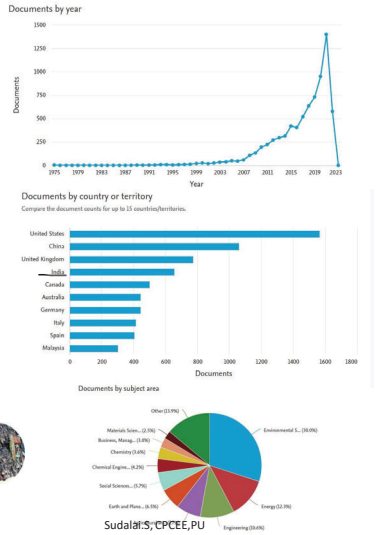


https://www.iberdrola.com/sustainability/impacts-of-climate-change

Sudalai.S, CPCEE,PU

456,018 document results
TITLE-ABS-KEY (**climate AND change**)

7,567 document results 1.6 %
(TITLE-ABS-KEY (**climate AND change**)) AND (**solid AND waste**)



Sudalai.S, CPCEE,PU

.Global solid waste generation rates

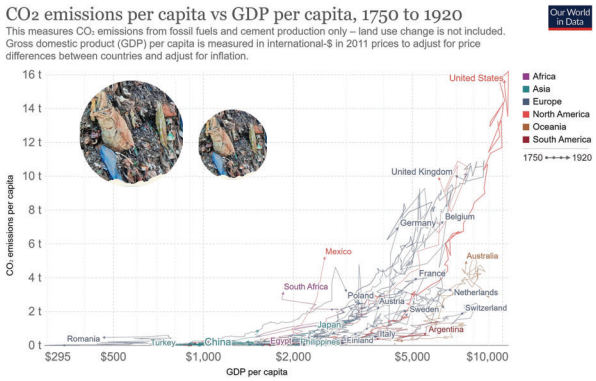
0.1-0.8t/cap/yr (tons per capita per year) low-income,

0.2-0.5 t/cap/yr in middleincome and

0.3-0.8 t/cap/yr in high-income countries

Positively correlated with

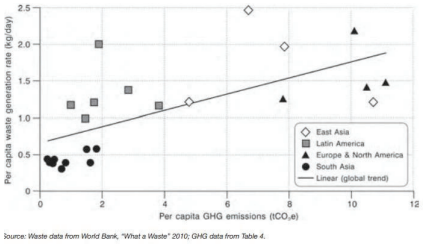
- **Per capita energy consumption,**
- **Gross domestic product, and**
- **Private consumption.**



The largest impact of climate change is that it could wipe off up to 18% of GDP off the worldwide economy by 2050 if global temperatures rise by 3.2°C, the Swiss Re Institute warns.

Sudalai.S, CPCEE,PU

Per Capita GHG Emissions (tCO2e) and Waste Generation Rate (kg/day)



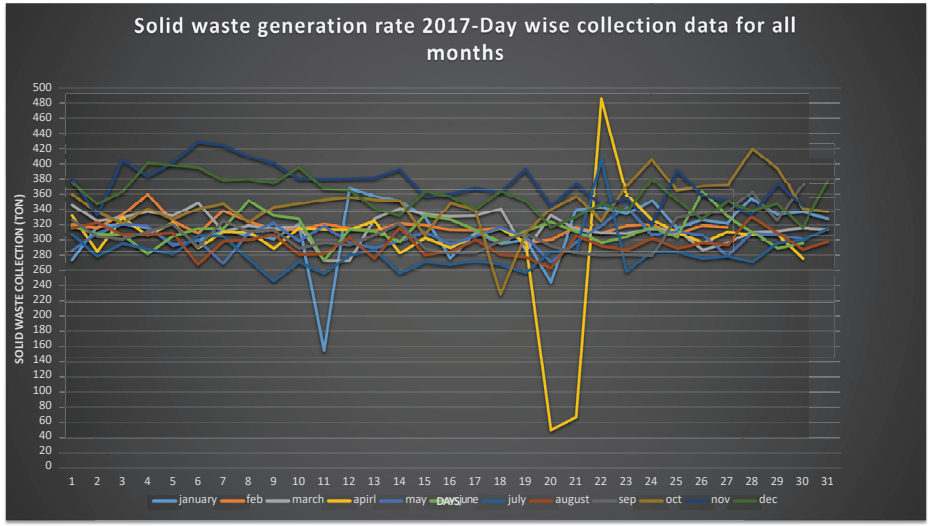
Source: Waste data from World Bank, "What a Waste" 2010; GHG data from Table 4.

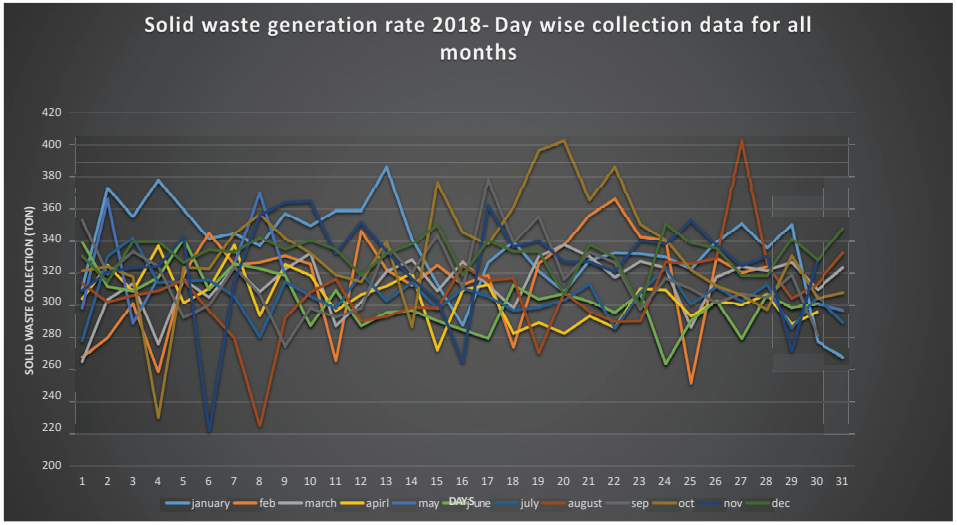
Sector	Percentage of global GHG emissions	Justification for estimating the proportion of GHGs from cities, from the perspective of the location of activities that produced them	Percentage of GHGs allocated to cities
Energy supply[a]	25.9	A high proportion of fossil fuel power stations are not in cities, especially the largest cities. One third to one half of emissions from city-based power stations.	8.6–13.0
Industry	19.4	A large proportion of heavy industry (which accounts for most GHGs from industry) is not located in cities, including many cement factories, oil refineries, pulp and paper mills, metal smelters. Two-fifths to three-fifths of emissions in cities.	7.8–11.6
Forestry[b]	17.4	No emissions assigned to cities.	0
Agriculture	13.5	Some large cities have considerable agricultural output, but mostly because of extended boundaries encompassing rural areas. No emissions assigned to cities.	0
Transport	13.1	Private use of motor vehicles a large part of this. Should commuting by car by those living outside cities be assigned to cities? Should city dwellers driving outside city boundaries be assigned to their city? 60 to 70 per cent of emissions assigned to cities.	7.9–9.2
Residential and commercial buildings	7.9	Large sections of middle- and high-income groups in developed countries live outside cities – and a significant and increasing proportion of commercial buildings are located outside cities. 60 to 70 per cent of emissions assigned to cities.	4.7–5.5
Waste and wastewater	2.8	More than half of this is landfill methane; but a proportion of this would be released outside urban boundaries from waste generated inside cities. 54 per cent of emissions assigned to cities.	1.5
Total[c]	100		30.5–40.0

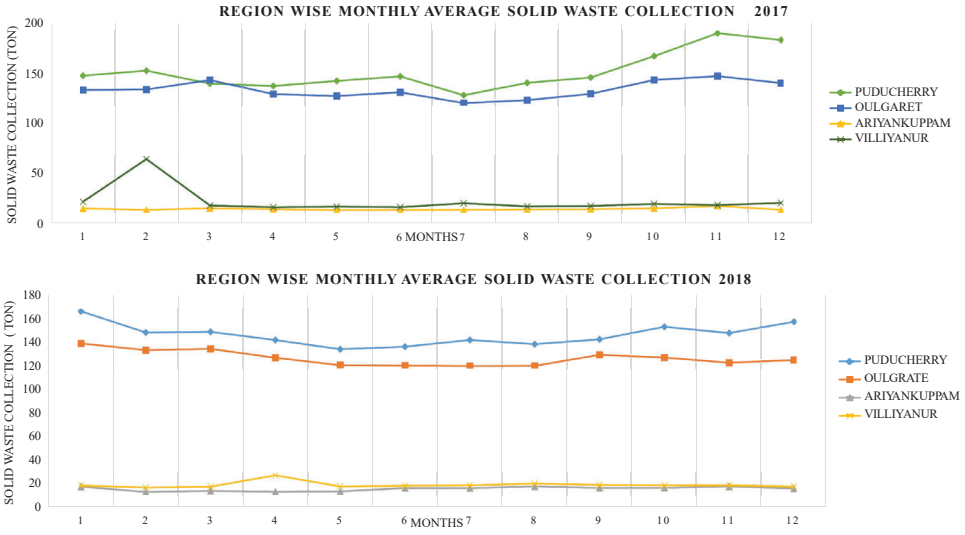
Notes: a A large part of this is from fossil fuel power stations. Excludes refineries, coke ovens, etc., which are included under industry.
b Land use and land-use changes.
c Total emissions for the GHGs covered by the Kyoto Protocol amounts to 49 billion tonnes of CO_2eq.
Source: based on Barker et al. 2007; Satterthwaite 2008b, p544

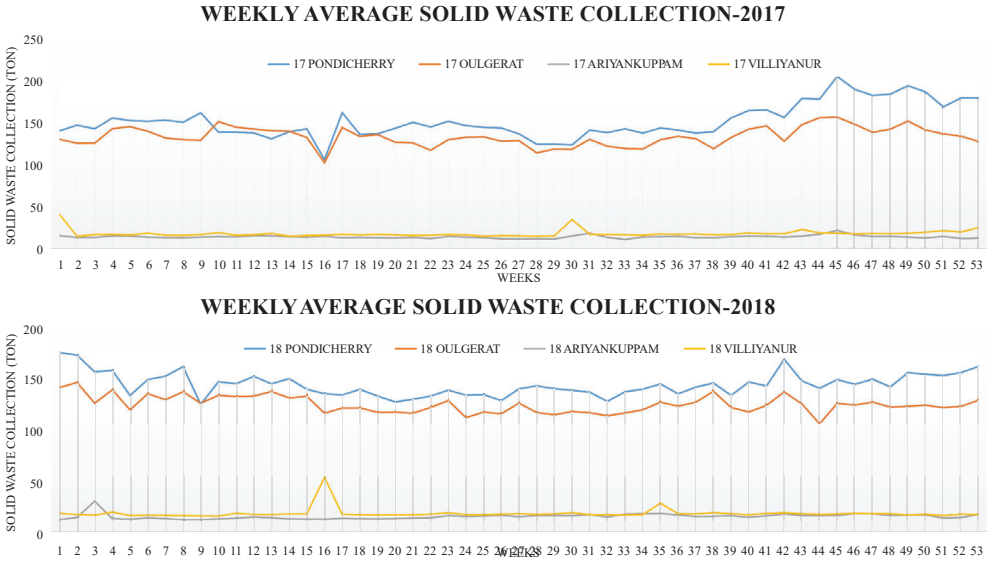
https://mirror.unhabitat.org/downloads/docs/GRHS2011-3.pdf

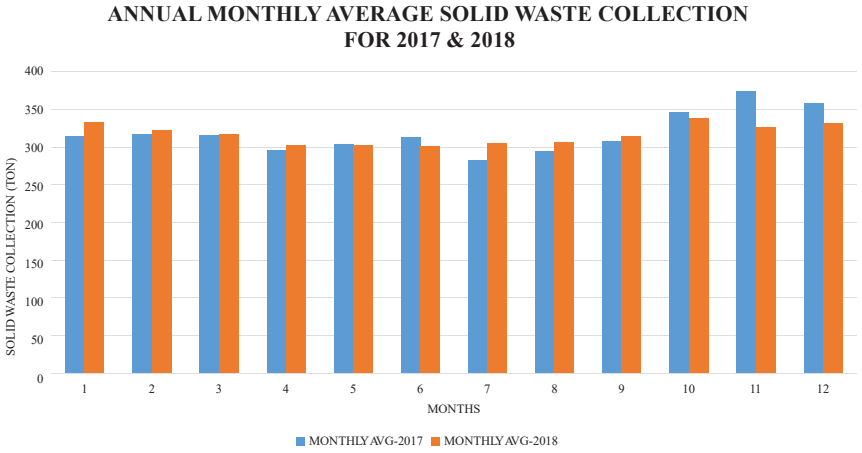
Sudalai.S, CPCEE,PU

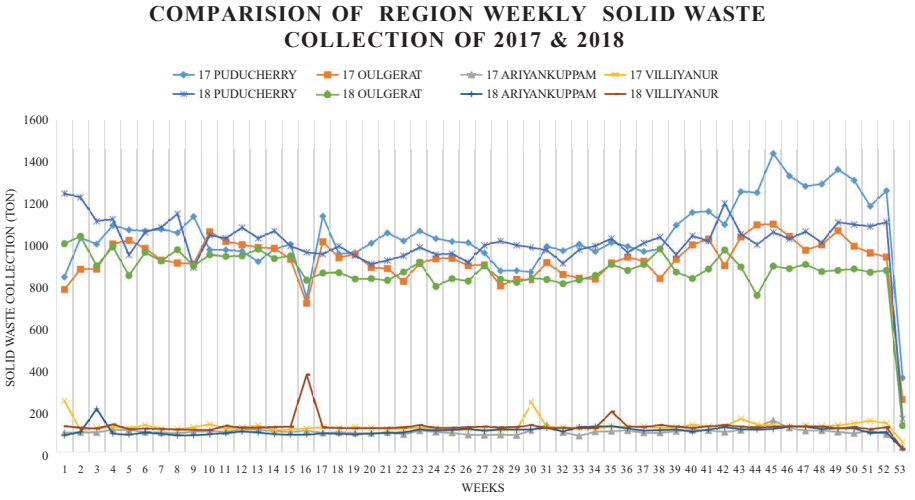


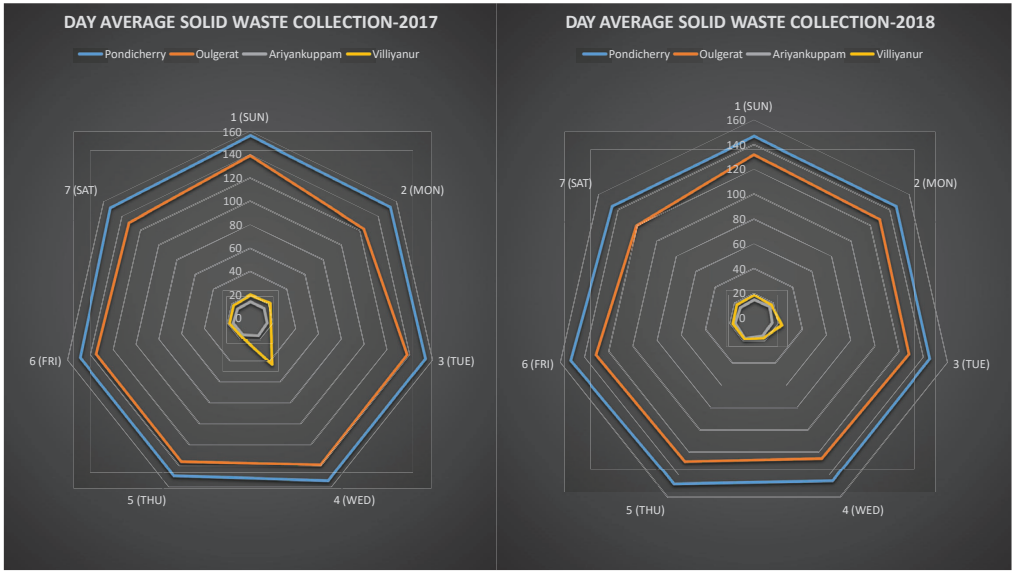


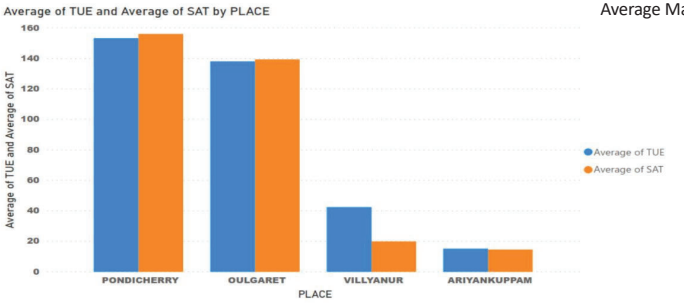



WEEKLY AVERAGE SOLID WASTE COLLECTION-2017
17 PONDICHERRY
17 OULGERAT
17 ARIYANKUPPAM
17 VILLIYANUR
SOLID WASTE COLLECTION (TON)
WEEKS
WEEKLY AVERAGE SOLID WASTE COLLECTION-2018
18 PONDICHERRY
18 OULGERAT
18 ARIYANKUPPAM
18 VILLIYANUR
SOLID WASTE COLLECTION (TON)
WEEKS

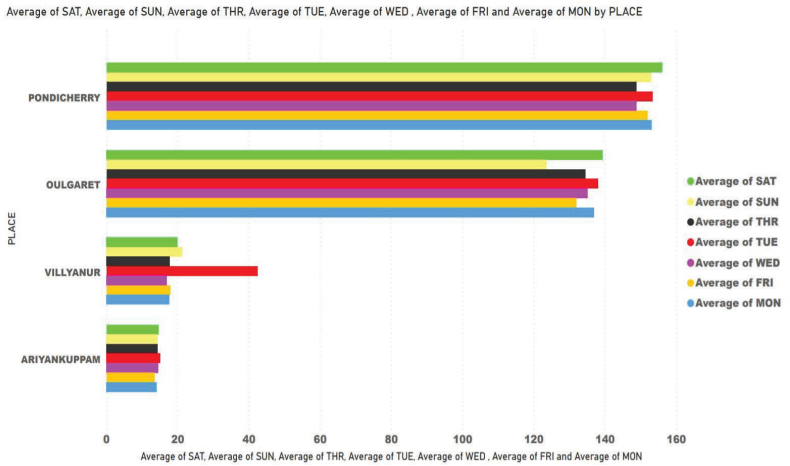

ANNUAL MONTHLY AVERAGE SOLID WASTE COLLECTION FOR 2017 & 2018
SOLID WASTE COLLECTION (TON)
MONTHS
MONTHLY AVG-2017
MONTHLY AVG-2018


COMPARISION OF REGION WEEKLY SOLID WASTE COLLECTION OF 2017 & 2018
17 PUDUCHERRY
17 OULGERAT
17 ARIYANKUPPAM
17 VILLIYANUR
18 PUDUCHERRY
18 OULGERAT
18 ARIYANKUPPAM
18 VILLIYANUR
SOLID WASTE COLLECTION (TON)
WEEKS


DAY AVERAGE SOLID WASTE COLLECTION-2017
Pondicherry
Oulgerat
Ariyankuppam
Villiyanur
1 (SUN)
2 (MON)
3 (TUE)
4 (WED)
5 (THU)
6 (FRI)
7 (SAT)
DAY AVERAGE SOLID WASTE COLLECTION-2018
Pondicherry
Oulgerat
Ariyankuppam
Villiyanur
1 (SUN)
2 (MON)
3 (TUE)
4 (WED)
5 (THU)
6 (FRI)
7 (SAT)



Average Max. day Tues vs Sat



PLACE	SUN	MON	TUE	WED	THR	FRI	SAT
ARIYANKUPPAM	776.88	748.74	801.56	769.35	762.20	713.92	772.57
OULGARET	6,545.14	7,119.87	7,175.80	7,022.75	6,989.89	6,856.91	7,244.62
PONDICHERRY	8,100.90	7,956.70	7,970.83	7,734.47	7,735.06	7,897.12	8,112.63
VILLYANUR	1,128.50	915.02	2,203.27	880.63	921.96	927.32	1,033.26
Total	**16,551.42**	**16,740.33**	**18,151.46**	**16,407.20**	**16,409.11**	**16,395.27**	**17,163.08**

18.15K
TUE

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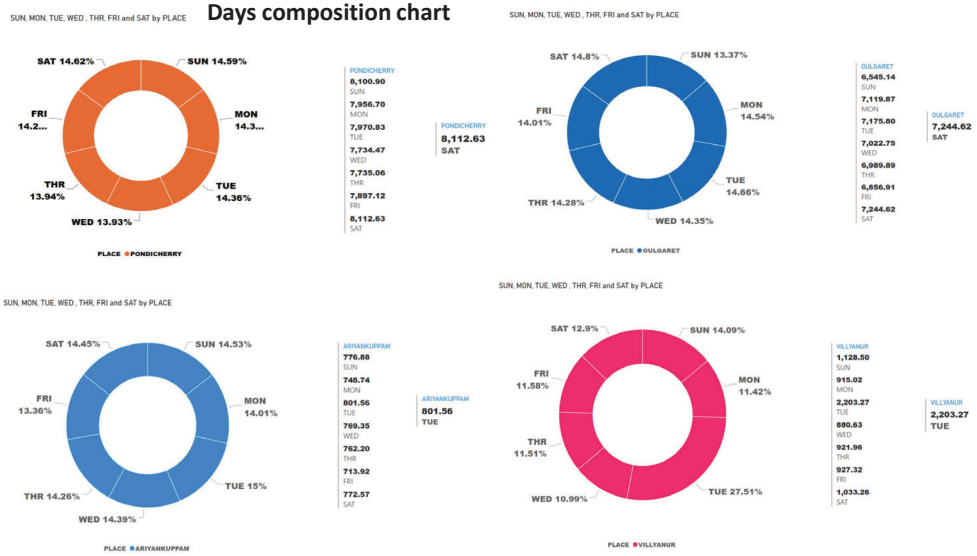
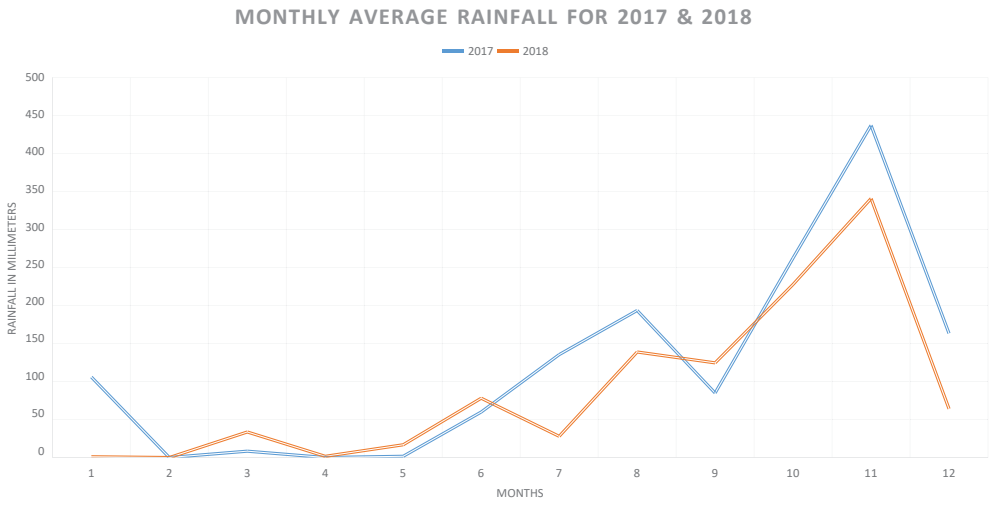
Days composition chart





Climate variables	Potential climate change	Impacts on Solid waste management
Temperature	Very high temperature	Increase water demand for workers and site operation
	More hot days increases in the dry season	Decline in air quality and following negative impacts of heat on vulnerable groups
	The number of cold days decreases in rainy season	Affects biological processes(composting, anaerobic digestion)
Precipitation	An increase of more water days	Increase risk of flooding
	Precipitation intensity increases	Disruption of infrastructure (rail, road)
		Affect slope stability on waste management site
		Affects biological processes(composting, anaerobic digestion)
Sea level	Increase sea level	Inundation of waste management facilities Increase erosion of coastal areas

Climate Change & Solid waste Management

https://www.researchgate.net/publication/332978670_Interrelation_between_Climate_Change_and_Solid_Waste

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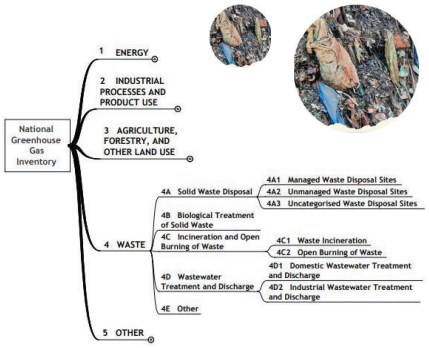
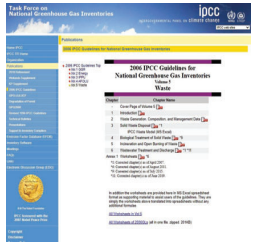
Solid waste contributes directly to greenhouse gas emissions through the generation of methane from the anaerobic decay of waste in landfills, and the emission of nitrous oxide from our solid waste combustion facilities.



Waste composition is one of the main factors influencing emissions from solid waste treatment, as different waste types contain different amount of degradable organic carbon (DOC) and fossil carbon. Waste compositions, as well as the classifications used to collect data on waste composition in MSW vary widely in different regions and countries.

In this Volume, default data on waste composition in MSW are provided for the following waste types:

(1) food waste
(2) garden (yard) and park waste
(3) paper and cardboard
(4) wood
(5) textiles
(6) nappies (disposable diapers)
(7) rubber and leather
(8) plastics
(9) metal
(10) glass (and pottery and china)
(11) other (e.g., ash, dirt, dust, soil, electronic waste)



https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_2_Ch2_Waste_Data.pdf

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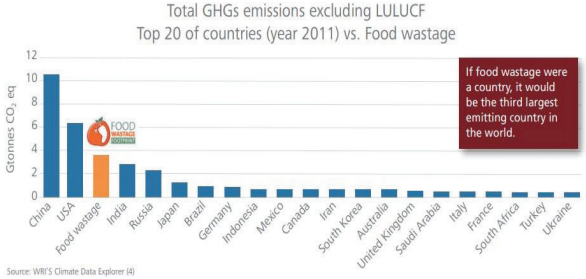
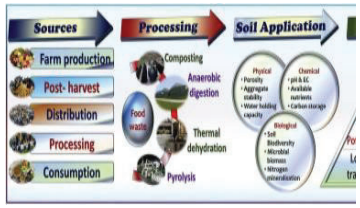
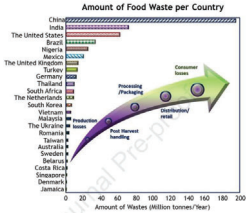




https://doi.org/10.1016/j.envpol.2020.115985

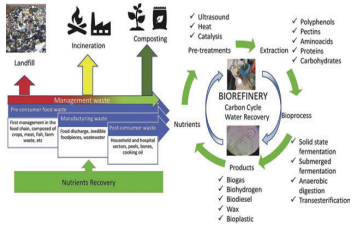


FOOD WASTE

The 2012 market value of food products lost or wasted was **USD 936 billion;** that is in the range of the GDP of countries such as Indonesia or the Netherlands.

Using FAO methodology and estimates (3), the total cost of GHG emissions from global food wastage is USD 411 billion.

Global food loss and waste generate annually **4.4 $GtCO_2$ eq,** or about **8%** of total anthropogenic GHG emissions . This means that the contribution of food wastage emissions to global warming is almost equivalent **(87%) to global road transport** emissions



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https://www.fao.org/3/bb144e/bb144e.pdf

FOOD WASTE

Globally, on average, **65 kg of food is wasted per year by one person** of which 25% is through wasted vegetables, 24% through cereals and 12% through fruits.

Daily wasted amounts of vitamin C, K, Zinc, Copper, Manganese and Selenium are especially high representing 25-50% of their daily dietary recommended intake (DRI) value.

Cereals, fruits and vegetables are the three major food groups contributing the most to wasted nutrients followed by meat, dairy and eggs that contribute substantially to the wasted calcium, choline, riboflavin, zinc, and vitamin B12.

Global average amount of food waste per capita per year contains 18 healthy diets meaning it can fulfil the DRIs of 25 nutrients for one person for 18 days.

The embedded environmental footprints in average person's daily food waste are:
124 g CO_2 eq., **58 Litre freshwater use,** 0.36 m^2 cropland use, 2.90 g nitrogen and 0.48 g phosphorus use.

Cereals, meat, and sugar are major food groups contributing to environmental impacts.

Canxi Chen, Abhishek Chaudhary, Alexander Mathys,
Nutritional and environmental losses embedded in global food waste,
Resources, Conservation and Recycling,Volume 160,2020,104912,ISSN 0921-3449,https://doi.org/10.1016/j.resconrec.2020.104912

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How much food is wasted

On Average, 40% of food produced were being disposed of. This means that 7.5 tons of food are discarded daily.

Some 84.7% of the whole waste material recorded was thrown within the bin, whereas the remainder was either fed to the poor or some animals.

A big portion of the waste material binned was still in edible condition.

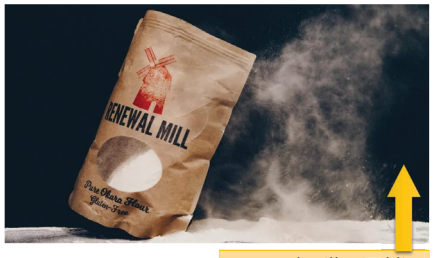
https://www.chintan-india.org/sites/default/files/2019-09/Food%20waste%20in%20India.pdf

https://www.avristech.com/food-waste-management-in-india/

[Photo: Wtrmln Wtr]

When the founders learned that hundreds of millions of pounds of watermelon stayed in fields to rot because the fruit was judged too unattractive for sale in supermarkets, they decided to create a product that could help avoid that waste. The juice is now available nationally, and the company is growing 30% year-over-year.

snack company founded in 2012 that sells "upcycled" dehydrated banana snacks made from bruised, overripe, or otherwise imperfect bananas that are usually left to rot on banana plantations. Now a multimillion-dollar business, it sells products in both natural and mainstream supermarkets, and has rescued roughly 20 million tons of bananas to date.



Renewal Mill, a public benefit corporation that reduces food waste by transforming fiber-rich scraps from food processing operations into flour that can be sold wholesale.

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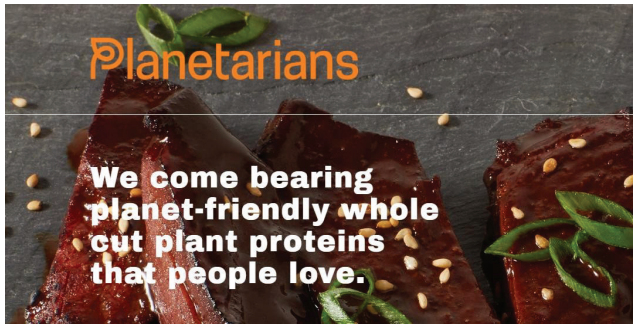
https://www.fastcompany.com/90337075/inside-the-booming-business-of-fighting-food-waste

[Photo: Render]

Render

Bryner, a savory drink mix made with upcycled pickle brine that can be used in making a Bloody Maryln a collaboration with chefs from San Francisco's State Bird Provisions, it recreated a snack that the chefs make for themselves in the restaurant kitchen to make use of leftover quinoa.



When sunflower seeds are processed for their oil, the end result is a hard, dry, wood-like "oilcake" that's usually used as animal feed. But the ingredient has more protein than meat, and the founders of this startup realized that it had potential as a food for humans. They found a way to process the oilcake with steam, heat, and pressure to puff it up and turn the ingredient into chips.

WHITE MOUSTACHE TREASURE8 RISE PRODUCTS

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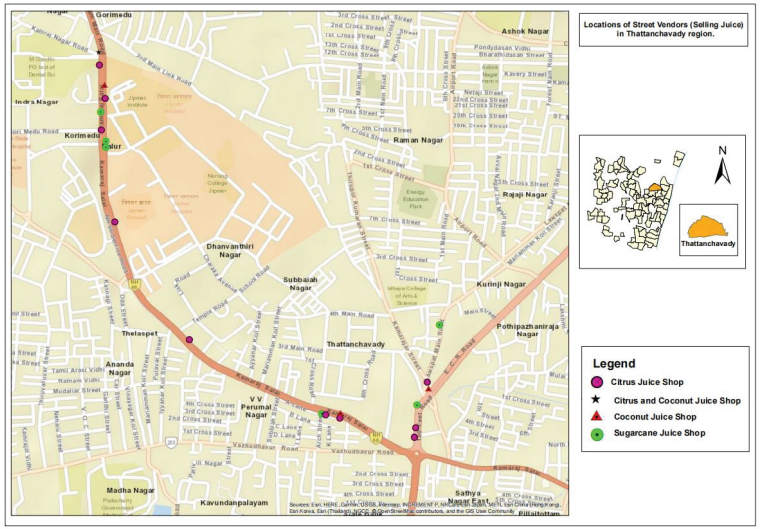
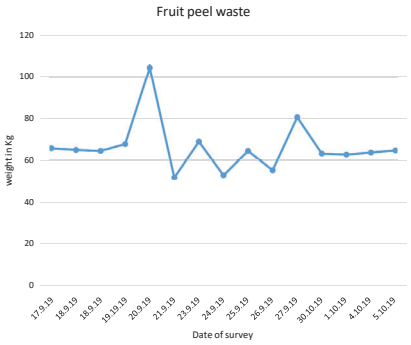


26

BIO-CLEANER FROM WASTE FRUIT PEELS

CHAPTER V CONTINUES

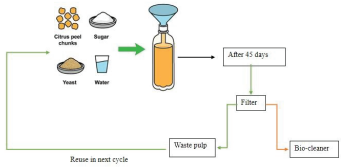
Fruits peels waste generation in campus



The shops located in shopping complex of PU campus alone generate 50 Kg /day. Which are collected at source and mixed with the other waste. It is wet waste

Before and After decay of Fruits peels waste in PU dump site

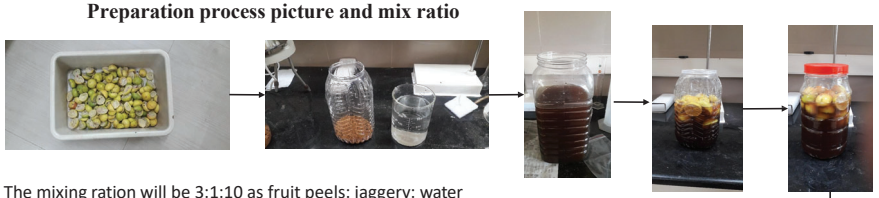
PREPARATION PROCESS



27

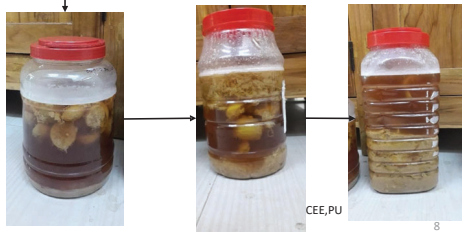
CHAPTER V CONTINUES

Preparation process picture and mix ratio



The mixing ration will be 3:1:10 as fruit peels: jaggery: water

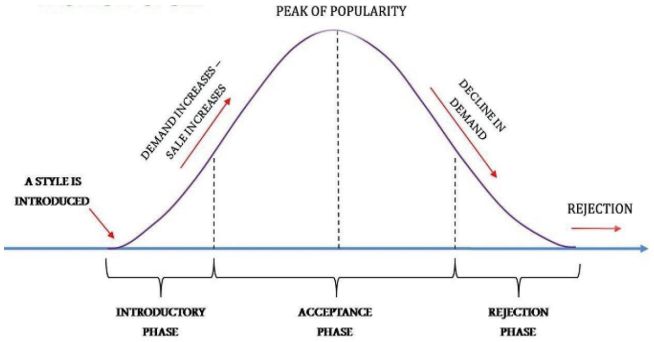
SAMPLES	FRUIT PEELS (gram)	JAGGARY (gram)	WATER (Liter)	YEAST
S1	300	100	1	Yes
S2	400	150	1.5	Yes
S3	600	250	2.5	No
S4	900	400	4	No
S5	400	150	1.5	No



CEE,PU

8

Recycling in Fashion and Textiles



Sudalai.S, CPCEE,PU Ref: Prof. K.Arul NIFT

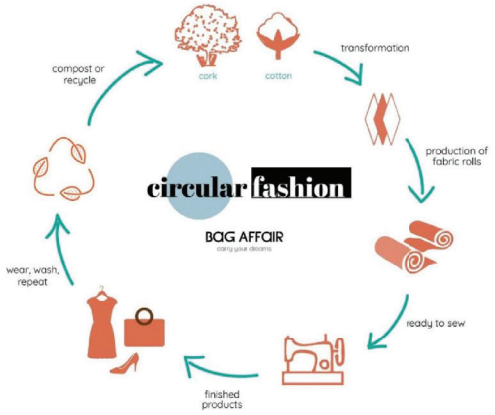
ENVIRONMENTAL IMPACT OF TEXTILES

- **80 Billion garments are produced in each year**
- **Brands release 52 micro collections per year**
- **An average of 35 kg of textile waste is generated by each person per year**
- **To produce one cotton shirt the fashion industry uses 2700 liters of water. That's the equivalent of 2.5 years of drinking water for a person.**
- **In total, up to 85% of textiles go into landfills each year.**

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION

"A circular fashion industry is defined as a regenerative system in which garments are circulated for as long as their maximum value is retained, and then returned safely to the biosphere when they are no longer of use."

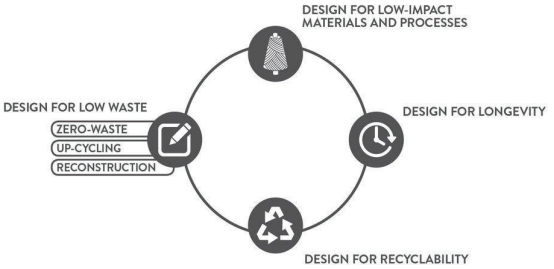


Source: https://www.bag-affair.com/what-is-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR DESIGN

- Design to facilitate their disassembly or repair, reusing and recycling
- Design with quality materials and with a timeless style to maximize its durability



Source: https://www.redressdesignaward.com/learn/strategies

Ref: Prof. K.Arul NIFT

CIRCULAR PRODUCTION

- **Produced with non-toxic, high quality and preferably biodegradable materials.**
- **Waste generation is minimized during the manufacturing process**
- **Minimizing the extraction and use of new virgin raw material**
- **Produced, transported and marketed using renewable energy**

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION CONSUMER

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION CONSUMER

- **Buy items that they really appreciate, with the intention of maintaining and actively using them for a long time, possibly a lifetime.**
- **Buy articles that are organic, non-toxic or recycled materials, preferably with environmental certification**
- **Prefers natural materials (such as wool, linen, silk and viscose) rather than synthetic (such as polyester, acrylic and nylon)**
- **Find fashionable pieces through rental, loan or exchange rather than buying freshly made products**

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

DESIGNERS

The 4 fundamental pillars for sustainable fashion strategy adopted by the designer 'Stella McCartney'

- **Respect for nature**
- **Respect for people**
- **Respect for animals**
- **Circular Solutions**

Source: https://varunjainblog.wordpress.com/2015/05/22/stella-mccartney-sustainable-fashion/

REPAIR… To Enjoy The Product For Long Time

"We now offer repairs at all of our stores," says Nanushuk's Senior Sustainability Manager, Veronica Pravato.

"It's part of our responsibility"

Source: https://www.nanushka.com/sustainability/our-ethos

MARA HOFFMAN

New York based Mara Hoffman designs women's clothing, including swimwear, made from pre and post-consumer waste.

Source: https://www.nanushka.com/sustainability/our-ethos

SUSTAINABLE FASHION BRANDS OF INDIA

- **No Nasties**
- **Doodlage**
- **B-Label**
- **11.11**
- **InSom**
- **Mio Borsa**
- **Nicobar**
- **Ka Sha**
- **Chakori Ethnic**
- **Upsana**
- **Liva**
- **Mix Mitti**

Image Credits: Ka Sha

Image Credits: Upasana

Source: https://www.prakati.in/12-sustainable-fashion-brands-of-india/

DESIGN…

H&M has launched a new denim collection, designed using the principles of circularity

The denim fabric is made from a mix of:

- **Organic cotton**
- **Up to 35% recycled cotton (from post-consumer waste)**
- **Dyes that considerably reduce water waste and energy consumption**

Source: https://www.theindustry.fashion/hm-and-ellen-macarthur-foundation-rethink-design-and-production-of-denim/

BOTTLE to FASHION

Recycled polyester is an artificial fiber made from oil-based waste, like old PET bottles. Then it is blended with organic and recycled cotton to achieve a soft, fleecy fabric.

https://www.hm.com/by/4013a-lets-clean-up-bottle-2-fashion/

RECYCLING PET BOTTLE to GARMENT

Environmental Benefits :

- While Manufacturing
- Made from 5 recycled PET plastic bottles.
- 70% less CO_2 emission.
- Saves 810 litres of water.
- Landfill saving– 6.00 kg / year
- Water saving – 438.000 liters / year
- Co_2 emission saved – 14.60 kg/ year

Source: http://ecohike.in/

RECYCLING PET BOTTLE to FOOTWEAR

Nike

Adidas

Source: https://thelastfashionbible.com/2019/04/29/shoes-from-recycled-plastic/

QUALITY PRODUCT CERTIFICATION

OEKO-TEX®

Consist of 18 independent research and test institutes in Europe and Japan.

Enables consumers and companies to make responsible decisions which protect our planet for future generations.

Source: https://www.oeko-tex.com/en/our-standards/made-in-green-by-oeko-tex

QUALITY PRODUCT CERTIFICATION

GLOBAL ORGANIC TEXTILE STANDARD (GOTS)

Standard is to define requirements to ensure organic status of textiles

Source: https://global-standard.org/press/gots-images

45

SUSTAINABLE BUSINESS

46

SUSTAINABLE BUSINESS

SOEX is dedicated to sustainable business through the collection, processing, trading and recycling of used textiles.

- **Collecting used textiles and shoes throughout Germany, Europe and the world**
- **Sorting, domestic sales and export of second-hand clothing**
- **Trading end-of-line goods, surplus goods, new goods, returned goods and goods with manufacturing flaws**
- **Recycling used textiles**

47

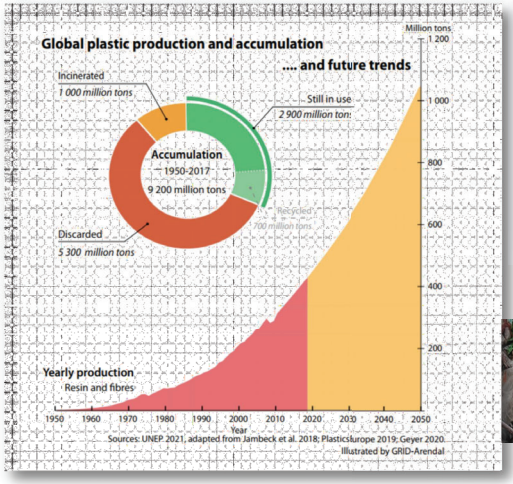
SUSTAINABLE PROJECTS IN EDUCATION

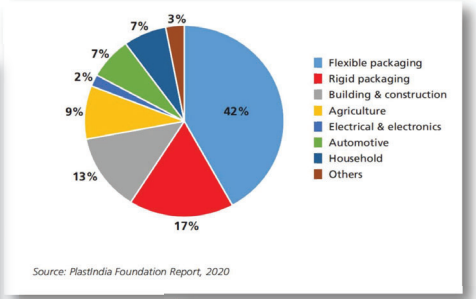
National Institute of Fashion Technology (NIFT) working with different Craft Clusters in Handloom and Crafts of India

Source: https://nift.ac.in

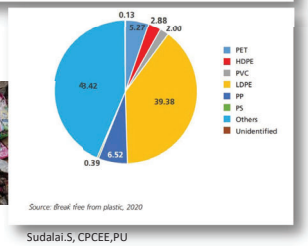
48

Plastics- Matter of concern





As of 06 April 2021, only 89 brand owners and four producers have registered under the EPR scheme with the CPCB.



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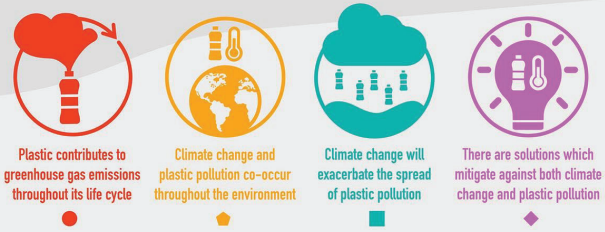
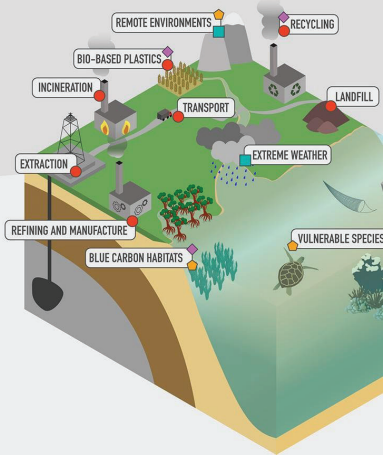
Adopted from the report- Plastic recycling decoded by CSE

The fundamental links between climate change and marine plastic pollution

Ford et al., 2021

We have collated evidence that marine plastic pollution and climate change are linked in at least three ways:





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Plastics- Matter of concern

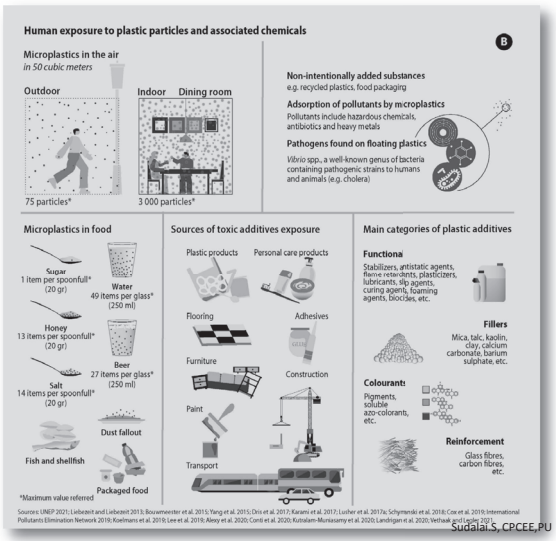
Nearly **700 marine species and more than 50 freshwater species are known to have ingested** or become entangled in macroplastic.

The lower-bound estimate of the economic impact on **costs of plastic pollution** to fishing, tourism, and shipping have been estimated at **$13 billion annually**

United Nations Environment estimates that up to **80 %of all litter in our oceans is made of plastic**, Every year at least 8 million tonnes, the equivalent of one full refuser truck per minute, of plastic find its way into the worlds oceans

Plastic production accounted for 96% of particulate matter health footprint. *ETH Zurich, a public research.*

The global carbon footprint of plastic doubled since 1995, reaching two billion GtCO2-tonnes of carbon dioxide equivalent (CO2e) in 2015 and accounting for 4.5 % of global greenhouse gas emissions, according to the study-*Nature Sustainability. (13 December 2021- Down to earth)*



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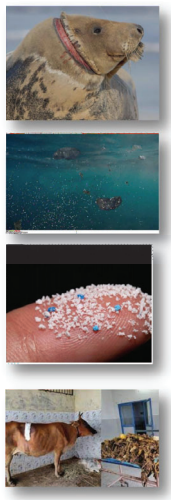
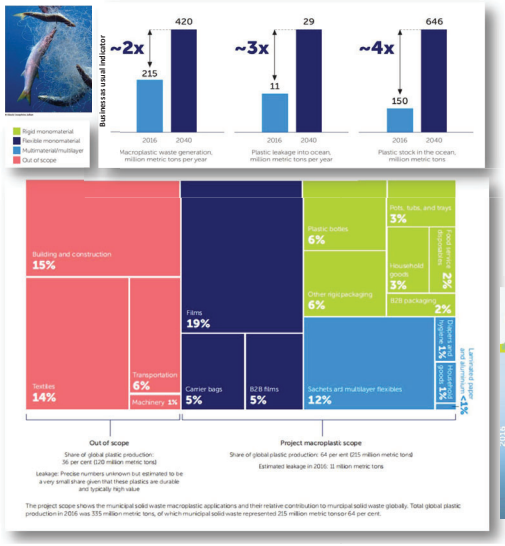
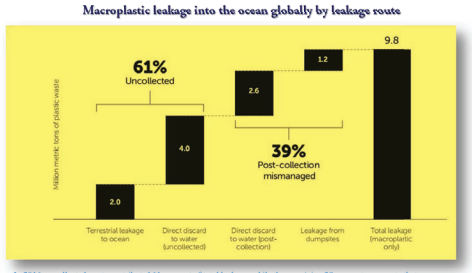


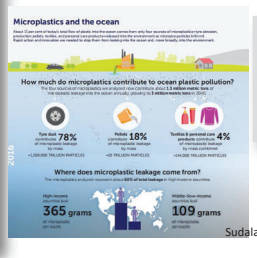
Plastics- Matter of concern

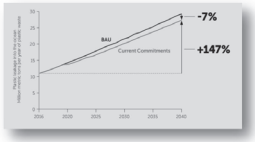
Name of Methodology	Organisation	Link	Short name	Includes microplastics	Date of release
Plastic Scan	Seaforus Business	http://oceanexpert-database.oceanwebatlas.net	Plastic Scan	NO	2017
Plastic Disclosure Project (PDP)	Ocean Recovery Alliance	http://plasticdisclosure.org	PDP	NO	2016
Plastic Footprint for Companies	Plastic Soup Foundation	https://www.plasticsoupfoundation.org/en/just-in-action/plastic-footprint-3/	PSF footprint	YES	2017
Plastic Scorecard	BizNGO	https://www.bizngo.org/sustainable-materials/plastics-scorecard	Plastic Scorecard	NO	2014
Marine Plastic Footprint	IUCN / EA	n.a.	Marine Plastic Footprint	YES	n.a. 2019
Plastic Leak Project	Quantis / EA	https://quantis-intl.com/metrics/initiatives/plastic-leak-project/	Plastic Leak Project	YES	n.a. 2019
Circularity Indicators Methodology	EMF	https://www.ellenmacarthurfoundation.org/programmes/insight/circularity-indicators	Circularity Index	NO	2015
Plastic Drawdown	Common Seas	https://www.commonseas.com/projects/plastic-drawdown	Plastic Drawdown	YES	2019
Marine Impacts in LCA	CIRAIG / PUCP / NTNU	n.a.	MariLCA	YES	n.a.
PlastikBudget	Fraunhofer Institute	n.a.	PlastikBudget	YES	n.a. 2020
Plastic Pollution Calculator	ISWA	n.a.	Plastic Pollution Calculator	NO	n.a. 2019
PET Collection, Landfill and Environmental Leakage Rates in South East Asia	GA Circular/companies	https://www.gacircular.com/publications/	PET GA PET Collection	NO	n.a. 2019
Plastic Life Cycle Assessment (LCA)	JRC	https://eplca.jrc.ec.europa.eu/permalink/plastic-lci/plastic-lca-report/2018.11.30.pdf	LCA	YES	n.a. 2020
PiPro SEA	EMF / Companies	n.a.	Project SEA	NO	2019
National Guidance For Marine Plastic Hotspotting and Shaping Action	UN Environment / IUCN	n.a.	Hotspot Action	YES	n.a. 2019
A Global Roadmap to Achieve Near-zero Ocean Plastic Leakage	SYSTEMIQ / PEW	n.a.	SYSTEMIQ Roadmap	YES	n.a. 2019
Plastic Footprinter	thEW	http://www.plasticfootprint.ch	thEW	NO	2014
My Little Plastic Footprint	PILP	http://mylittleplasticfootprint.org	MyLittle Plastic Footprint	YES	2017
Plastic Calculator	Greenpeace	http://secure.greenpeace.org.uk/page/content/plastic-calculator/	Greenpeace	NO	2016





In 2016, uncollected waste contributed 61 per cent of total leakage, while the remaining 39 per cent was waste that was mismanaged after collection





Land-based plastic leakage under the Business-as-Usual and Current Commitments scenarios

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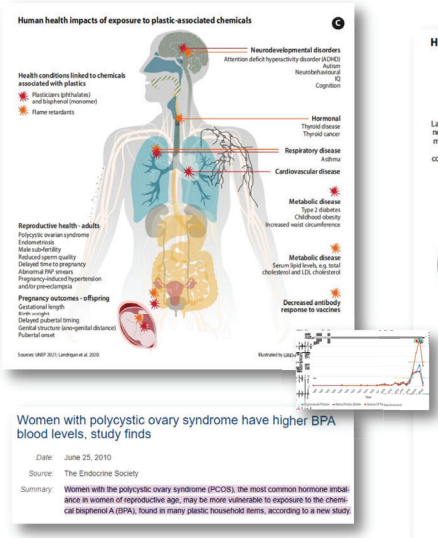

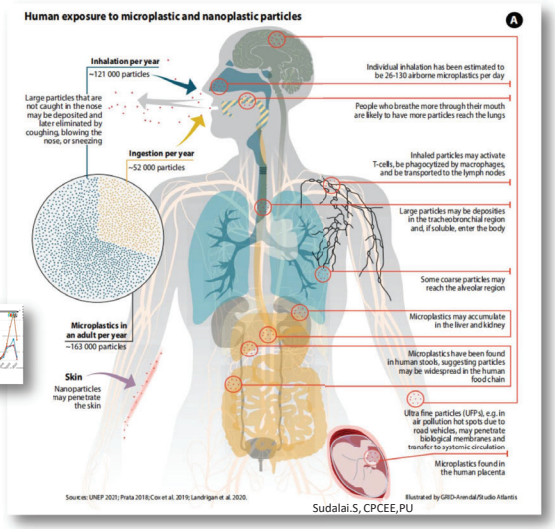

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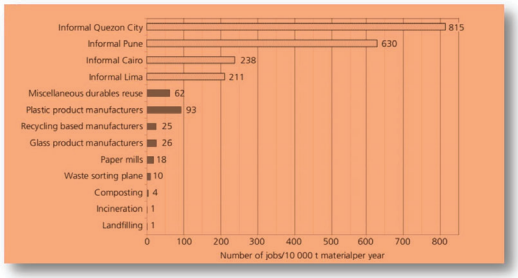
Informal Sector involved in SWM

City	Population range (year)	Number of reported informal workers (range)	Percentage of informal actors in overall population
Ahmedabad	4,800,000–5,570,585 (2003–11)	20,000–50,000	0.36–0.42
Amritsar	1,132,761–1,183,705 (2011)	3,000–3,500	0.25–0.31
Bangaluru	5,000,000–8,425,970 (2000–11)	25,000–70,000	0.30–1.40
Delhi	11,007,835–18,680,000 (2010–11)	80,000–300,000	0.43–2.73
Kanpur	2,767,031–2,920,067 (2011)	15,000–20,000	0.51–0.72
Kolkata	4,486,679–15,100,000 (2010–11)	20,000–80,000	0.13–1.78
Mumbai	12,478,447–19,200,000 (2010–11)	85,000–135,000	0.44–1.08
Overall (India)	364,459,000 (2010)	1,500,000	0.41 %

Source: Lerner and Lange, 2013



City (Country)	Mass percentage of waste recycled by informal sector: % of total waste generated	Mass percentage of waste recycled by formal sector: % of total waste generated	Source
Wuhan (CN)	21	0	Wilson et al. (2009)
Delhi (IN)	17–27	7	Agarwal et al. (2005); Scheinberg (2011)
Bangalore (IN)	13	1	Scheinberg (2011)
Dhaka (BD)	18	0	Scheinberg (2011)
Bandung (ID)	13	na	Sembiring and Nitivattananon (2010)
Manila (PH)	6	0	Wilson et al. (2009)
Quezon City (PH)	31	8	Scheinberg (2011)
Ormoc (PH)	22	na	Hetz et al. (2011)
Phnom Penh (KH)	9	na	Sengh et al. (2011)
Karachi (PK)	45	0	Wilson et al. (2009)
Ghorahi (NP)	9	2	Scheinberg (2011)
Lusaka (ZM)	2	4	Scheinberg (2011)
Moshi (TZ)	18	0	Scheinberg (2011)
Belo Horizonte (BR)	1	10	Scheinberg (2011)
Cañete (PE)	11	1	Scheinberg (2011)
Varna (BG)	2	26	Scheinberg (2011)

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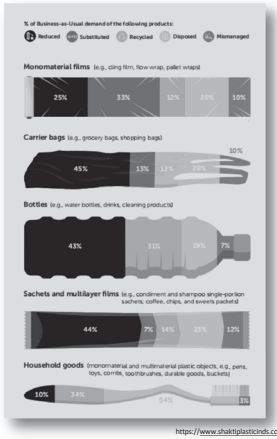
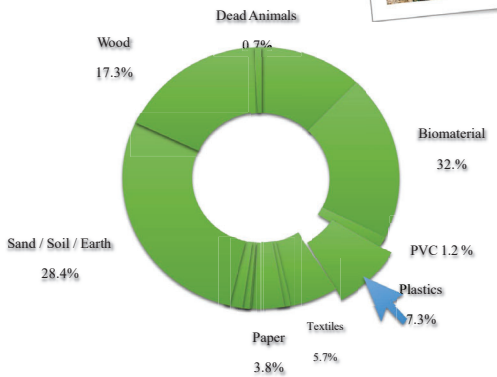
INPUTS FROM MHO- SHRI.SHIVAKUMAR

Opportunities for Recycling



https://www.shaktiplasticinds.com/blog/



Average Weighted Composition Of Waste Received At Dump Site

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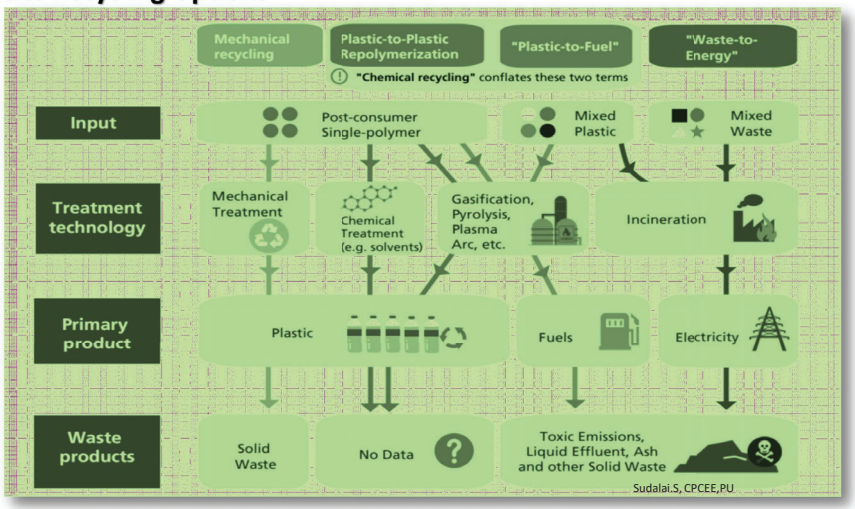
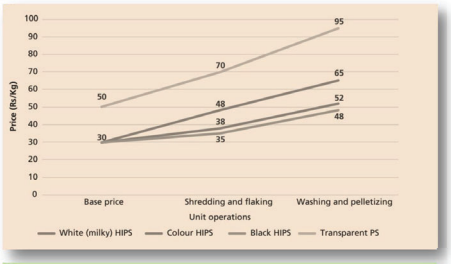
EIGHED PERCENTAGE FOR VARIOUS WASTE GENERATED IN LOCAL BODIES

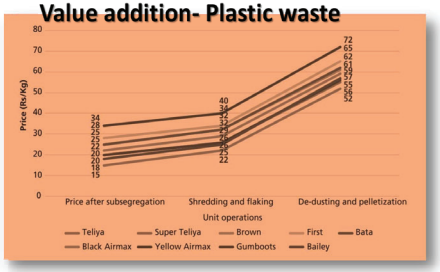
AS PER IL&FS REPORT -2016

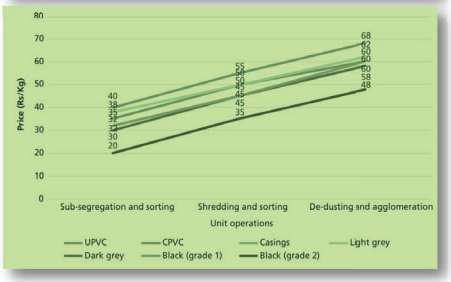
Plastics Recycling Options

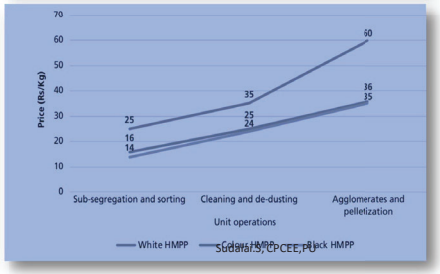


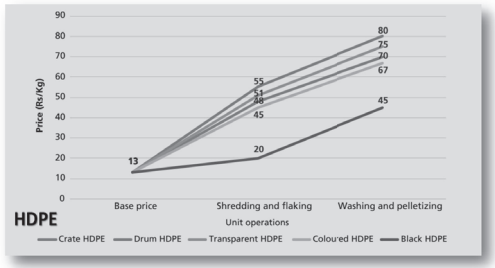
Value addition- Plastic waste



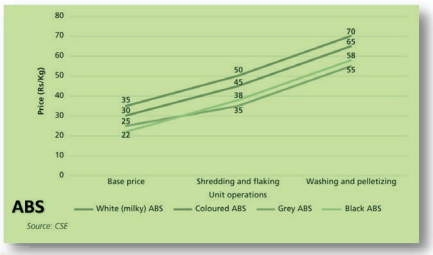


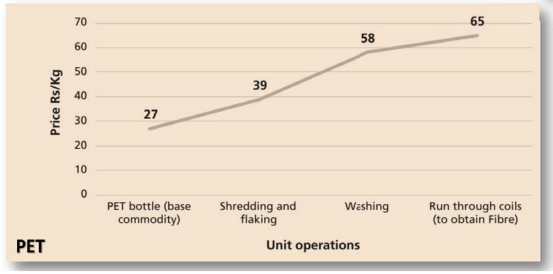


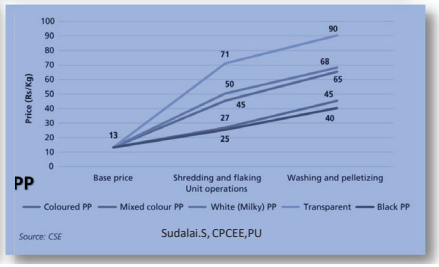




Value addition- Plastic waste



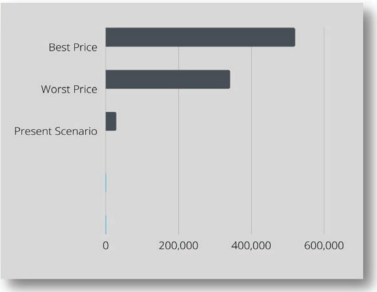




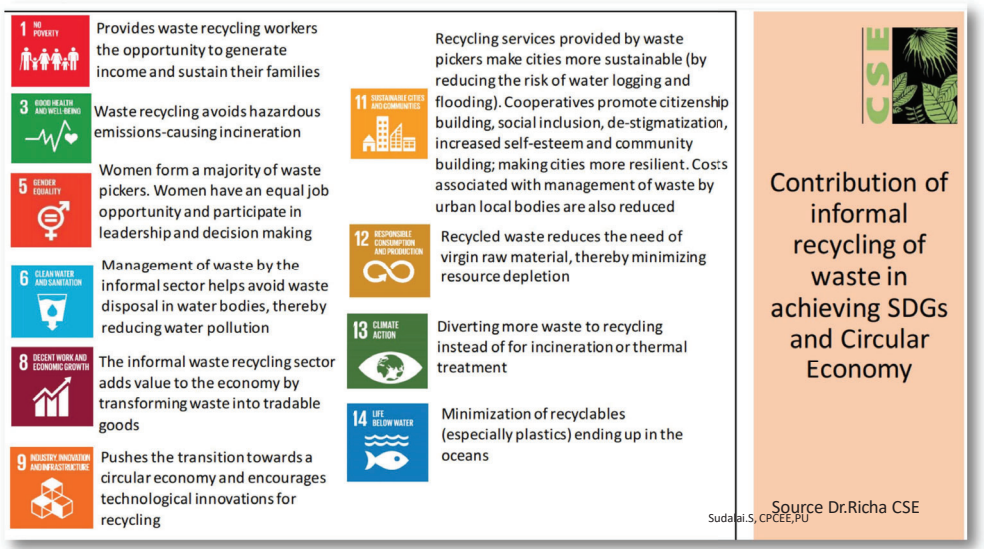
INPUTS FROM MHO- SHRI.SHIVAKUMAR

COST RECOVERY FROM PLASTIC WASTE -PUAA- OULGARET EXPERIENCE

Sl. No	Types of Plastic	% of Plastic	Projected Quantity from total plastic waste/day	Local Rate/KG (in Rs.)		Amount Recoverable (in Rs.)	
				Best Price	Worst Price	Best Price	Worst Price
1	1. PET	3.96	1326.6	15	10	19899	13266
2	2&4. HDPE & LDPE	84.6	28341	15	10	425115	283410
3	3. PVC	2.24	750.4	30	15	22512	11256
4	5. PP	4.31	1443.85	20	12	28877	17326
5	6. PS	4.41	1477.35	15	10	22160	14774
6	7. Others	0.49	164.15	5	3	821	492
Total						519384	340524



At Present cost recovered from plastic waste by menial employees (Door to Door Collectors and Rag pickers) is around Rs. 28,000 which is not even 10% of the worst value that may be recovered in worst case scenario.



EMPOWERING MARGINALIZED GROUPS - CONVERGENCE BETWEEN SBM AND DAY-NULM

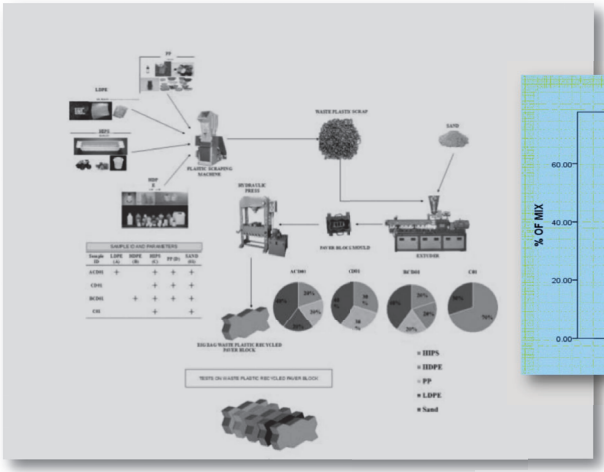
- Identification of vulnerable groups
- Skill training of marginalised groups and enterprises
- Formation and handholding of CIGs of marginalised groups, and access to finance
- Recognizing CIGs and SHGs involved in sanitation and/or waste management work in ULB's service frameworks
- Monitoring Mechanisms

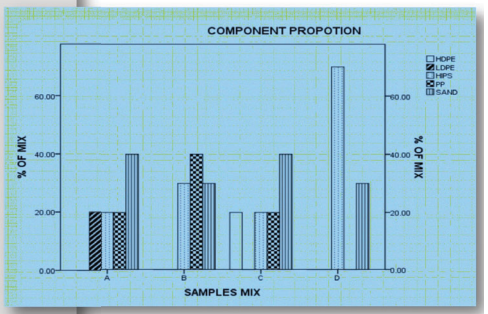
Setting up dry waste/resource segregation centres

Reference	Study area	Objective	Material for Compaction	Method of preparing
(B. Shanmugavalli et al. 2017)	India	Cement with mixed plastic waste	LDPE plastic	Burn-in open
(Nataraja and Das 2012)	India	Strength properties of paver block	Crushed granite, Kadapa and broken paver	Concrete mix
(Agyeman et al. 2019)	India	Properties of blocks made with RPW	HDPE	Burn-in open
(Ghude et al. 2019)	India	Waste plastic in the building materials	HDPE, LDPE	Burn-in open
(Nivetha et al. 2016)	India	Plastic mixed	PET	Burn-in open
(Ghuge et al. 2019)	India	Comparison of a plastic paver with ordinary paver block	Mixed plastic	Burn-in open
(Pawar and Bujone 2017)	India	Plastic with fly ash	Fly ash with cement, Plastic with crush aggregate	Burn-in open
(Kumi-Larbi et al. 2018)	UK	LDEP with sand	LDPE	Aggregate mix
(Razdan 2018)	India	Cost efficiency	Portland Cement Concrete and Asphalt Concrete	Concrete mix
(Frigione 2010)	Italy	Waste un-washed PET bottles	PET	Aggregate mix
(Hannawi, Kamali-Bernard, and Prince 2010)	France		PET, PC	Aggregate mix

Reference	Study area	Objective	Material for Compaction	Compressive strength (n/mm²)	Tensile strength (n/mm²)	Flexural strength (n/mm²)	Water absorption	Sample size	Mix ratio
(B. Shanmugavalli et al. 2017)	India	Cement with mixed plastic waste ceramic waste	LDPE	13.03	-	-	-	9	1:1:1, (no ceramic waste) 1:1:2:1, 1:1:2:1
(M. C. Nataraja et al.2016)	India	Strength properties of paver block	Crushed granite, Kadapa and broken paver	43.38	2.82	5.66	6.45	15	1:1.5:3
(S. Agyeman et al.2019)	India	Properties of blocks made with RPW	HDPE	5.88-9.99	-	-	0.50-2.9	27	1:1:2, 1:1:2, 1:0.5:1
(Aarti Ghude et al.2019)	India	Waste plastic in the building materials	HDPE, LDPE	10.85-28.48	-	-	-	9	1:4,1:5,1:6
(S. Raju et al. 2019)	India	physical properties of paver block	HDPE	4-26.9	-	-	-	18	
(Nivetha C et al. 2016)	India	Plastic mixed	PET	51	-	-	-	4	1:1:2, 6:5:9, 7:5:8
(Jeevan Ghuge 2019)	India	Comparison of plastic paver with ordinary paverblock	Mixed plastic	16.05	-	-	-	12	
(Sarang Shashikant Pawar et al. 2017)	India	Plastic with fly ash	Fly ash with cement, plastic with crush aggregate	13.5-25	-	-	-	14	1:10,1:5,1:2 (both)

Process- Plastic brick





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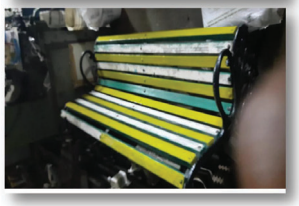
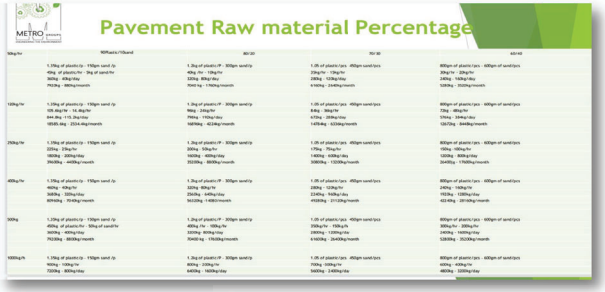
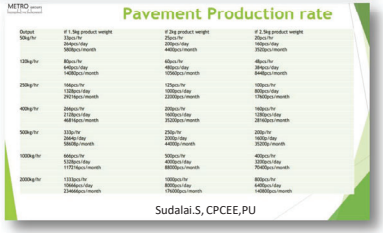
Science to Society

Thiru. Azaganandam 8300935302







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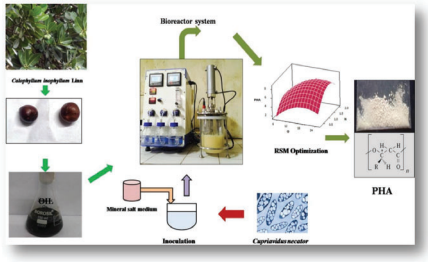

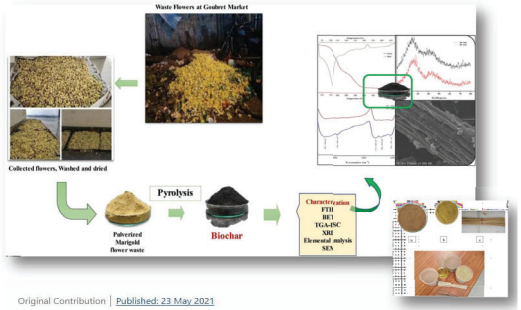

› Int J Biol Macromol. 2018 Jun;112:598-607. doi: 10.1016/j.ijbiomac.2018.02.012. Epub 2018 Feb 3.

Production and optimization of polyhydroxyalkanoates from non-edible Calophyllum inophyllum oil using Cupriavidus necator

A Arumugam [1], S G Senthamizhan [2], V Ponnusami [2], S Sudalai [3]

Affiliations + expand

PMID: 29408394 DOI: 10.1016/j.ijbiomac.2018.02.012

Original Contribution | Published: 23 May 2021

Renovation of Waste *Chrysanthemum morifolium* (Marigold) into Valuable Biochar: A Study on the Utilization of Solid Waste by Pyrolysis

Tajamul Shafi Panditha, S. Sudalai & A. Arumugam

Journal of The Institution of Engineers (India): Series E **102**, 239–248 (2021) | Cite this article

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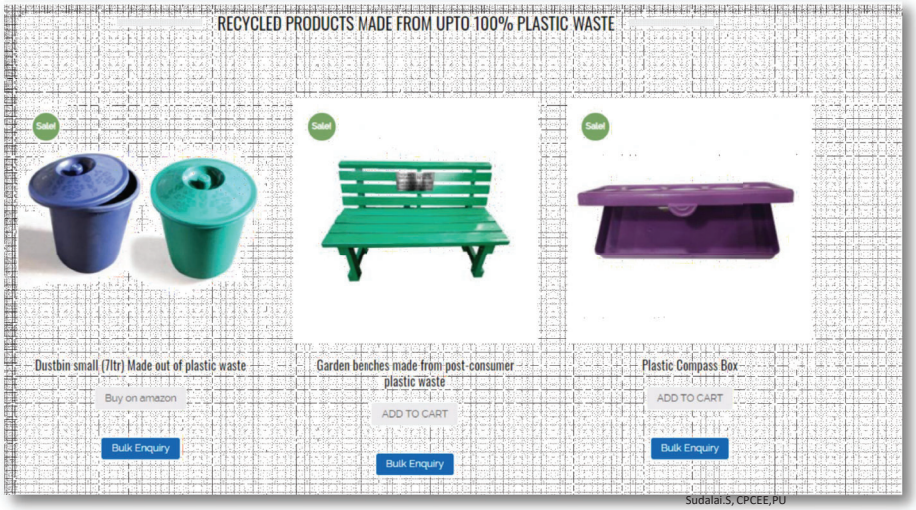

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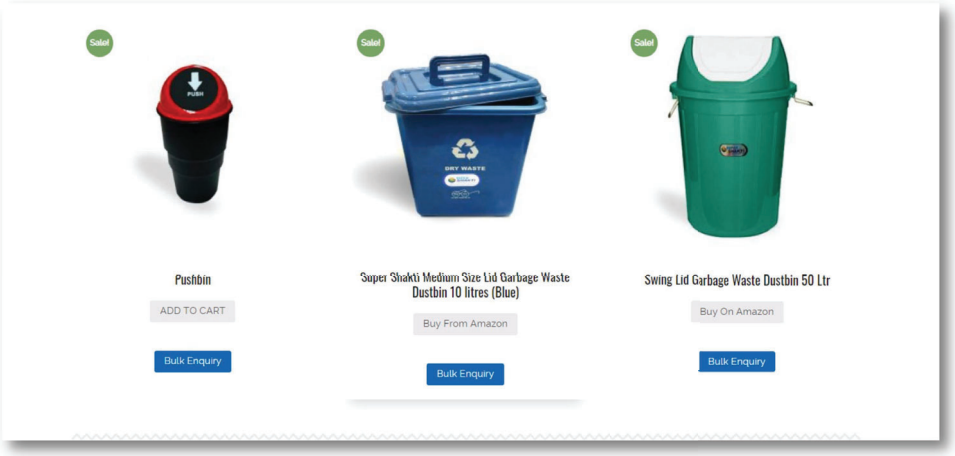

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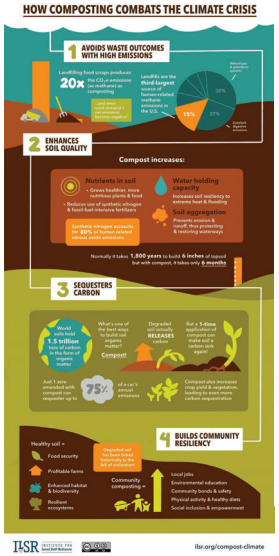
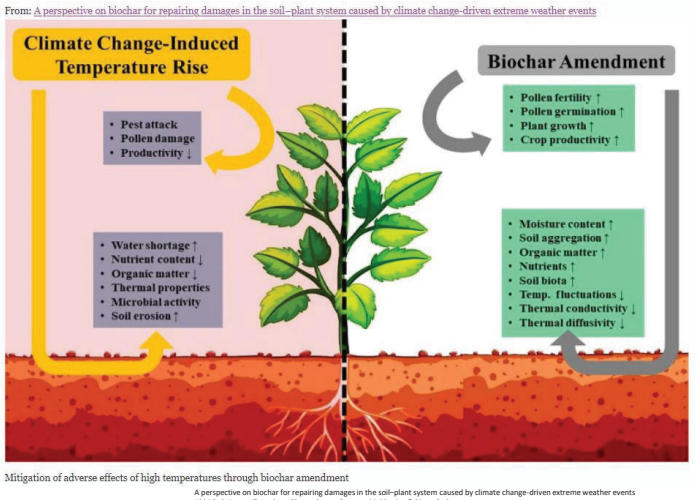




Mitigation of adverse effects of high temperatures through biochar amendment

A perspective on biochar for repairing damages in the soil–plant system caused by climate change-driven extreme weather events
Abhishek Kumar, Tanushree Bhattacharya, Santanu Mukherjee & Binoy Sarkar
Biochar volume 4, Article number: 22 (2022) Cite this article,776

Thank you

sudalaijothi@gmail.com

Enhancing Climate Resilience through Integrated Water Resource Management

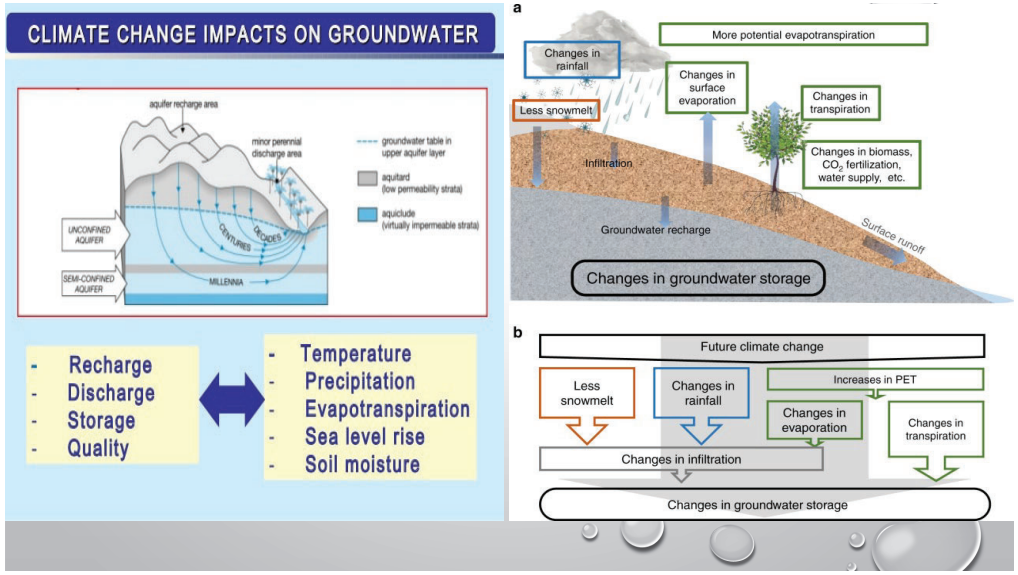
Speaker: Dr. K. Srinivaramoorthy, Department of Earth Science, Pondicherry University

Date: 06.05.2022

Workshop on Integrating Climate Action in the Development Planning of Puducherry Union Territory

ENHANCING CLIMATE RESILIENCE THROUGH INTEGRATED WATER RESOURCE MANAGEMENT

DR.K.SRINIVASAMOORTHY
PONDICHERRY UNIVERSITY
moorthy_ks@yahoo.com



ASSESSMENT OF CLIMATE CHANGE OVER THE INDIAN REGION: MINISTRY OF EARTH SCIENCES (MOES, 2020)

TEMPERATURE:

- DURING 1901-2008, THE AVERAGE TEMPERATURE OF INDIA HAS RISEN BY 0.7°C.
- TEMPERATURE IN INDIA IS EXPECTED TO RISE BY 4.4°C BY END OF THIS CENTURY DUE TO GREEN HOUSE GASES EMISSION.
- THE RISE WILL INCREASE HEAT WAVES (APRIL AND JUNE) OVER INDIA BY 3-4 TIMES BY THE END OF THIS CENTURY WHICH WILL ALSO INCREASE DROUGHT INTENSITY.

RAINFALL:

- THE INDIAN MONSOON VARIABILITY IS PROJECTED AS 14% BY 2100 AND MAY GO UP BY 22.5%.
- DECLINE IN RAINFALL (UP TO 6%) DURING SUMMER MONSOON BETWEEN 1950 TO 2015, WELL WITNESSED IN INDO-GANGETIC AND WESTERN GHATS REGION.
- FREQUENCY OF DRY SPELLS AND WET SPELLS DURING MONSOON HAS INCREASED BY 27% AND 75% RESULTING IN DROUGHTS.

CHANGES IN THE HIMALAYAN REGION:

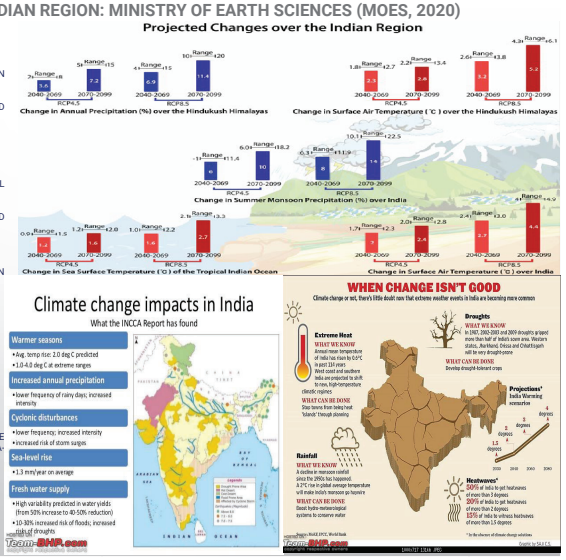
- HINDU KUSH HIMALAYAS HAVE WITNESSED RISE IN TEMPERATURE (1.3°C) RESULTING IN SNOWFALL DECLINE.
- FURTHER DECLINE IN SNOW FALL IS ALSO WITNESSED.
- TEMPERATURE IS PROJECTED TO RISE BY 5.2°C.

SEA LEVEL RISE:

- INDIAN OCEAN HAVE EXPERIENCED SEA LEVEL RISE AT A RATE OF 1.06 TO 1.75 MM.
- FURTHER IT IS PROJECTED TO INCREASE BY 300 MM.

TROPICAL CYCLONES:

- THE FREQUENCY OF SEVERE CYCLONIC STORMS HAVE INCREASED, RISE IN AVERAGE TEMPERATURE, DECREASE IN THE MONSOON PRECIPITATION, RISE IN RAINFALL, DROUGHTS, SEA LEVEL, INCREASED INTENSITY OF CYCLONES, ETC.



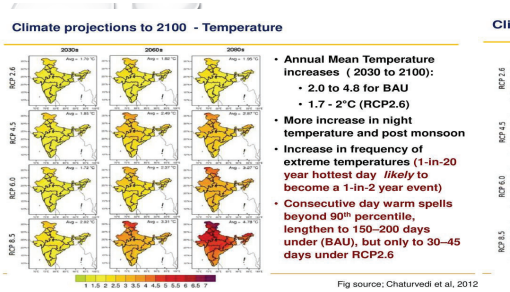


Fig source; Chaturvedi et al, 2012

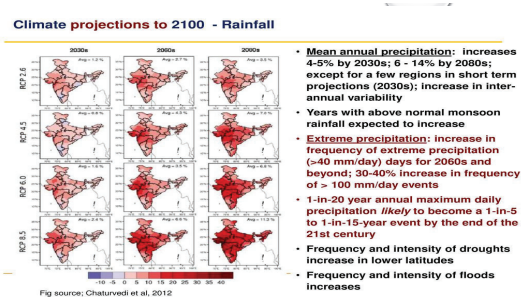
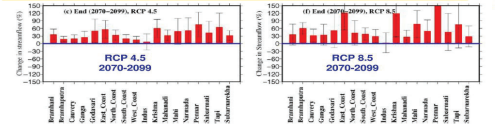
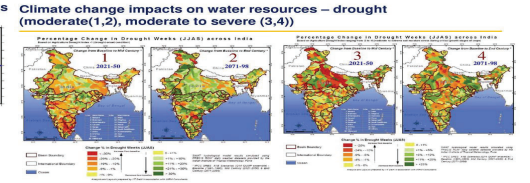


Fig source; Chaturvedi et al, 2012

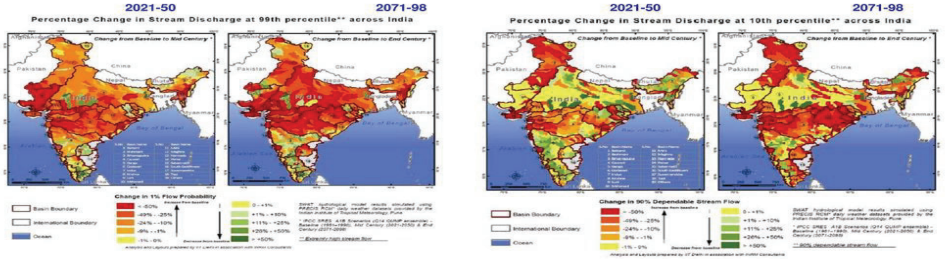


Source: Mishra & Lihare 2016



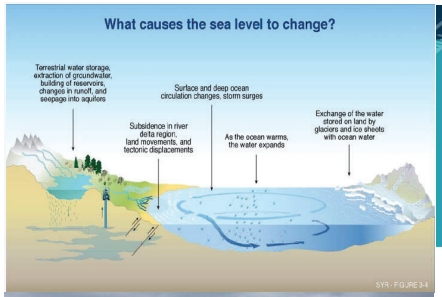
Source: Gosain et al, 2012

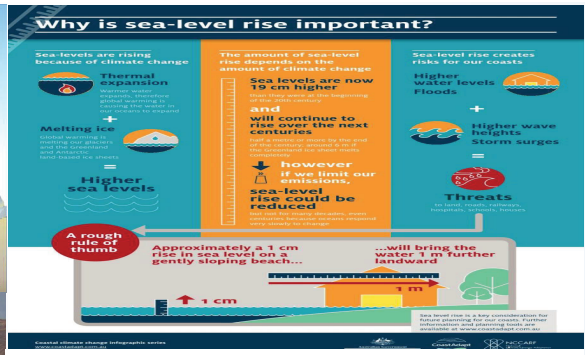
Climate change impacts on water resources – extreme flows, dependable flows

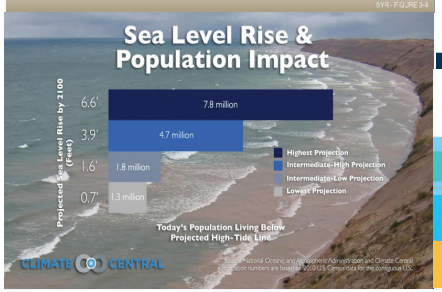


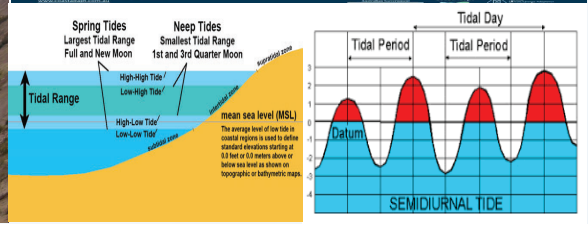
- Extreme flows (99th percentile) increase by 10-50% leading to flooding in majority of the river basins; few sub-basins show some decrease in the peak flows
- dependable (10th percentile) flows also increase; in some basins in central India dependable flows decline
- Substantial efforts required to develop future water management strategies

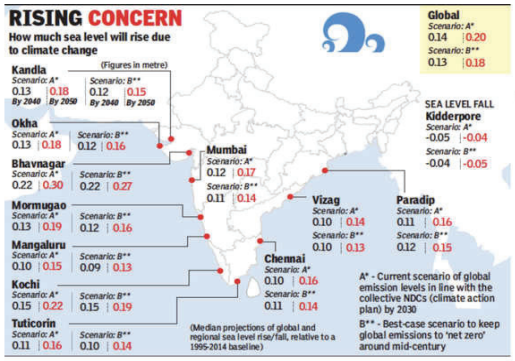
Source: Gosain et al, 2012

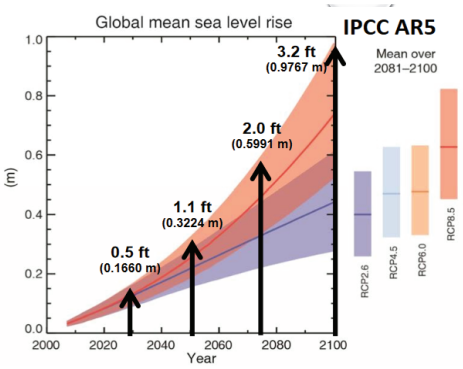












Rise in sea level in metres	By 2040		By 2050	
	A*	B**	A*	B**
Mumbai	0.12	0.11	0.17	0.14
Mangaluru	0.10	0.09	0.15	0.13
Kochi	0.15	0.15	0.22	0.19
Chennai	0.10	0.11	0.16	0.14
Vizag	0.10	0.10	0.14	0.13
Global	0.14	0.13	0.20	0.18

A* - Current scenario of global emission level in line with the collective nationally determined contributions (climate action plan) by 2030
B** - Best-case scenario to keep global emission to 'net zero' around mid-century
(Median projections of global and regional sea level rise or fall, relative to a 1995-2014 baseline)

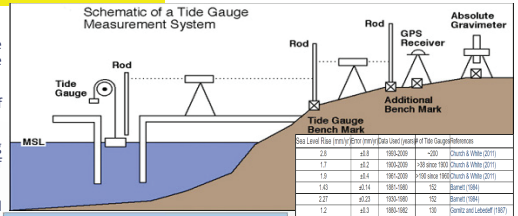
Representative concentration pathways

RCP	Forcing	Temperature	Emission Trend
1.9	1.9W/m2	~1.5°C	Very Strongly Declining Emissions
2.6	2.6W/m2	~2.0°C	Strongly Declining Emissions
4.5	4.5W/m2	~2.4°C	Slowly Declining Emissions
6.0	6.0W/m2	~2.8°C	Stabilising Emissions
8.5	8.5W/m2	~4.3°C	Rising Emissions

MEASURING SEA LEVEL

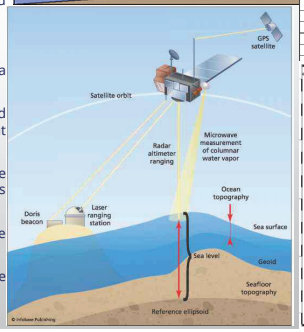
Measuring sea level using tide gauges

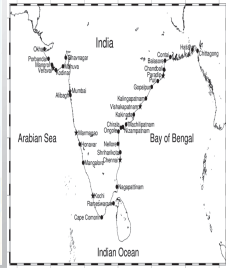
- Measuring sea level (SL) using tide gauges provide long and reliable records of water levels that can be used to isolate sea level change trends.
- The tide gauge detect high and low points of tides in a given period of time.
- These data points are also important for detecting water levels during storms and other events as well as in the long-term investigation of relative water level change (rise or fall).
- Tide levels are also measured by floating buoys, which may also be used to detect tsunami waves.



Measuring sea level using satellite altimetry

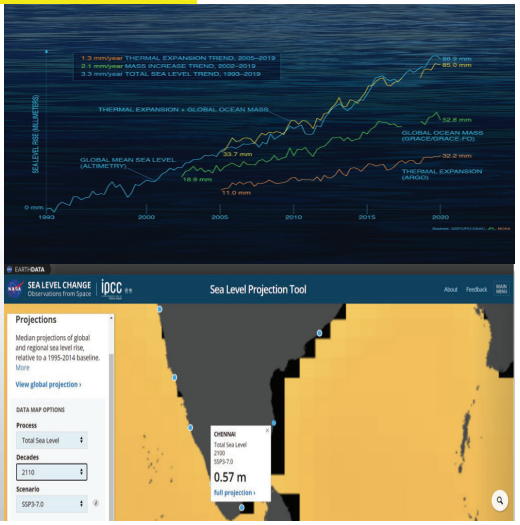
- Satellite altimetry with multiple satellites provided much better data resolution and coverage.
- The measurements utilize multi-beam methods that are very precise and can measure changes in elevation on the earth's surface to great precision in the range of centimeters.
- These methods have shown that water bodies are not flat but are incredibly dynamic and have high and low spots due to factors such as gravitational variability.
- Data such as ocean circulation, sea level rise, and wave heights can be measured.
- these measurements have provided insight into the links between the ocean and the atmosphere and how the connections drive climate.





MODELS ON SEA LEVEL RISE

- Sea level rise scenarios termed as Global mean sea level (GMSL) scenarios.
- Represent future sea level changes in view of increasing GHG emissions, atmospheric warming and ocean.
- It helps to support planning and decision making in how much sea level rise could occur under what circumstance and by when.
- It also predicts how sea level rise both globally and locally.
- Sea level rise scenarios are generally based upon climate model outputs.
- **Climate models simulate different responses, like how ocean might warm, where ice melts and how additional water disperses around the world's oceans and affects circulation patterns.**
- These responses differ under models that use different bounding conditions like varying GHG emissions and ocean and atmospheric warming projections for future sea level rise.
- Thus sea level rise scenarios help us plan in the face of uncertainty by providing a range of possible futures that help represent a) potential future human-driven greenhouse gas emissions, and b) how earth's physical processes will respond to increased temperatures.



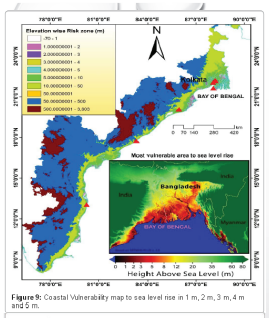


Figure 9: Coastal Vulnerability map to sea level rise in 1 m, 2 m, 3 m, 4 m and 5 m.

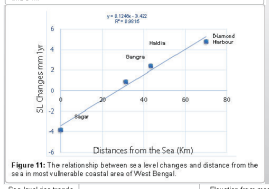


Figure 11: The relationship between sea level changes and distance from the sea in most vulnerable coastal area of West Bengal.

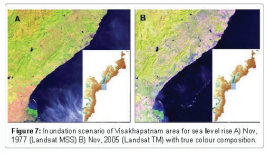


Figure 7: Inundation scenario of Visakhapatnam area for sea level rise A) Nov, 1977 (Landsat MSS) B) Nov, 2005 (Landsat TM) with true colour composition.

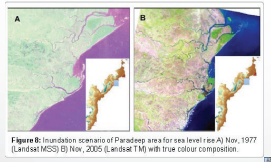
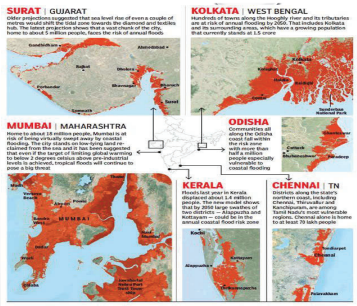
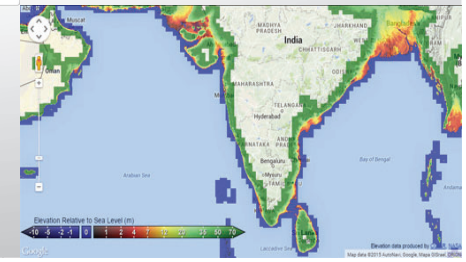


Figure 8: Inundation scenario of Paradeep area for sea level rise A) Nov, 1977 (Landsat MSS) B) Nov, 2005 (Landsat TM) with true colour composition.





Sea level rise trends (mm/year)	Location (station wise adjoining area)	Elevation from mean sea level(m) (fig. no. 11)	Slope (in degree)	Inundation level and erosion	Tidal amplitude (m)	Vulnerability and risk zone
Below 0.5	Bhubaneswar and Chennai	Up to 200 m	0.10	medium	40-120	high
0.5 – 1.0	Visakhapatnam	Up to 1000 m	0.3	medium	60-85	medium
Above 1.0	Diamond Harbour	Up to 20 m	0.05	very high	180	very high

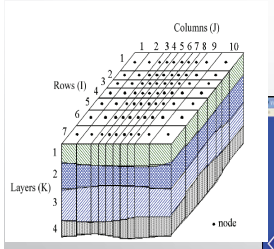
Pramanik et al., 2015

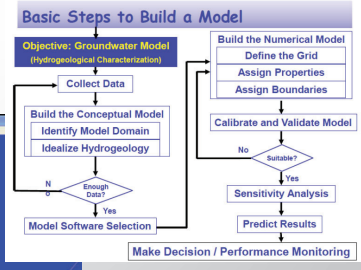
Groundwater Flow modeling

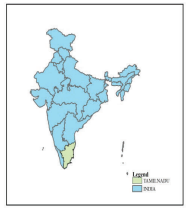
$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_{zz}\frac{\partial h}{\partial z}\right)+W=S_s\frac{\partial h}{\partial t}$$

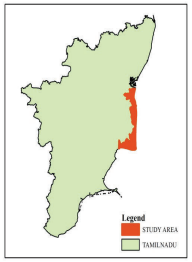
$$\nabla\cdot\rho K_f+\left(\nabla h_f+\frac{(\rho-\rho_f)}{\rho_f}\nabla z\right)=\rho S_f\frac{\partial h_f}{\partial t}+n\frac{\partial\rho}{\partial C}\frac{\partial C}{\partial t}-\overline{\rho q}$$

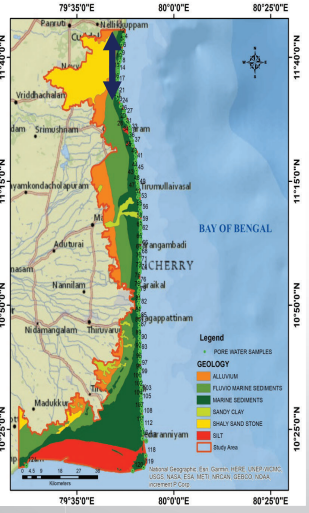
K_{xx}, K_{yy} and K_{zz} are hydraulic conductivity along x,y, z Directions (L/T), h - is Potentiometric head (L), w - is volumetric flux per unit volume representing sources or sinks of water, Ss - is the specific storage of the porous material (L^{-1}) , t - is time (T), P i s fluid density (ML^{-3}). Kf fresh water hydraulic conductivity (LT^{-1}), Hf equivalent fresh water head (L). Pf is the density of fresh water (ML^{-3}), Sf equivalent fresh water storage, coefficient (L^{-1}), tis time (T), N is porosity (L0), C concentration of dissolved constituent (salinity, Cl) (ML^{-3}), ρ fluid density of source or a sink (ML^{-3}, q is the flow rate of the source or sink (T^{-1}).





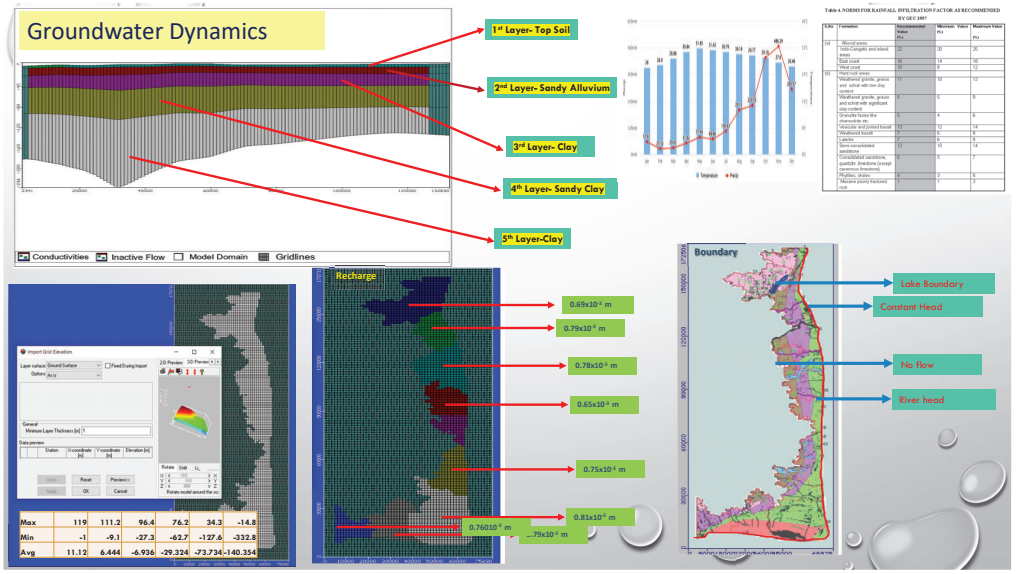


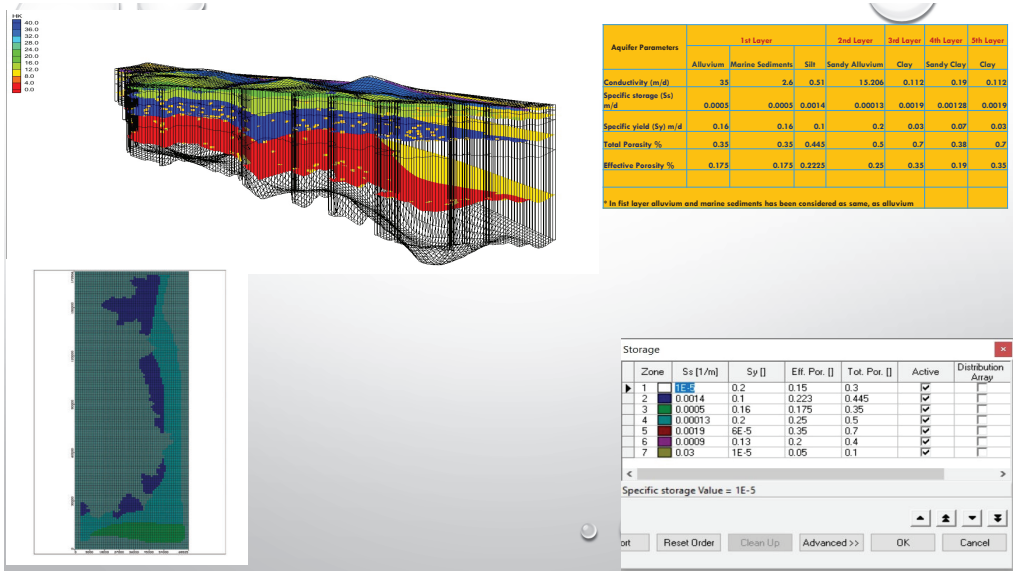




Epoch	Stage/formation	Lithology
Recent Pleistocene	Quaternary	Soils, Alluvium and beach sand, boulder conglomerate, Older alluvium and laterite
Pliocene	Karaikal beds	Sand and clay with fossils
Miocene	Cuddalore sandstone Niniyur Ariyalur	Mottled and friable sandstone, buff coloured, clay and gravel Arenaceous limestone and sandstone and clay
Cretaceous to Upper Carboniferous	Tiruchirappalli Uttatur Satyavedu Sriperumbudur	Sandstone, clay and shell limestone Basal limestone, coral clay and sandy bed Ferruginous sandstone and conglomerate Clay, shale and feldspathic sandstone
Unconformity		
Archaean		Gneissic complex, charnockite, granite and associated basic and ultra-basic intrusive

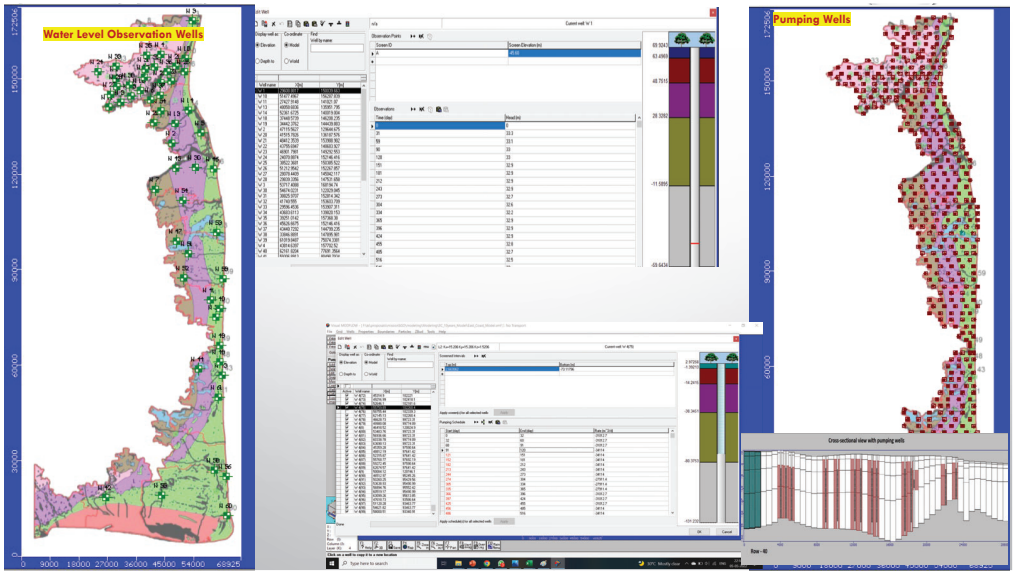
- Total coastal stretch-**200 km**
- Annual Normal Rainfall -**1000 to 1500 mm**.

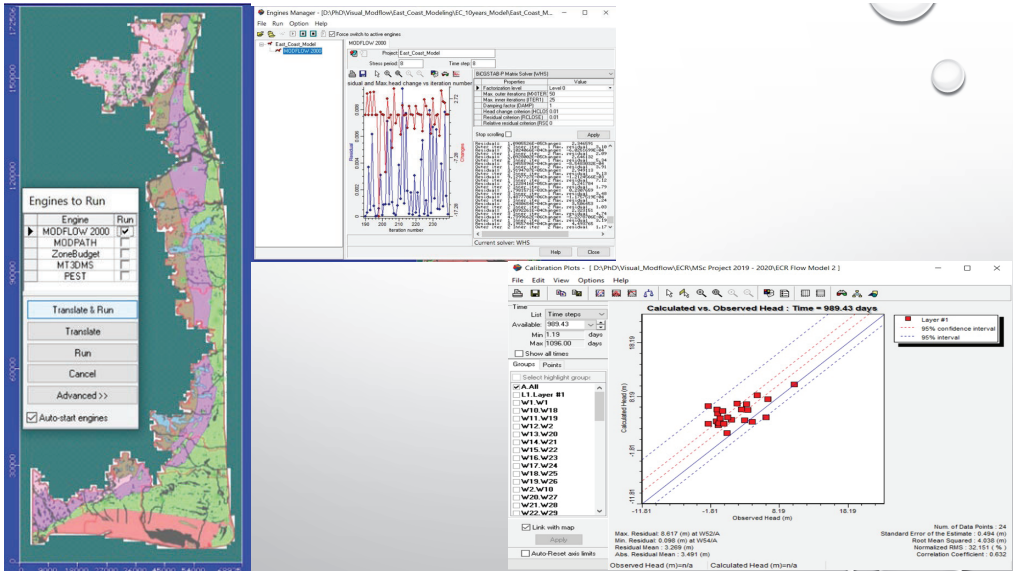


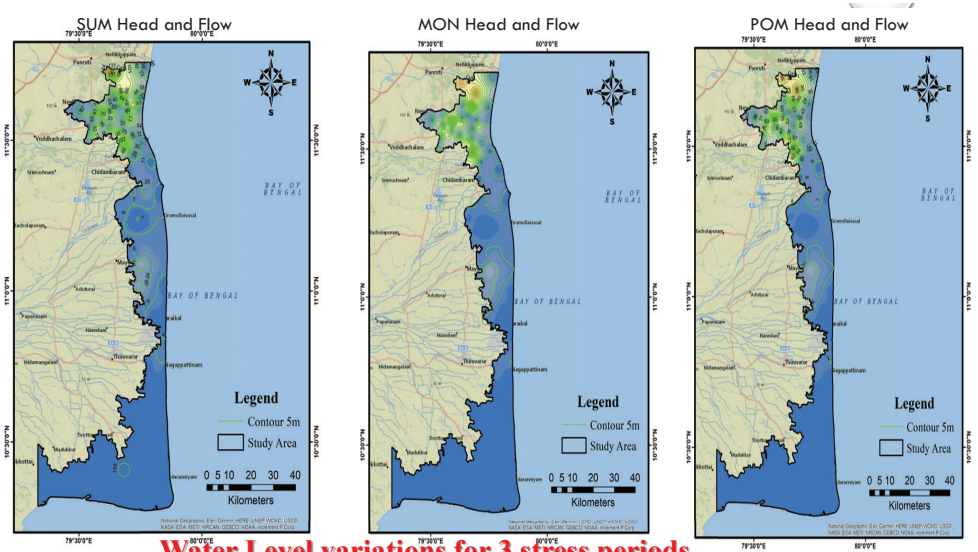


Aquifer Parameters	1st Layer			2nd Layer	3rd Layer	4th Layer	5th Layer
	Alluvium	Marine Sediments	Silt	Sandy Alluvium	Clay	Sandy Clay	Clay
Conductivity (m/d)	35	2.6	0.51	15.206	0.112	0.19	0.112
Specific storage (Ss) m/d	0.0005	0.0005	0.0014	0.00013	0.0019	0.00128	0.0019
Specific yield (Sy) m/d	0.16	0.16	0.1	0.2	0.03	0.07	0.03
Total Porosity %	0.35	0.35	0.445	0.5	0.7	0.38	0.7
Effective Porosity %	0.175	0.175	0.2225	0.25	0.35	0.19	0.35

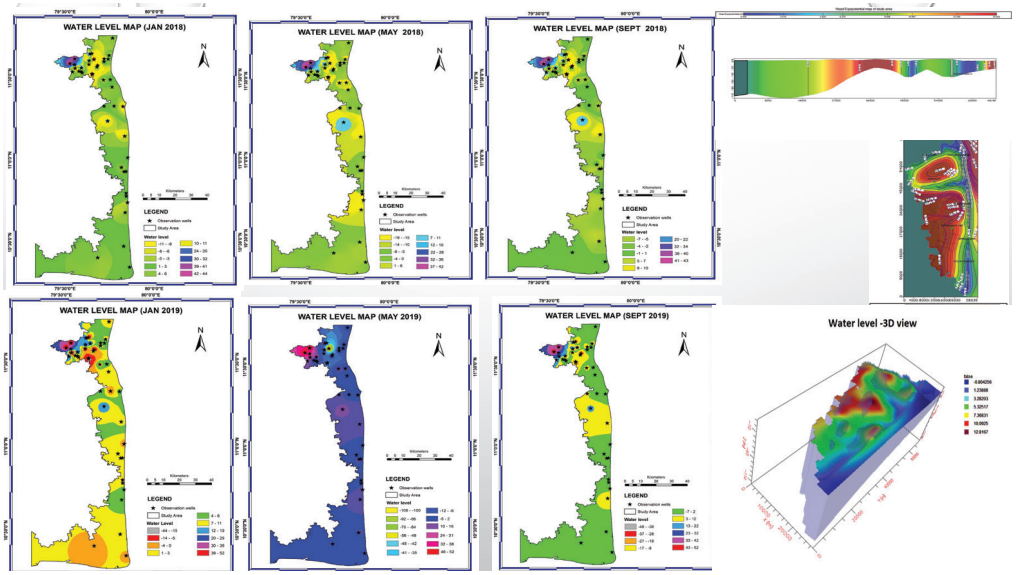
* In fist layer alluvium and marine sediments has been considered as same, as alluvium

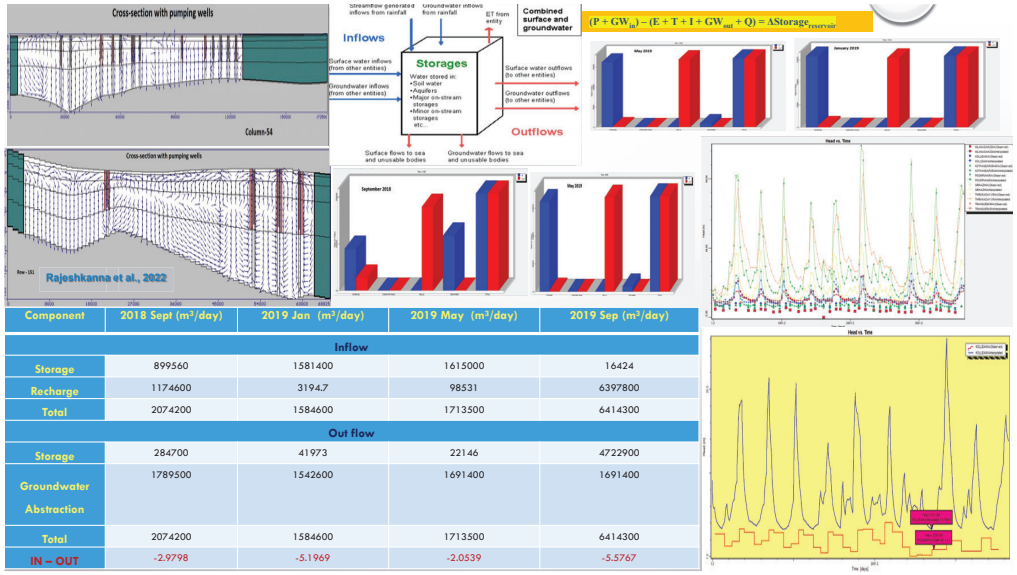




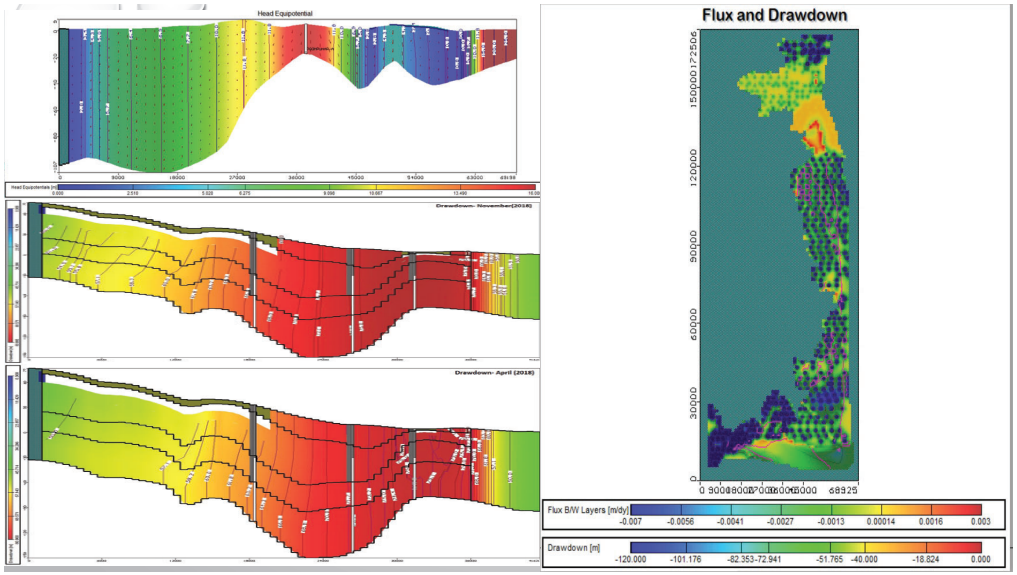


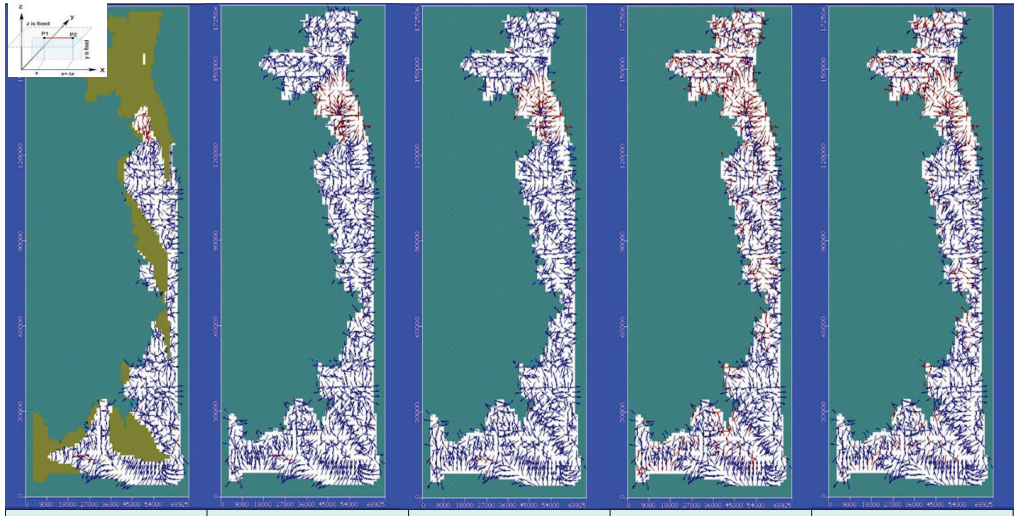
Water Level variations for 3 stress periods



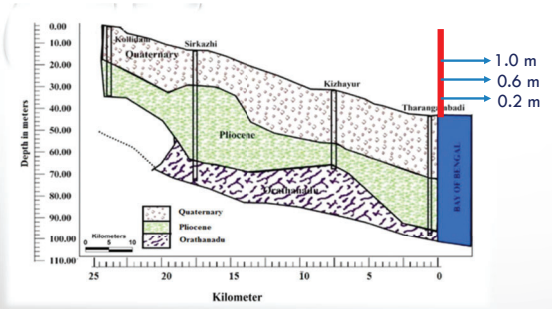


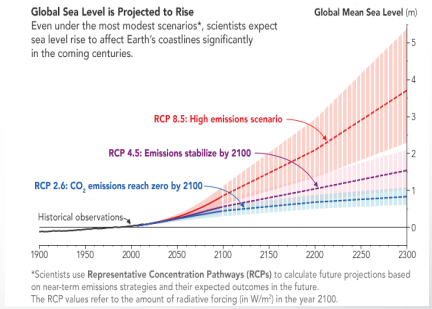
Component	2018 Sept (m³/day)	2019 Jan (m³/day)	2019 May (m³/day)	2019 Sep (m³/day)
Inflow				
Storage	899560	1581400	1615000	16424
Recharge	1174600	3194.7	98531	6397800
Total	2074200	1584600	1713500	6414300
Out flow				
Storage	284700	41973	22146	4722900
Groundwater Abstraction	1789500	1542600	1691400	1691400
Total	2074200	1584600	1713500	6414300
IN – OUT	-2.9798	-5.1969	-2.0539	-5.5767





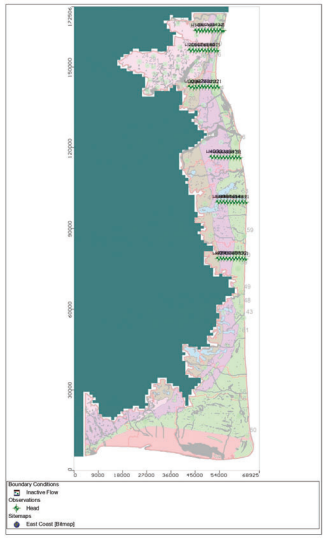
1st Layer	2nd Layer	3rd Layer	4th Layer	5th Layer
2.8 m/d	2.5 m/d	0.069 m/d	0.03 m/d	0.017 m/d

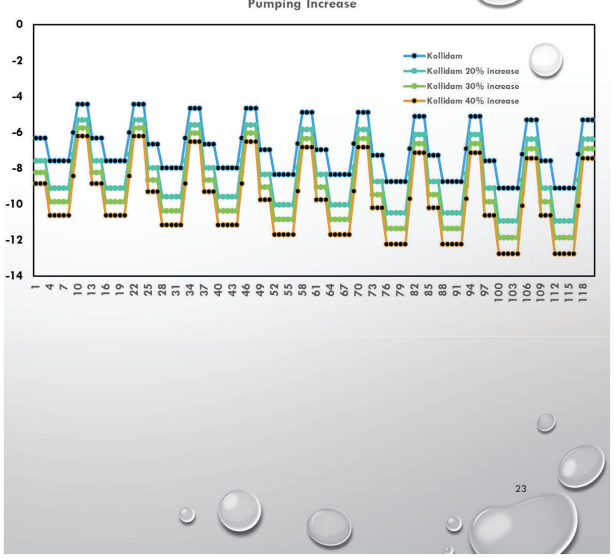




SLR (m) (Cuddalore)	SLR(m) Nagapattinam)	Global scenarios (prediction) (NASA, 2021).
0.2	0.2	2040
0.6	0.6	2080
1.0	1.0	2100

22





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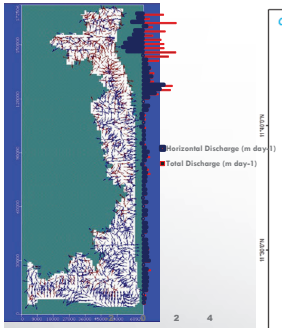
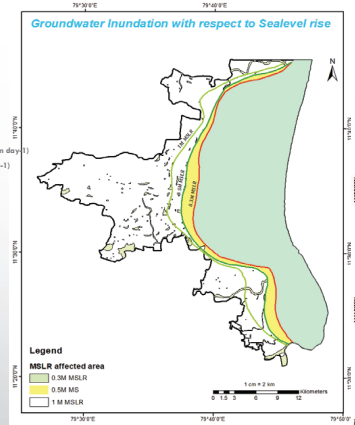
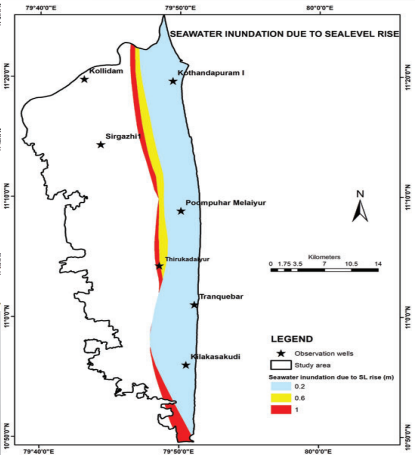


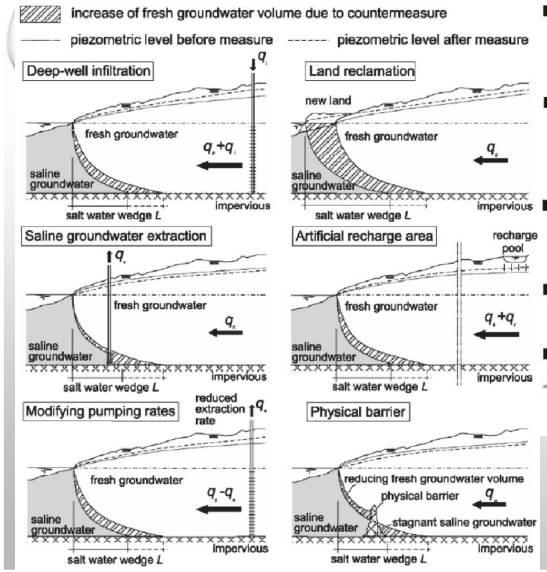


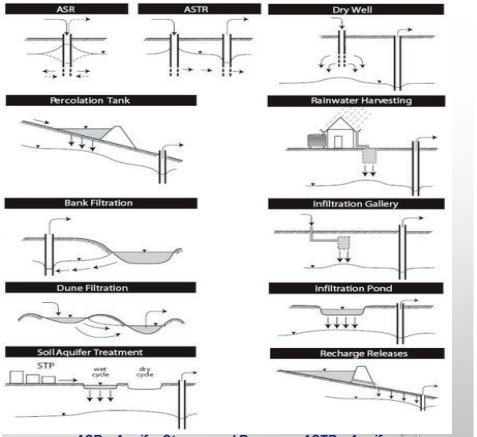


UNCERTAINTIES

- Factors like tidal, wave, altitude and other factors influencing sea-level rise were not considered.
- Seawater intrusion was not reflected
- The initial head for sea level is the present sea level
- The study aims to highlight the combined impact of sea-level rise and pumping.
- The transient and steady-state for the initial model were calibrated, but the prediction models were not calibrated due to more significant uncertainties.

25





ASR—Aquifer Storage and Recovery; ASTR—Aquifer Storage Transfer Recovery; STP—Sewerage Treatment Plant.

Source: Gualbert H. P. Oude Essink 2018; Dillon 2005

Renewable Energy for Climate Change Mitigation
Speaker: Mr. Shirish S Garud, Renewable Energy Technologies, TERI.
Date : 06.05.2022.

"Renewable Energy for Climate Change Mitigation"

Workshop on Integrating Climate Action in the Development Planning of Puducherry Union Territory
Organized by:
The Energy and Resources institute (TERI)
New Delhi

Shirish S Garud,
Senior Fellow and Director
TERI

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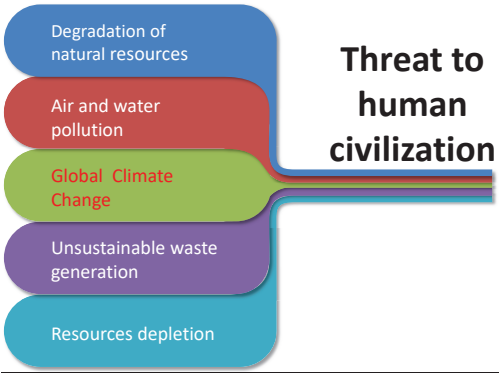
1

Flow of the presentation

- Energy and its impacts
- Renewables : Introduction
- Puducherry Power system
- Possible RE interventions
- Progress so far
- Way forward

Impacts of uncontrolled and rapid development



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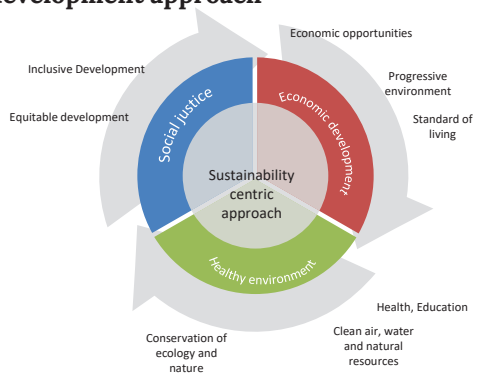
Sustainability centric development approach

- Quality of life
  - Physical needs
  - Emotional
  - Spiritual
  - Intelligence



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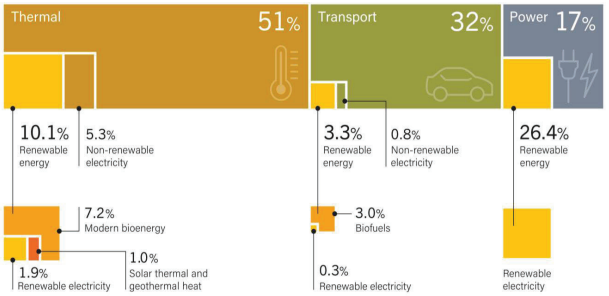
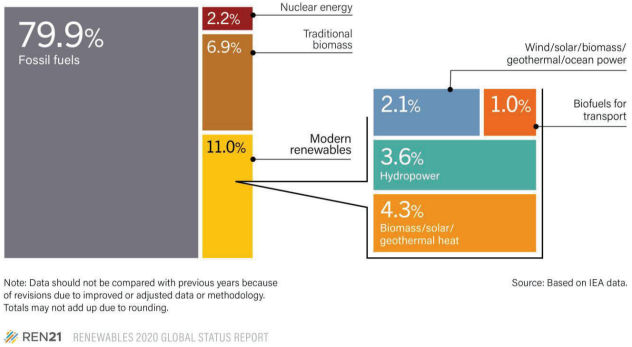
Energy demand global scenario

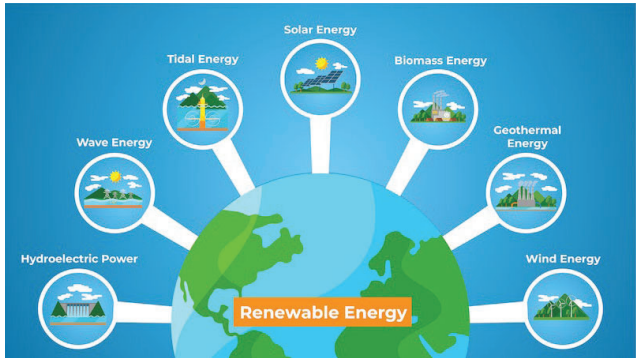


More than 80% of the energy is consumed in heating, cooling and transport

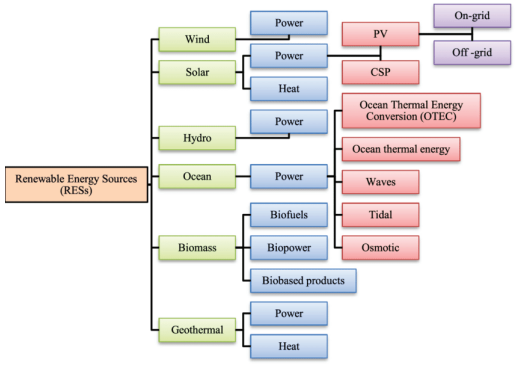
RE share in Energy Demand



Renewable Energy Technologies



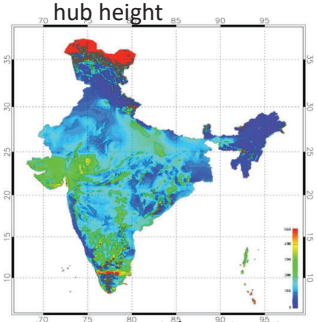
Renewable Energy Technologies



Solar Technologies

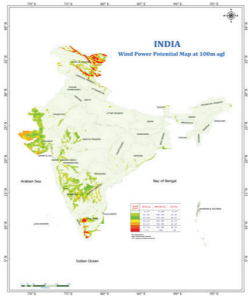
Wind energy basics

Wind energy potential at 80 m hub height



Gross potential= 102,788 MW

Wind energy potential at 100 m hub height



Gross potential- 302,251 MW

- Wind power density min 200 W/m^2
- Wind speed:
  - Min 2- 5 m/s

Source : http://inwea.org/wind-energy-in-india/wind-power-potential/

Turbine technologies

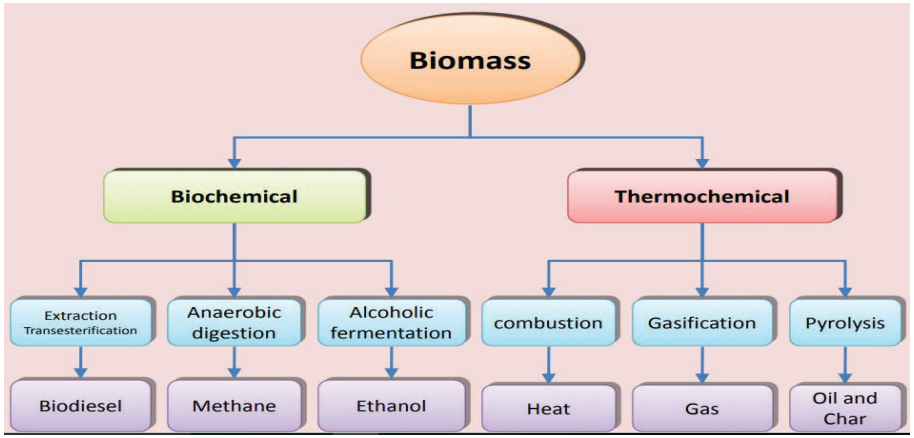
- India
  - India has 8 manufacturers
  - Manufacturing capacity 9.5 GW per year
  - 250 kW to 2.1 MW capacity turbines
- Global
  - Maximum capacity – 9.5 MW turbine
  - Offshore wind industry is expanding

Suzlon 88-100 turbine
Rated power 2.1 MW
Rotor diameter 88 m
Cut-in wind speed – 4m/s
Rated wind speed 14m/s
Swept area 6,082 m^2
Rotational speed 15 rpm
Hub height – 80m

Wind industry

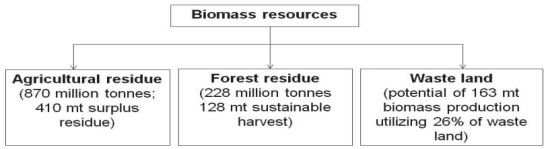
- 13 turbine manufacturing companies
- 35 wind turbine models from 250kW to 2750 kW capacity
- EPC, developers and servicing companies

Biomass Energy recovery routes



Biomass Energy in India

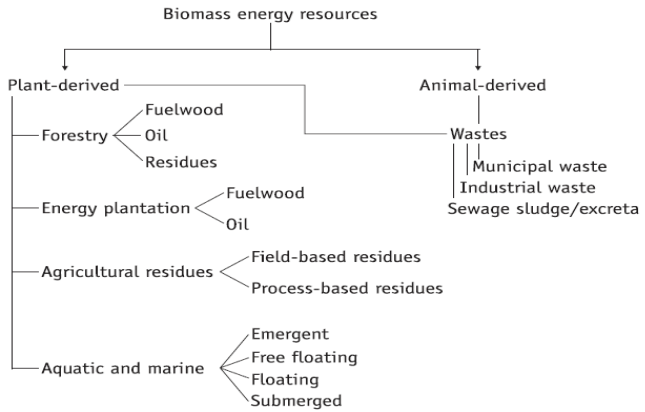
- **Biomass energy** an important **renewable energy resource** for India
- **150 million tonnes** per annum of **surplus biomass** is generated from different sources
- Many unutilized biomass residues such as pine needles, lantana etc. are also available.
- **Gasification technology** a viable alternative for efficient utilisation of surplus biomass
- **Biomass energy** is fast emerging as a potential for meeting **India's energy security** and for its **low-carbon development path**



Biomass types

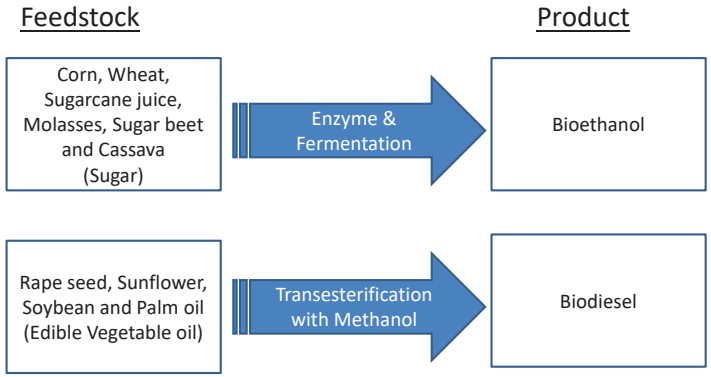
Virgin	Terrestrial biomass	Forest biomass Grasses Energy crops Cultivated crops
	Aquatic biomass	Algae Water plant
Waste	Municipal waste	Municipal solid waste Biosolids, sewage Landfill gas
	Agricultural solid waste	Livestock and manures Agricultural crop residue
	Forestry residues	Bark, leaves, floor residues
	Industrial wastes	Demolition wood, sawdust Waste oil or fat

Classification of biomass resources on the basis of their origin



First Generation Biofuels

Biofuels produced using edible crops and vegetable oils.



Second Generation Biofuel

Food vs. Fuel

- Large-scale production of crop based (first generation) biofuels may not be feasible without adversely affecting global food supply or encroaching on other important land uses.
- Biofuels from non crop, non edible feedstock with limited use of land without affecting food supply leads to second generation Biofuels (Bioethanol & Biodiesel). It would be possible to produce a large portion of transportation fuels using advanced biofuel technologies.

Third Generation Biofuels

Production of sustainable Biofuel (Biodiesel) from algae and aquatic biomasses.

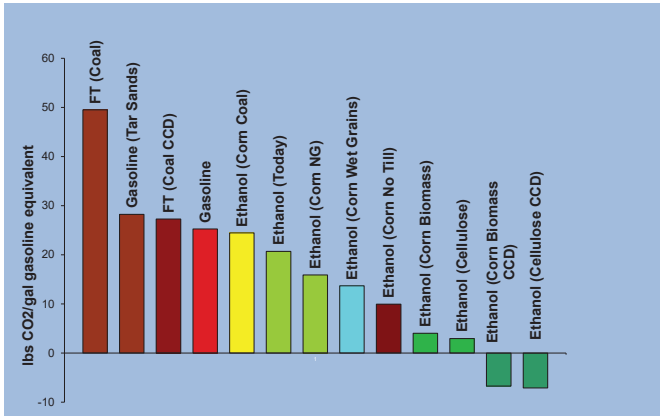
Algal Biofuel Process Systems

- Open Pond System
- Hybrid System,
- Modular Closed Photobioreactor,
- Heterotrophic Fermentation,
- Integrated Cultivated System.

Fourth Generation Biofuels

- Production of sustainable biofuels from specially created plants or biomass with greater yields and easier cellulosic breakdown.
- Additionally, they can be developed on land and water bodies that are unfit for agriculture.
- It would be co-processed using hydro processing facility in petroleum refining industry.
- It should possess greater environmental benefits, be cost competitive, and producible in sufficient amounts as Drop-In fuel to have a meaningful impact on fuel demands.
- Most importantly, the net energy derived from the feedstock should exceed the amount that is required for production.

CO_2 Emission from Alternate Fuels



21

Wave and Tidal Energy Potential (MW) of India

State	Tidal power potential	Wave power potential
Gujarat	10,425	4100
West Bengal	900	na
Odisha	400	600
Tamil Nadu	230	10,600
Maharashtra	200	8100
Andha Pradesh	100	6900
Karnataka	100	6100
Kerala	100	4900
Total	**12,455**	**41,300**

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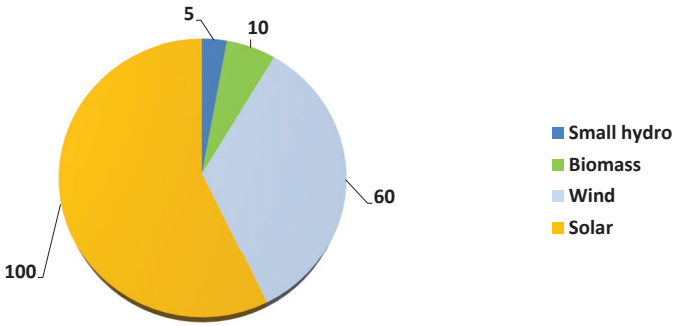
Renewable Power Target -175 GW by 2022



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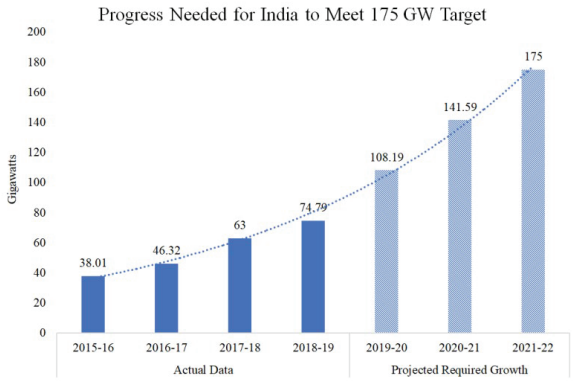
Growth of Renewables



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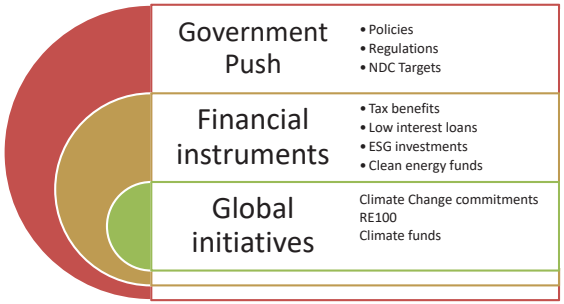
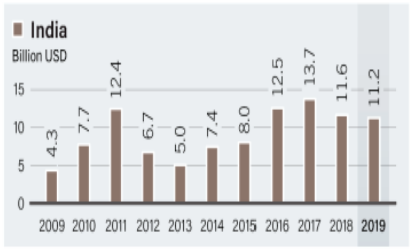
India: 8 levers are identified in the INDC, of which 6 are also quantified

Reduction levers			Included in INDC?	Specification
Energy	Non-fossil	Wind	✓	Wind: 60 GW by 2022
		Solar	✓	100 GW by 2022
		Other	✓	Biomass: 10 GW by 2022 Nuclear: 63 GW by 2032
	Energy efficiency	Buildings	✓	E.g. Energy Conservation Building Code
		Industry	✓	E.g. Perform, Achieve and Trade scheme
		Transport	✓	E.g. Vehicle fuel efficiency standard
	Fuel shifts	Coal to gas	✗	Not mentioned in the INDC
		Transport (NG/ biofuels)	✓	20% blending of biofuels
Non energy		Specification	✗	Not mentioned in the INDC
Other	Non-core energy	Methane	✗	Non-CO_2 emissions are not mentioned specifically in the INDC. However, various measures related to reducing emissions from waste are included.
		Nitrogen oxide	✗	
		Other	✗	
	LULUCF[1]	Afforestation	✓	Additional (cumulative) carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030.
		Reforestation	✗	

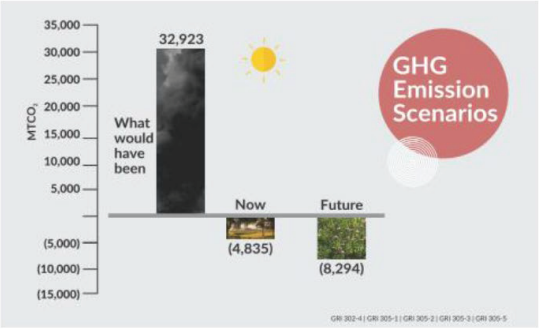
1 LULUCF: Land Use, Land Use Change and Forestry

Drivers for Energy Transition





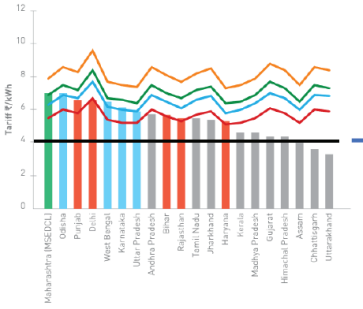
Creating Impact- Magarpatta City



The 2018-19 Sustainability report of Magarpatta City, Pune was awarded as "Asia's Best First Time Sustainability Report" by Asia Sustainability Reporting Awards

Roof top solar

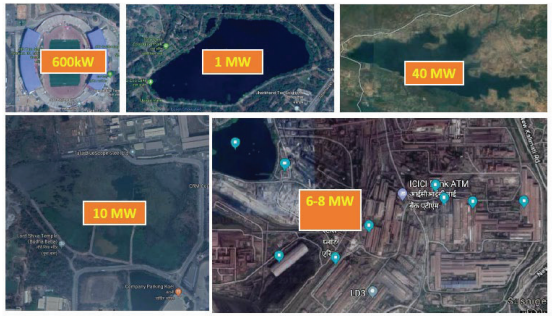
State-wise industrial tariff (HT) vs LCOE of solar power (100 kW system, ₹/kWh)[20]



This was in 2014

This is now

RE potential assessment for Industry



TERI's TEAM technology for kitchen waste to bio gas

- It uses kitchen/ garden waste
- Available from 50kg/ day to 2 ton /day
- Odourless / compact
- Gas can be used back for cooking / common facilities

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Saal Leaf Plate making

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Solar Powered Loom

Under the CSR initiative of Indus Towers, installation of 102 hybrid units (solar + grid) to supply power to 408 power looms, in and around Varanasi, is underway

- Capacity of each Solar PV Unit : 2 KWp
- Lithium Battery capacity: 6 KWh
- Power Conditioning Unit: 5 KVA
- Electrical Motor : 0.5 hp (230V , 50 Hz)
- No. of connected Looms with each unit : 4

Battery Powered Boat

Under the CSR initiative of Indus Towers, Installation of 4 Solar Charging Stations for running 40 Battery Operated Boats at Varanasi is underway.

- Capacity of each Charging Station : 5 KWp
- Lithium Battery used for each boat : 2.2 KWh
- Propeller :
  - ✓ Hydrodynamic Weed less Wedge Propeller
  - ✓ Max Load Thrust : 100 lbs
  - ✓ Weight : 28 lbs
  - ✓ Input Power : 48 V DC
- Passengers: 10-15 persons per boat

Biomass gasifier based cold storage cum power generation

Biomass Gasifier – Thermal Applications

Silk reeling

Dyeing oven

Rubber drying

Retrofitted with bakery oven

Large scale cooking

A cooking oven

Overview: Hydrogen value chain

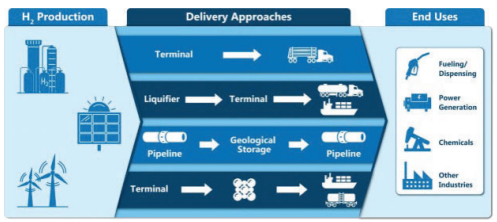
Storage and transportation of hydrogen could be a potential challenge for scaling up the hydrogen economy for India.

Existing infrastructure is limited and could be insufficient to support the widespread use of hydrogen as an energy carrier.

Globally, most hydrogen is transported using pipelines. However, pipelines need to be designed with higher specifications to minimize leakage and embrittlement.

Alternatively, hydrogen can be transported in the form of ammonia, methanol, and Liquid Organic Hydrogen Carriers (LOHCs). These fuels will have higher energy conversion costs. At lower volumes, transporting hydrogen using trucks could be a viable option

Hydrogen value-chain



Source: CleanH2.org

Potential- Green Hydrogen

S.no	Source	Gross Potential (a)	Installed Capacity (b)	Under Construction (c)	Under Planning (d)	Resource requirement for 2022 target (e)	Resource requirement for 2030 target (f)	Resource available for Green Hydrogen Production (g)= (a)-{(b)+(c)+(d)+(e)+(f)}	CUF
1	Solar	748	90	14	24	10	200	410	22%
2	Wind*	302	40	12		10	100	140	29%
3	Micro Hydel	21	5	-	-	-	-	16	40%
4	Large hydro	148	47	13	11	-	25	52	45%
5	Tidal	12	-	-	-	-	-	12	10%
6	Geothermal	10	-	-	-	-	-	10	71%
7	Offshore wind	71	-	-	-	-	-	71	30%
8	Biomass	42	10	-	-	-	-	32	40%
Total (GW)		**1354**	**192**	**39**	**35**	**20**	**325**	**743**	

743 GW of non fossil potential would be available for green hydrogen production

*Potential considered at 100 m hub height

Source: NISE,NIWE,MNRE,CEA, Teri Analysis

Potential - Green Hydrogen

Source	Net potential	CUF	Net available capacity (GWhr)	HHV of Hydrogen (GWhr)*	Hydrogen potential (MT per annum)
	(a)	(b)	(c) = (a x b x 8760 hrs.)	(d) = (c x electrolyser efficiency)	(e) = (d x 10^6 /39.39/1000/10^6)
Solar	451	22.00%	869167.2	564959	14
Wind	140	29.00%	355656	231176	6
Micro Hydel	16	40.00%	56064	36442	1
Large hydro	52	45.00%	204984	133240	3
Tidal	12	10.00%	10512	6833	0.5
Geothermal	10	71.00%	62196	40427	0.5
Offshore wind	71	30.00%	186588	121282	3
Biomass	32	40.00%	112128	72883	2
Total			**1857295.2**	**1207242**	**30**

Assuming that the net potential of RE is the power available to a hypothetical commercial-grade electrolyzer, and its efficiency is 65% (as per existing commercially available electrolyzers) the total potential of Hydrogen in India works out to ~ 30 MT per annum.

*HHV of Hydrogen is 39.39 kWh/kg

Source: TERI Analysis

National Hydrogen Mission

- The Government of India has **allotted Rs 25 crore in the Union Budget 2021–22** for R&D in hydrogen energy and intends to produce three-fourths of its hydrogen from renewable resources by 2050.
- In July 2021, The Minister for Power, announced the introduction of **Green Hydrogen Consumption Obligation** (similar to Renewable Purchase Obligations) in fertilizer production and petroleum refining. A green hydrogen bid in the next four-five months is also expected.
- India also plans to call **bids for 4 GW electrolyzer capacity**. The government could also extend the production-linked incentive (PLI) scheme for manufacturing electrolyzers to produce green hydrogen.
- TERI analysis indicates that H_2 demand could increase to 28 Mt by 2050, driven by demand from industrial sectors. Expanding in existing sectors - fertilizer and refineries, or growing into new sectors, such as steel.
- Estimates suggest that, demand for hydrogen in the transport sector will see growth mainly in the heavy-duty and long-distance segments. H_2 could also play a role in the power sector as a long-term storage vector.

Hydrogen demand could at least multiple 3 fold by 2050, likely to be driven by industry

- H2 demand in India today is around 6 Mt, mainly in fertilisers (ammonia) and refineries.
- Steel sector is also expected start consuming hydrogen, replacing coal to process iron ore
- By 2050, this could increase at least 3 fold, largely driven by growth in industry.
- Transport will see some growth, mainly from heavy-duty and long-distance transport.
- There is the potential for some limited use of hydrogen in the power sector.

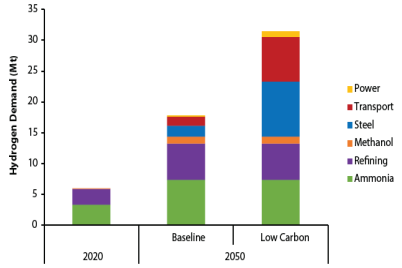


Figure 4: Baseline and Low Carbon scenarios, 2020 and 2050

Source: TERI analysis

Note: Demand projections exclude potential use of hydrogen in shipping, aviation, and petrochemicals, which are not covered in this report.

Some initiatives by Indian industry

IOCL

- Announced development of India's first green H_2 plant at Mathura.
- MoU with Tata Motors -15 H_2-powered fuel-cell buses developed in collaboration with ISRO.
- Developing Type-3 High Pressure H_2 Cylinder and material-based H_2 storage.
- Green H_2 from biomass

NTPC

- Fuel cell based micro grid in Ladakh.
- Hydrogen storage for renewable power.
- Green methanol plant (H_2 plus carbon capture and utilization).
- Green ammonia production.
- Plans for Green H_2 generation in Gujarat.

BHEL

- Fuel cell technology development and testing infrastructure.
- Business plan across the value chain (supply/ EPC/ Project design etc.).
- Hydrogen buses

Reliance Industries

- Announced investment in four "giga factories" to manufacture photovoltaic modules, batteries, fuel cells and electrolyzers.
- Set out a 1-1-1 target of bringing down the cost of green H_2 to under $1 per 1 kg in 1 decade.

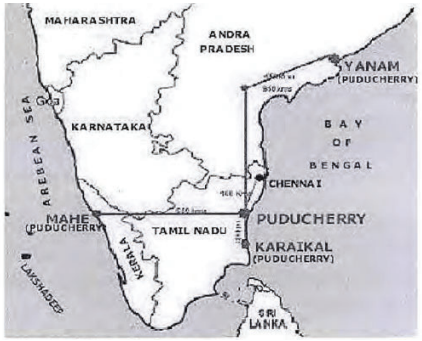
Adani Enterprises

- Announced plans to invest across the entire green energy value chain.
- MoU with Maire Tecnimont to develop projects in producing ammonia, and hydrogen, and from renewable feedstock.

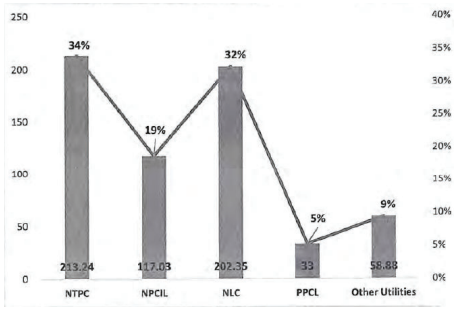
ACME Group

- Set up the world's first integrated commercial-scale pilot plant for Green Hydrogen and Green Ammonia production in Rajasthan in 2021.

Puducherry Power System



Power supply position



Source: Business plan Petition, Dept of Electricity, Puducherry

Power Consumption Times Series Data

Parameters	Year					
	2014	2015	2016	2017	2018	2019
Residential	610.38	645.22	685.00	720.22	733.52	721.80
Industry	1,479.53	1,449.75	1,425.00	1,425.00	1,509.08	1,614.24
Commercial	181.00	182.22	198.00	198.00	216.41	212.85
Total	2,270.91	2,277.19	2,308.00	2,343.22	2,459.01	2,548.89

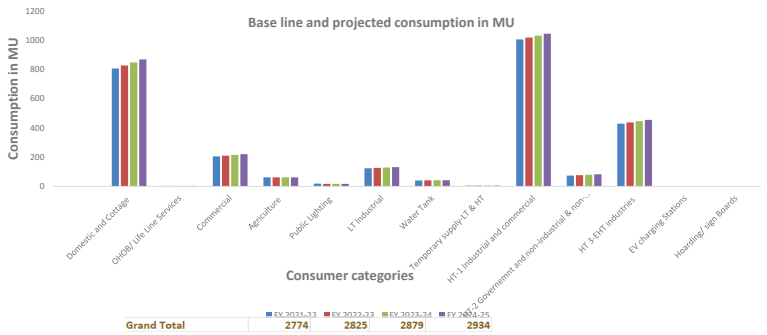
Sectorial emissions

Installed Capacity of Power Utilities in UT of Puducherry as on 31.10.2021 (Figures in MW)

Ownership/Sector	Modewise breakup								Grand Total
	Thermal					Nuclear	Hydro	RES*	
	Coal	Lignite	Gas	Diesel	Total				
State	0	0	32.50	0	32.50	0	0	0	32.50
Private	0	0	0	0	0	0	0	5.51	5.51
Central	140.80	111.80	0	0	252.60	86.00	0	0	336.50
Total	140.80	111.80	32.50	0	285.10	86.00	0	5.52	382.62

* - Renewable energy systems

Annual consumption in UT



Source: *Business Plan Petition, Dept of Electricity, UT Puducherry*

GoI schemes and SDGs

Scheme	Targets	Impacts on sustainability and SDGs
Renewable Power	450 GW by 2030	• Green job creation • GHG emission reduction
National Solar Mission	100 GW by 2022	• Rural employment • Industry development • International partnerships (ISA) • GHG reductions
Wind revolution	60 GW by 2022	• Rural employment • Industrial development • GHG emission reduction
Hydro mission	5 GW by 2022; 80 GW by 2030	Decentralised rural electrification; livelihood generation; improved quality of life
National Biofuels Policy and SATAT	E20 by 2025; 5000 BCNG plants	• GHG emission reduction; Recycling of agricultural, industrial and municipal waste (250million tonnes per annum) • INR 100,000 crore (USD 13.8 billion) Potential reduction in India's annual fuel import bill by using biofuels

How industries can play role

- Switching to renewables
- Adapting strategies to reduce carbon foot print of supply chain through EE, renewables, circular economy
- Diversification into RE sector
  - Hydrogen economy
  - Energy storage
  - Electrification of industrial activities

Potential areas for RE interventions

- Solar PV and thermal
  - Industrial systems
  - Rooftop solar systems
  - Irrigation systems
  - Floating solar systems
- Wind
  - Off shore
- Bioenergy
  - Waste to energy (rural / urban)
  - Biofuels
- Hydrogen
  - Industrial applications

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The Energy and Resources Institute
Creating Innovative Solutions For A Sustainable Future
ENERGY AGRICULTURE ENVIRONMENT HABITAT RESOURCE SECURITY CLIMATE HEALTH & NUTRITION

Multimodal Climate Change Assessment - A case study of Puducherry
Speaker: Mr. Akash Sinha, Research Scholat, IIT, Madras.
Date : 06.05.2022.

Environmental and Water Resources Engineering
Department of Civil Engineering
Indian Institute of Technology Madras

Workshop on "Integrating Climate Action in the Development Planning of Puducherry Union Territory"

Multimodal Climate Change Assessment – A case study of Puducherry

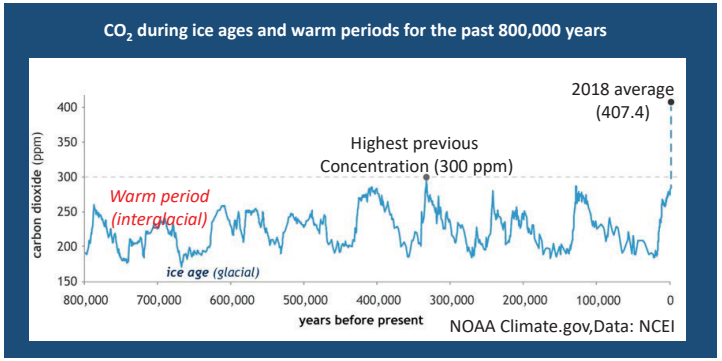
Akash Sinha
Research Scholar
Email: ce16d040@smail.iitm.ac.in

Puducherry, 6th May, 2022

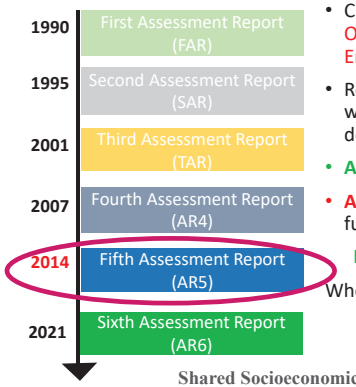
ABOUT CLIMATE CHANGE

For the first time in last 300,000 years the carbon dioxide level has gone more than 300 ppm

Post industrialization, the CO_2 level has gone to 400 ppm



Intergovernmental Panel for Climate Change



- Created in **1988** by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP)
- Responsible to provide governments at all levels with scientific information that they can use to develop climate policies
- **AR6** is the latest report
- **AR5** is used in the present work where four possible future scenario based on GHGs emission

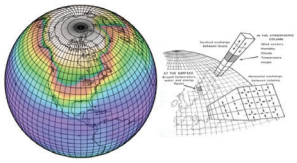
RCP 2.6 RCP 4.5 RCP 6.0 RCP 8.5

Where, RCP is Representative Concentration Pathways

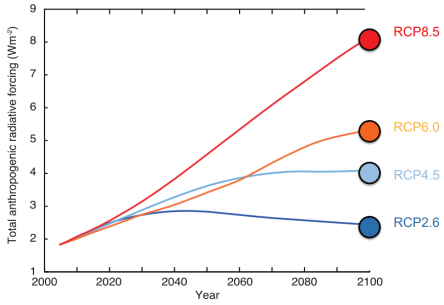
GENERAL CIRCULATION MODELS (GCMs)

- **Global Climate Models (GCMs)** are the primary tool for understanding how the global climate may change in the future.
- **Numerical model** - represent physical processes in the atmosphere, oceans, cryosphere and land surface. They depict climate using a three-dimensional grid.

Three-dimensional models which simulate the atmosphere, Atmospheric General Circulation Models (AGCMs) and a model to simulate the ocean, Ocean General Circulation Models (OGCMs)is coupled to form an atmosphere-ocean coupled general circulation model



Fifth Assessment Report (AR5)



- Consist of an **even number** of scenarios, in order to avoid a clear middle scenario
- **Year 2100** is selected as the base year to stabilizing the radiative forces
- **"Concentration"** is used instead of "emissions (as used in AR4 and earlier report) "

To emphasize that **concentrations are used as the primary product** of the RCPs, designed as input to climate models

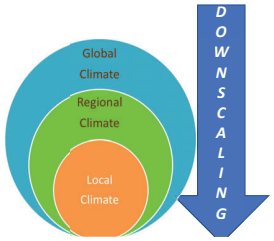
Representative Concentration Pathways (RCPs)

KEY CHALLENGES

- **GCMs accuracy** decreases from free tropospheric variables to surface variables

Atmospheric Variable, Land Surface variable, Oceanic variable

- Downscaling – Statistical and Dynamic
- Spatial mismatch
  - Scale ranges from 100-150 km
- Model **uncertainty**
  - **Temporal reliability – Monthly, Daily, Hourly**
  - **Model reliability**

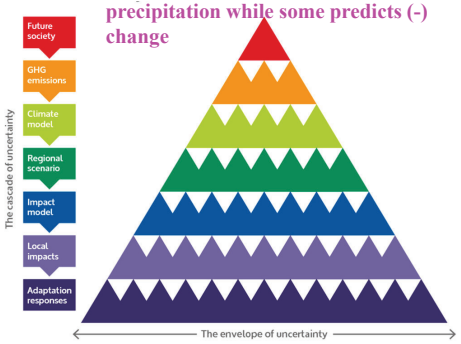


Envelop of Uncertainty

Some of the models shows a consistent bias under different scenarios in different regions.

The uncertainty among various models are also quite high

i.e. some models predicts (+) change in precipitation while some predicts (-) change

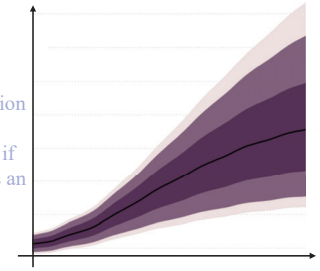


Multimodal Climate Change Prediction

A single model analysis may not be sufficient to establish a possible climate change projection.

Researchers have advocated use of **multimodal climate analysis.**

However, a **simple averaging** of multimodal prediction **may give an unrealistic results** if one single model is an outlier



Reliability Ensemble Averaging

Reliability of a model depends on

ability of a GCM to reproduce different aspects of present-day climate – **"model performance"**

convergence of simulations by different models for a given forcing scenario – **"model convergence"**

(greater convergence implying higher reliability of robust signals)

$$R_i = \left[\frac{\epsilon_T}{abs(B_{T,i})}\right]\left[\frac{\epsilon_T}{abs(D_{T,i})}\right]$$

ϵ_T is the measure of natural variability in 30-yr average regional precipitation

Model Bias
Absolute difference between simulated and observed mean precipitation for the present-day period of 1971–2000

Model Convergence
Distance of the change calculated by a given model from the REA average change

Reliable Ensemble Average Change and uncertainty range

$$\widetilde{\Delta P} = \frac{\sum_i R_i \Delta P_i}{\sum_i R_i} \qquad \widetilde{\delta_{\Delta P}} = \left[\frac{\sum_i R_i \left(\Delta P_i - \widetilde{\Delta P}\right)^2}{\sum_i R_i}\right]^{1/2}$$

A Multimodal Precipitation Change - A Case Study of Puducherry

- Based on **AR 5** of IPCC
- Grid size is around 100 km ×100 km
- 7 GCM models are used
- Seasonal variability of precipitation is assessed
- Two hydrological cycle years have been selected for future prediction: **2021–2050 (Near future)** and **2051–2080 (Far future)**

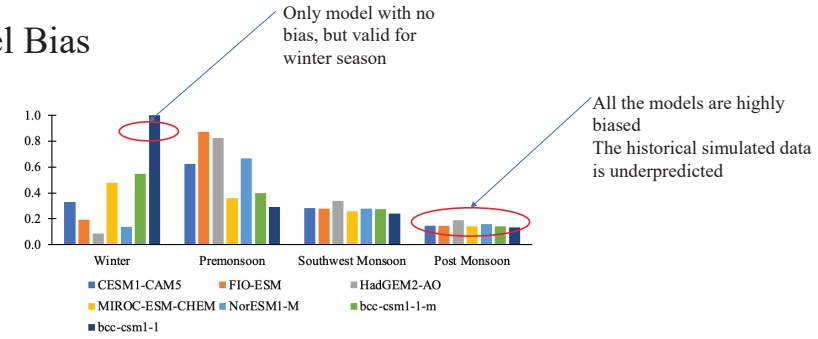
Mean seasonal rainfall

	Winter	Pre-monsoon	Southwest Monsoon	Post Monsoon
Mean rainfall (mm)	42.12	118.1	382.6	637.3

Experiment	Centre	Location
BCC CSM 1.1 M	Beijing Climate Centre	China
BCC CSM 1.1	Beijing Climate Centre	
FIO ESM	The First Institute of Oceanography	China
MIROC ESM CHEM	Atmosphere and Ocean Research Institute, National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Tech.	Japan
NCAR CESM 1 (CAM5)	National Center for Atmospheric Research	USA
NCC NOR ESM1 -M	Bjerknes Centre for Climate Research, Norwegian Meteorological Institute	Norway
NIMR KMO KadGEM2 A0	National Institute of Meteorological Research, Korea Meteorological Administration	South Korea

https://www.ipcc-data.org/sim/gcm_monthly/AR5/Reference-Archive.html

Model Bias



Model bias depends mainly on the difference between the observed data and historical simulated data, irrespective of any scenario

The model bias is very consistent in the post monsoon season

A typical value of 1 indicates that the model does not have any systematic bias.

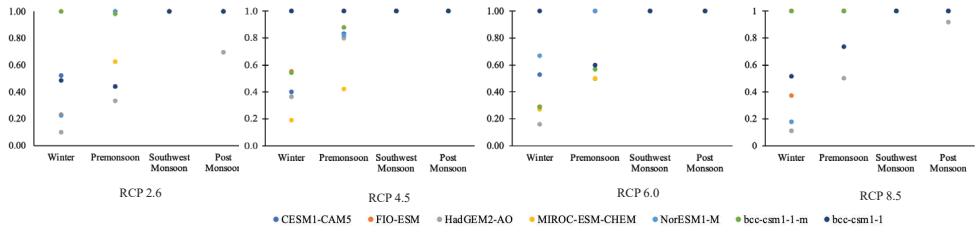
Lower the value, higher the bias

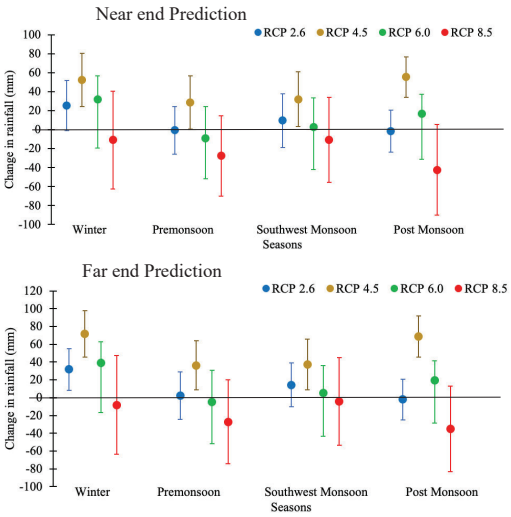
Model Convergence

Most of the models have model convergence 1. Hence, the variability in the projection of climate among various models is very less

The model **Had GEM2-A0** performs poorly in all the scenarios with least convergence

All the models consistent in predicting southwest monsoon and post-monsoon period, with maximum variation in winter season





The mean seasonal change in both the period (near end and far end) are comparatively similar

Under RCP 2.6 the mean seasonal change in minimal.

All the models indicates that increase in precipitation in maximum in RCP 4.5

Under RCP 8.5, the models shows a continuous decline in mean seasonal rainfall

It should also be noted that the amount of change in **mean precipitation** is in the range of -50 to 50 mm

RCP 4.5 shows overall increase in the mean seasonal rainfall of all the season.

The winter precipitation shows an increase in rainfall for RCP 2.6, RCP 4.5 and RCP 6.0

Summary

- The uncertainty in the climate model need to be assessed with the confidence interval, and is important for decision making
- Proper choice of Climate model, **downscaling technique** can minimize the uncertainty in the modelling
- **Ensemble of set of realization** can give a better result for forecasting climate change projection

Green Campus Initiatives for Climate Change Adaptation

Speaker: Dr. M. Nandhivarman, Coordinator, Office of Green Campus, Pondicherry University

Date : 06.05.2022.

Green Campus Initiatives for Climate Change Adaptation

INTEGRATING CLIMATE ACTION IN THE DEVELOPMENT PLANNING OF PUDUCHERRY UNION TERRITORY
Two Day Workshop

PCCC - DST&E, Puducherry
06-05-2022

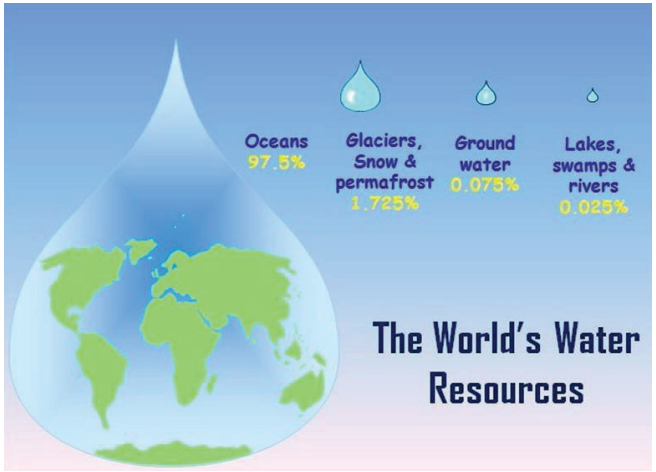
by

Dr. M. Nandhivarman, MSc., MBL, PhD.

Coordinator
Office of Green Campus
Pondicherry University

The Progress of Global Sustainability

- **Whistle Blower:** Late 1960s "the Union of Concerned Scientists reported that fundamental transformational changes mitigating the environmental challenges are urgent, if we are to avoid the collision our present course will bring about".
- **Stockholm Conference, 1972 -** the protection of the environment were incorporated into the 42nd Constitutional Amendment Act passed in 1976.
- **Brundtland Report, 1987** – "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".
- **The Earth Summit, 1992** - The Earth Summit's landmark document - **'Agenda 21'**, mapped out a comprehensive plan of **'down to action'.**
- **World Summit on Sustainable Development, 2002 -** 'decade of education for sustainable development'.
- **Sustainable Development Goals 2016-30**



India's urban utilities usually **lose up to 40–60%** of the water produced

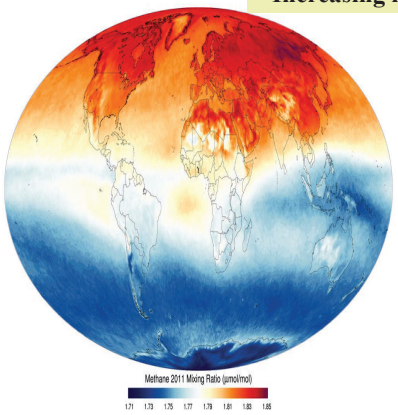
Every Indian Wastes Up to 45 litres of Water Per Day

30 to 60% of domestic drinking water is used to water yards and gardens

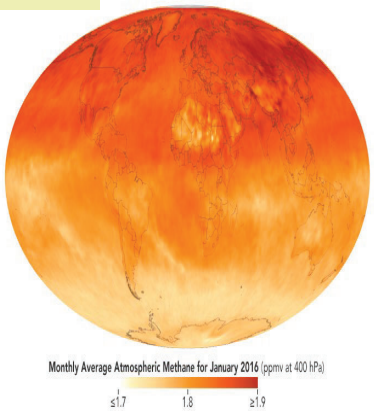
Raw Food Waste

Cooked Food Waste

Increasing levels of GHGs



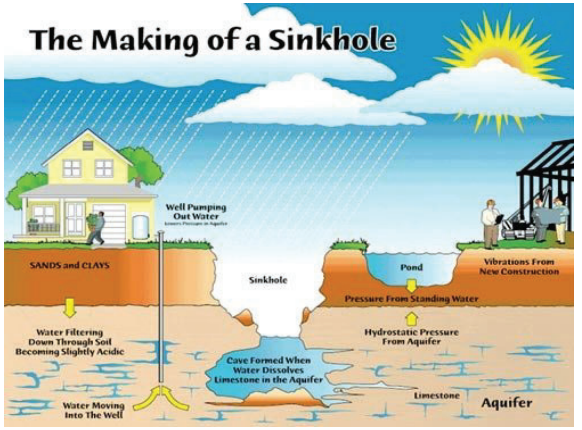
NASA 2011



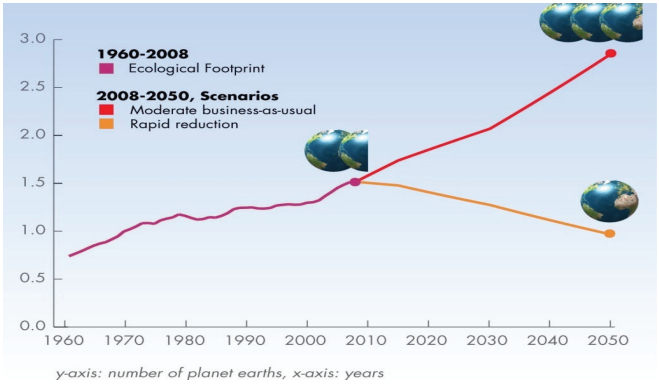
NASA 2016

6 major GHGs - Carbon dioxide (CO2), **Methane** (CH4), nitrous oxide (N2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF6), and Nitrogen triflouride (NF3)

The Almost Forgotten Sink Hole



How many EARTH do we need by 2030 & 2050?



Over Exploitation

Cassin's auklet (Ptychoramphus aleuticus) is a small, chunky seabird that ranges widely in the North Pacific.

2014 summer mass death in US

Late summer of 2014, the **carcasses of thousands of Cassin's auklets** washed ashore from Northern California up to the north coast of Washington State.

The Coastal Observation and Seabird Survey Team estimated a toll between 50,000 and 100,000 deaths that year.

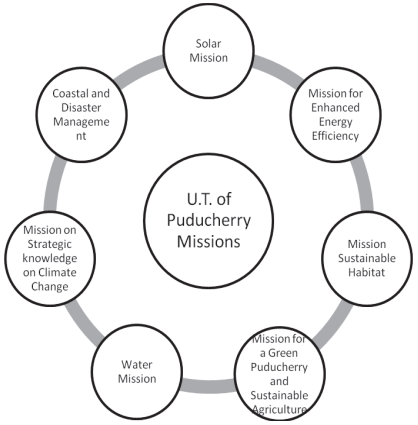
Scientists were uncertain about the cause of these deaths. While viruses, bacteria, and oil spills were ruled out, and the cause appeared to be **starvation**.

The efforts of these place-based data collectors — along with data on temperature, ocean circulation and the abundance of prey — have provided the first definitive answer to what killed the seabirds: **starvation, brought on by shifts in ocean conditions linked to a changing climate.**

North Pacific warmth which is pushing marine food chains, affected other species of **zooplankton, krill, copepods and fish that normally develop in cold waters** and the birds that consume them including the Cassin's auklets.

Mass Deaths

Action Plan on Climate Change



4 Pillars

Precautionary Principle 15 of the Rio Declaration

"where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation"

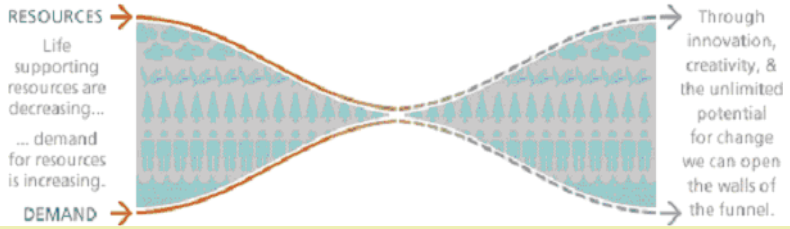
Fundamental Duties of a Man

Article 51A(g) makes it 'the fundamental duty of every citizen to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures'

Environment (Protection) Act, 1986

"environment" includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property and the same shall duly be protected and conserved for common good

Backcasting is a planning method that starts with defining a desirable future and then works backwards to identify policies and programs that will connect that specified "future to the present".



The Natural Step (TNS) framework is based on scientific principles; is focused on the beginning of cause-effect relationships; and incorporates the wider environment-social-economic system in its thinking. Designed to guide actions and behaviours, TNS framework works towards achieving sustainability.

Launch of Green Protocol @ PU

PPCC — Puducherry Pollution Control Committee, Government of Puducherry
Department of Science Technology and Environment, Government of Puducherry
Pondicherry University
APSCC — Association for Promoting Sustainability in Campuses and Communities

COMPREHENSIVE GREEN PROTOCOL for the Educational Institutions, Industries, Residences and Other Organizations of the Union Territory of Puducherry

Towards Elimination of Plastics @ PU – UGC Notification

Towards the Elimination of Plastic Wastes @ PU Fostering UGC Notifications & Govt. of Puducherry Notifications

UNIVERSITY GRANTS COMMISSION

"Swachhata Hi Sewa Campaign"

UGC Guidelines for Ban of Plastic Use in Higher Education Institutions

Whereas plastic waste has emerged as one of the biggest environmental concerns adversely impacting the soil, water, health and well-being of citizens at large;

Whereas excess-consumption of plastic combined with limited waste disposal systems has become a challenge to the urban waste disposal systems, and has choked the rivers and water systems in rural areas;

Whereas the time has come for a systematic campaign to reduce the usage of plastic, especially the single use plastic;

Whereas the Government has decided to take plastic ban as a national level campaign to address the environmental hazards being and bring attitudinal changes that shun use of plastics; and

Whereas the educational institutions have the unique spread and influence to educate the students and households on the need for avoiding usage of plastics,

University Grants Commission hereby issues the following guidelines for all the higher educational institutions in the Country:

Guidelines

1. **Scope of guidelines:**
   (a) These guidelines are applicable to all the higher educational institutions (HEIs) in the Country.
   (b) They encourage HEIs (universities and colleges) to adopt policies and practices towards cleaner and plastic free campuses.
2. All the HEIs in the Country shall strive to make their campuses 'plastic-free' by systematically banning use of plastics and replacing the same with suitable environmental friendly substitutes.
3. Every HEI shall:
   a. Ban use of single-use plastics in canteens, shopping complexes in the institution's premises and hostels, etc.
   b. Carry out awareness drives and sensitization workshops on the harmful impacts of single use plastics.
   c. Mandate all students to avoid bringing non-bio-degradable plastic items to the institution.
   d. Encourage their students to sensitize their respective households about harmful effects of plastics and make their households 'plastic free'.
   e. Install necessary alternative facilities like water units to avoid the use of plastic water bottles, and encourage use of alternative solutions like cloth bags, paper bags etc., instead of plastic bottles, bags, covers and other goods on campuses.
4. All HEIs which have adopted villages under Unnat Bharat Abhiyan shall undertake a campaign in their adopted villages till they are converted into 'plastic-free villages' through promoting awareness and encouraging shift to alternative products.

****

Measures Taken – Phase I

THE HINDU

HOME NEWS OPINION BUSINESS SPORT CRICKET CROSSWORD ENTERTAINMENT

CITIES BENGALURU CHENNAI COIMBATORE DELHI HYDERABAD KOCHI KOLKATA MUMBAI KOZHIKODE MADURAI

NEWS › CITIES › PUDUCHERRY

PUDUCHERRY

Puducherry bans 10 single-use plastic items from tomorrow

STAFF REPORTER

PUDUCHERRY, AUGUST 01, 2019 01:32 IST
UPDATED: AUGUST 01, 2019 12:44 IST

A release from Director of Department of Science, Technology and Environment, R. Smitha, said single use plastic materials such as polythene/plastic/polypropylene carrybags, polythene plastic cups, polythene plastic plates, styrofoam (thermocol) plates, styrofoam cups, plastic sheet pouches used to wrap cooked food, plastic sheets used to spread on dining table, water pouches, plastic straw and plastic flag would be banned in the UT, effective Friday.

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

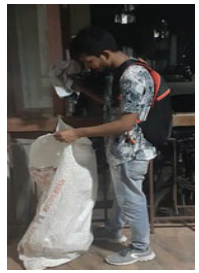
House Keeping Staff Participation

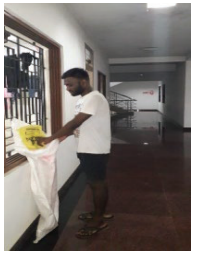
Scientific Study (Inventories, Analysis, Strategies)

'Backend Approach' – Inventories

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

Students Participation





‘Cotton Carry Bag Drive’ – Elimination of Plastic @ PU

Department of Social Work, NSS (National Service Scheme), NCC (National Cadet Corps), of Pondicherry University, Puducherry Pollution Control Committee, Dept. of Science, Technology & Environment, and the Association for Promoting Sustainability in Campuses and Communities (APSCC), had initiated the ‘cotton carry bag drive’

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

- Tailor-Made Initiatives
- Change in Approaches
- Involving Volunteers

} Sorting of wastes generated during VIVA, Synopsis, Parties, etc. by the student volunteers (Pilot Scale)

Sorting, prevents spillage, reduces volume and easy for management

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

Sl. NO.	Banned Plastic Item by Govt. of Puducherry	Item Image	Stopped Using – Yes: Tea Shop (1)	Fruit and Veg. shop (2)	Tailor cum fancy shop (3)	Cake Shop (4)	Snack and fruit juice (5)	No (Until Stock Exists): Tea Shop (1)	Fruit and Veg. shop (2)	Tailor cum fancy shop (3)	Cake Shop (4)	Snack and fruit juice (5)
1.	Polythene carry bags		✓	○	✓	✓	✓	-	✓	-	-	-
2.	Plastic carry bags		✓	✓	✓	✓	✓	-	-	-	-	-
3.	Polypropylene carry bags		✓	✓	✓	✓	✓	-	-	-	-	-
4.	Polythene plastic cups		✓	✓	✓	✓	○	-	-	-	-	✓
5.	Polythene plastic plates		✓	✓	✓	✓	✓	-	-	-	-	-
6.	Styrofoam (thermocol) plates		✓	✓	✓	✓	✓	-	-	-	-	-
7.	Styrofoam cups		✓	✓	✓	✓	✓	-	-	-	-	-
8.	Plastic sheet pouches used to wrap cooked food		✓	✓	✓	○	✓	-	-	-	✓	-
9.	Plastic sheets used to spread on dining table		✓	✓	✓	✓	✓	-	-	-	-	-
10.	Wafer pouches		✓	✓	✓	✓	✓	-	-	-	-	-
11.	Plastic straw		✓	✓	✓	○	○	-	-	-	✓	✓
12.	Plastic Spoon and Fork		✓	✓	✓	○	✓	-	-	-	✓	-
13.	Plastic flag		✓	✓	✓	✓	✓	-	-	-	-	-

Self Declaration by Eatery Owners @ Shopping Complex Switching to ‘eco-friendly’ materials and for certain materials until stock lasts

Minimizing the usage of Plastics @ Shopping Complex – UGC & Govt. of Puducherry Notifications

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

Minimizing the usage of Plastics @ Shopping Complex

- Self-declaration by the shop owners
- Over 70% of single use plastics are eliminated
- Elimination of plastic laminated paper cup

Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

Plastic Wastes to Pavement Blocks/ Others*




Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

- Cotton Back - Drops, Banners & Others, replacing PVC Flex

Transformation of used 'Cotton Banners' into carry bags and designer bags



Towards Elimination of Plastics @ PU – UGC Notification (Contd.)

Transformation of used 'Cotton Banners' into carry bags and designer bags


http://www.pondiuni.edu.in/sites/default/files/Appendix%20A-C%20-21012020--.pdf
(Circular Dated: 21-01-2020)

http://www.pondiuni.edu.in/news/avoidance-pvc-flex-banners
(Circular Dated: 21-01-2020)

Quick Launch Actions (Sustainable Waste Management) @ PU


Plant, Tree, Horticulture Wastes are Source Segregated and Composted

Windrow Composting - Organic Waste from 'Common Waste Stream'

Paper, boards, plant materials, etc.

Windrow Composting

Appearance of Indicator Organisms in the Windrow Composting Pile in 1 month*

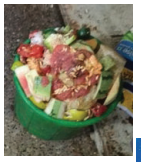
Termite

Earthworm

Quick Launch Actions (Sustainable Waste Management) @ PU

Un-shredded Fruit Waste

Source Segregation of Wastes @ Shopping Complex



Shredding minimized the volume of waste & paved way for easy handling

Source Segregated Fruit Waste & Tea Waste

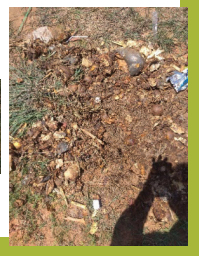
Quick Launch Actions (Sustainable Waste Management) @ PU (Contd.)

Composting of Organic Fraction (Fruit Waste, Tea Waste and Others)

The leftovers are decomposing under the sun

Shredded fruit waste (Partial) would be consumed by the native wild animals within two days

The fruit waste from the Shopping Complex are not mixing with the 'waste stream'



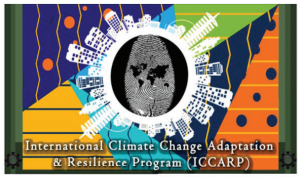
Entrepreneurship Development

Climate Launchpad Launching of 'Green Business Ideas Competition' & 'Boot Camp'

Green Business Idea Competition @ PU

The green business idea named **'Green Voltz-Cera Tech System'** which is a ceramic-based microbial fuel cell for wastewater treatment, resource recovery, electricity production, crop cultivation and revenue generation developed by the 'Pondicherry University Team' was selected for the International finals at Amsterdam, Netherlands.

Nation Building & Reversing the Loss of Biodiversity Program/ Projects with International Scope - Participation of Universities, Colleges, Schools and Communities



Nation Building & Reversing the Loss of Biodiversity Programs/ Projects with International Scope (Contd.)

Top Soil Up-gradation for Ecosystem Restoration and Organic Food Production

APSCC
Association for Promoting Sustainability in Campuses and Communities

Pondicherry University

Directorate of School Education
Government of Puducherry

Dept. of Agri & Farmers Welfare
Government of Puducherry

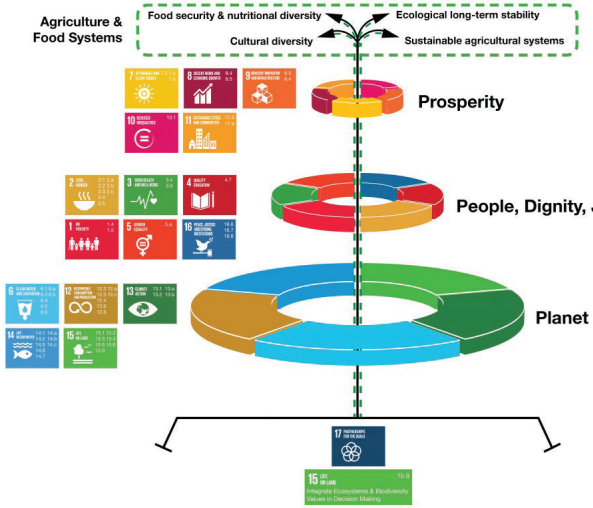
Dept. of Forest & Wildlife
Government of Puducherry

GLOBAL SOIL PARTNERSHIP

Partnering Organization

1. Pondicherry University
2. Department of Agriculture and Farmers Welfare
3. Directorate of School Education
4. Department of Wildlife and Forests
5. FAO - Global Soil Partnership
6. Official FAO-GSP Partner APSCC

http://www.pondiuni.edu.in/news/approval-carry-out-multiple-student-centered-activities-cum-awareness-programs-and-internationa (Circular Dated: 21-01-2020)



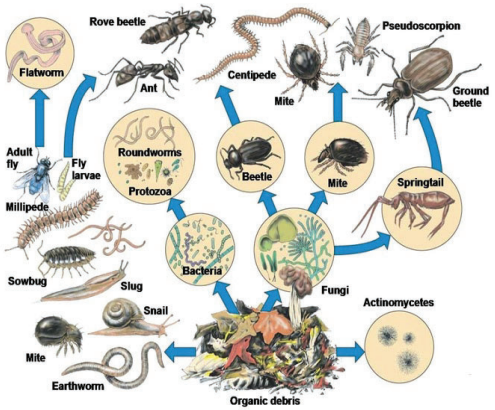
Soil Ecology

Tertiary Consumers
(organisms that eat secondary consumers)
centipedes, predatory mites, rove beetles, fomicid ants, carabid beetles

Secondary Consumers
(organisms that eat primary consumers)
springtails, some types of mites, feather-winged beetles, nematodes, protozoa, rotifera, soil flatworms

Primary Consumers
(organisms that eat organic residues)
bacteria, fungi, actinomycetes, nematodes, some types of mites, snails, slugs, earthworms, millipedes, sowbugs, whiteworms

Organic Residues
leaves, grass clippings, other plant debris, food scraps, fecal matter and animal bodies including those of soil invertebrates



Training & Capacity Building - Regenerative Agriculture

Soilless farming – Hydroponics and Aquaponics (soil Pollution Prevention)

Nutrient Solution Preparation

Lab-to-Land Environment Education

Training & Capacity Building (Contd.)

Lab-to-Land Environment Education

Establishing an Organic Vegetable Garden

Application of Vermicompost for Garlic

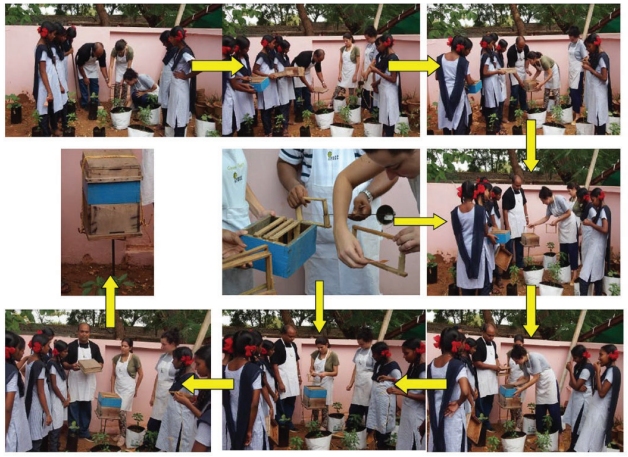
Seed Ball Production (Sand + Red Soil + Field Soil + Compost + Vermicompost + Seeds)

Bio-pest Repellent Preparation

Resource Reusing - Discarded Plastic Cups for Seed Ball Germination Study

Training & Capacity Building (Contd.)

Establishing Apiculture Unit
Step-by-Step Process Flow for the Natural Colony Establishment



Training & Capacity Building (Contd.)

Sekkizhar Government High School, Puducherry

Lab-to-Land Environment Education

Nation Building & Reversing the Loss of Biodiversity Programs/ Projects with International Scope

National Level Green Campus Initiative Awareness Program

Partnering Organizations

- Pondicherry University, India
- Department of Science, Environment and Technology (DSTE), Puducherry, India
- Puducherry Pollution Control Committee(PPCC), Puducherry, India
- University Leaders for a Sustainable Future (ULSF), USA
- SULITEST (Sustainability Literacy Test), France
- Association for Promoting Sustainability in Campuses and Communities (APSCC), India

Nation Building & Reversing the Loss of Biodiversity Programs/ Projects with International Scope (Contd.)

Conserving Fauna of Concern (Protection and Conservation)

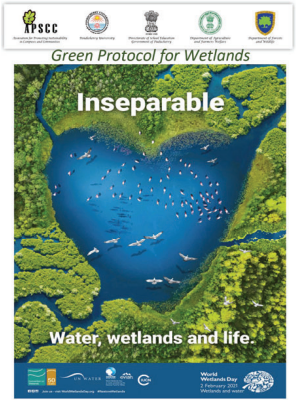
Partnering Organization

1. Pondicherry University
2. Department of Wildlife and Forests
3. Directorate of School Education
4. Department of Agriculture and Farmers Welfare
5. United Nations Decade on Biodiversity - UNDB
6. Official UNDB-2020 Partner APSCC

http://www.pondiuni.edu.in/news/approval-carry-out-multiple-student-centered-activities-cum-awareness-programs-and-internationa (Circular Dated: 21-01-2020)

Nation Building & Reversing the Loss of Biodiversity Programs/ Projects with International Scope (Contd.)

Wetlands Conservation

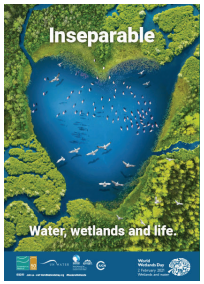


Partnering Organization

1. Pondicherry University
2. Department of Agriculture and Farmers Welfare
3. Directorate of School Education
4. Department of Wildlife and Forests
5. FAO - Global Soil Partnership
6. Official FAO-GSP Partner APSCC

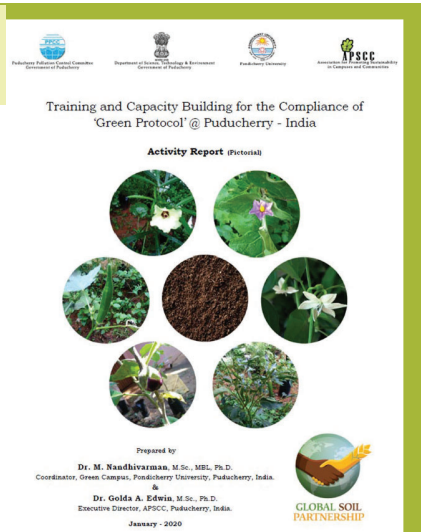
http://www.pondiuni.edu.in/news/approval-carry-out-multiple-student-centered-activities-cum-awareness-programs-and-internationa (Circular Dated: 21-01-2020)

Launching of Green Protocol for Wetlands



Nation Building & Reversing the Loss of Biodiversity Programs/ Projects with International Scope (Contd.)

The Vice-Chancellor Gurmeet Singh, Pondicherry University and Thiru P. Dhanabal, Chief Judge & Chairman, District Legal Services Authority, Puducherry jointly released the 'Activity Book' in the presence of Thiru L. Robert Kennedy Ramesh, Principal Sub Judge & Secretary, District Legal Services Authority, Puducherry, Prof K. V. Devi Prasad, Pondicherry University; Director Aravazhi Irissappane, KMCPGS; Eminent Professors from USA, Germany, Cyprus and the Conference Chairman, Dr. M. Nandhivarman.


Training and Capacity Building for the Compliance of 'Green Protocol' @ Puducherry - India

Activity Report (Pictorial)

Prepared by

Dr. M. Nandhivarman, M.Sc., MBL., Ph.D.
Coordinator, Green Campus, Pondicherry University, Puducherry, India.
&
Dr. Golda A. Edwin, M.Sc., Ph.D.
Executive Director, APSCC, Puducherry, India.

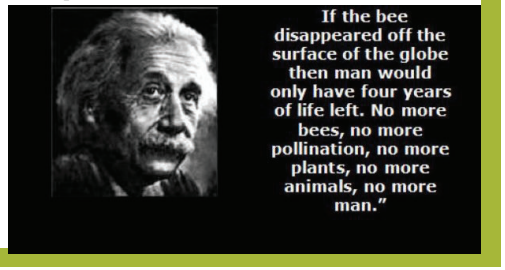
January - 2020

GLOBAL SOIL PARTNERSHIP

Lab to Land Environment Education - Over 75 Green Practices were evolved for Action Research

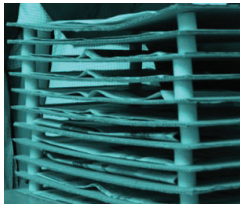
Importance of 'Apiculture' and its Role in Climate Change Adaptation

1) Pollination
2) Conservation of Natural Resources
3) Habitat Restoration
4) Awareness, Education and Research
5) Entrepreneurship

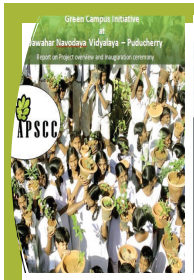


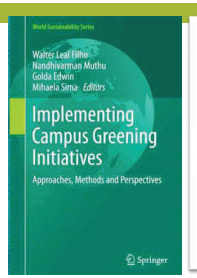
Herbarium – A Climate Change Perspective

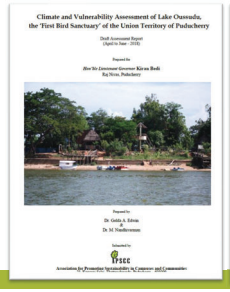
- Anthropology/ Archeology / Forestry
- Ecology
- Entomology
- Environmental Regulation
- Forensics
- History
- Horticulture
- Pharmaceutical
- Poison Control and Medical Care
- Veterinary Science
- Zoology, etc.

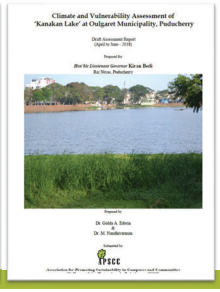


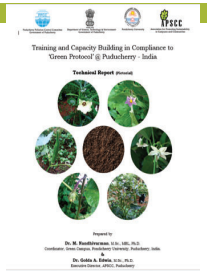
Resources

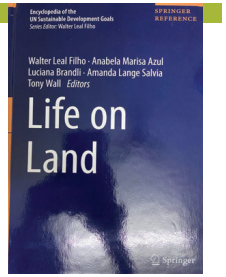


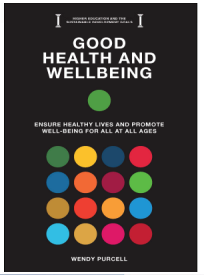


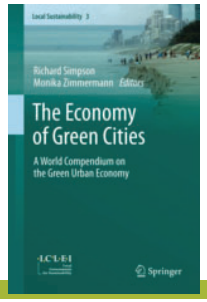


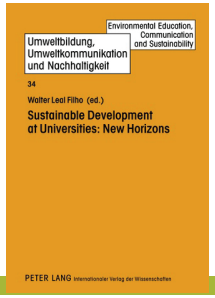


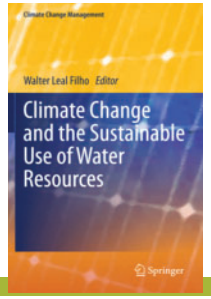


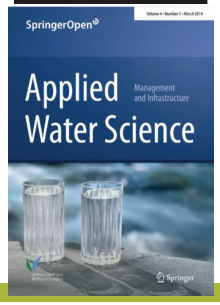












Pondicherry University - The Times Higher Education University Impact Rankings & District Green Champion Award

2019

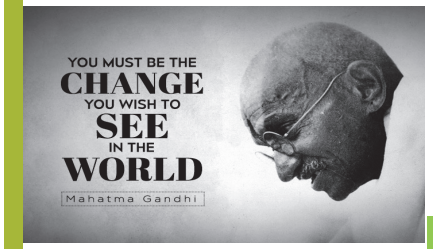
Times Higher Education University Impact Ranking

PU ranked in 101-200 in two categories namely
'Gender Equality (Goal 5)'
&
'Climate Action (Goal 13)'

2020

Times Higher Education University Impact Ranking

PU ranked in 101-200 in three categories namely
'Gender Equality (Goal 5)'
'Partnerships for the goals (SDG17)'
&
Responsible consumption and production (SDG12)


YOU MUST BE THE
CHANGE
YOU WISH TO
SEE
IN THE
WORLD
Mahatma Gandhi

Thanks


Go Green

PUDUCHERRY CLIMATE CHANGE CELL

3rd Floor, Housing Board Complex,
Anna Nagar, Nellithope, Puducherry – 5.

Puducherry Climate Change Cell

https://dste.py.gov.in/PCCC/

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