DEPARTMENT OF SCIENCE, TECHNOLOGY AND ENVIRONMENT

PUDUCHERRY CLIMATE CHANGE CELL (PCCC)

CLIMATE CHANGE WEBINAR SERIES - REPORT

(For the period

August 2020 to March 2021)

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INTRODUCTION

A Climate Change Webinar series is organized by the Puducherry Climate Change Cell, Department of Science, Technology and Environment on various important themes pertaining to Climate Change, that focus on building capacity, knowledge and skills of the Government Officials, Academicians, Professionals, Researchers, Students and other Climate Enthusiasts, for preparing climate change mitigation and adaptation strategies in the sectoral development activities and informed decision making; and also for creating awareness among all the stakeholders on climate change issues and response strategies.

The Puducherry Climate, Change Cell was established under the project supported by Department of Science & Technology, Government of India under the National Mission for Strategic Knowledge for Climate Change (NMSKCC) for building capacity and creating awareness on climate change at the regional level.

For the period of August 2020 to March 2021, nine webinar on Climate Change Webinar Series has been conducted via Google meet platform and LIVE streamed in YouTube. The Participants representing the line department involved in preparation of revised State Action Plan on Climate Change (SAPCC) including Officials of the Climate Change Cell and other departments from various other States and U.T.s, Academicians, Researchers, Students, NGO's, Civil Societies and Climate Change enthusiasts were participated in the webinar. The presentations of the Climate Change Webinar Series are available on this website: https://dste.py.gov.in/PCCC/ and videos are available in Puducherry Climate Change Cell YouTube channel.

1. CLIMATE CHANGE WEBINAR SERIES – WEBINAR 1

On 28th August 2020 at 11:00 A.M. to 01:00 P.M. Puducherry Climate Change Cell hosted a webinar titled "**Mainstreaming Climate Change into Development Policies and Strategies**".

Dr. R. Sagaya Alfred, Senior Scientific Officer, DSTE delivered the keynote address. He mentioned about revision of SAPCC and requested the stakeholders to frame and implement the projects including adaptation and mitigation strategies for making the U.T. of Puducherry more resilient to the rising climatic issues and to streamline their activities more appropriate towards the climate change perspective.

Dr. Dhivya Dutt, Expert from UNEP INDIA, New Delhi delivered the first lecture session of the Webinar. She highlighted the following points

- Achieving the climate objectives of the Paris Agreement in terms of limiting the human-induced temperature rise within 1.5°C depends on greenhouse gas (GHG) emissions over the next decades. Lowering GHG emissions to 25 Giga tons of CO_2e by 2030 would limit global temperature rise or lead to a higher chance of keeping peak warming within 1.5°C to 2^0 C.
- As per UNEP's GHG Emission Gap Report by taking baseline emission at 2005, with the current policy scenario, conditional and unconditional NDC commitments of all the countries towards Paris Agreement is not possible to lower the global temperature below 1.5°C and it is expected to rise in temperature by 3.2^0 C of this century due to unconditional commitments of countries.

- Over the last decade i.e. 2010-20 it has been identified that there is no change in global emission with the existing actions, and hence it is necessary that we move ahead with the new commitments. The countries with more emission were expected to strengthen their new commitments like net zero emission, decarbonization at COP 26.
- Focusing on mainstreaming climate change in 6 sectors and also innovation on decarbonization policies and technologies would reduce the emission potential compared to the current policy scenario for 2030.
- Energy and transport sector dominates the total GHG emission. Decarbonizing energy sector by enhanced energy efficiency policies and more potential from renewable energy is expected as energy requirement in 2040 would increase by 30% approximately.
- In upcoming years, it is estimated that global energy demand for cooling would triple by 2050. Phasing out of HFCs and using environment friendly refrigerants would decrease global warming by 0.4^{o} C within 2100.
- In order to achieve 1.5^{o}C target, the idea of new coal power plants shall be avoided, as phasing out coal and adopting nature-based solution would make large contributions in removing CO2 from the atmosphere.

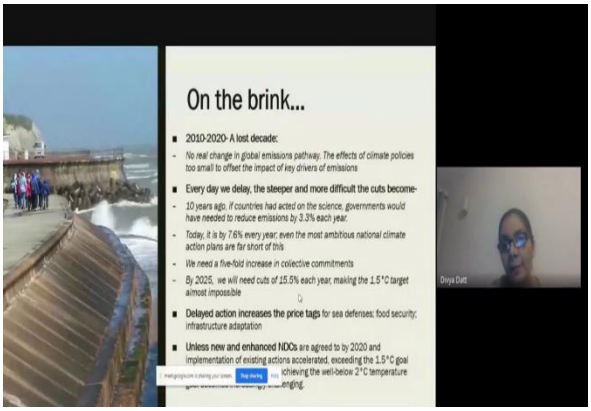
Second session was delivered by Ms. Suruchi Bhadwal, TERI, New Delhi on the title "Climate Change Impacts and Vulnerabilities". She highlighted the following points

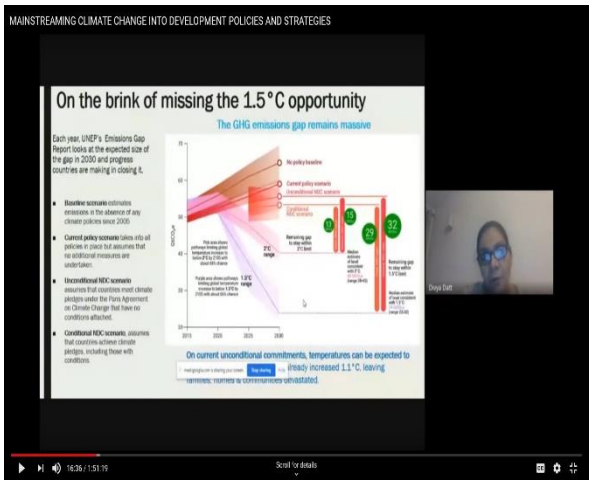
- As per IPCC report, by increase in 0.70 C of global mean temperature in 20th century have impacts of climate change like decrease in snow cover & ice content, 0.1 to 0.2

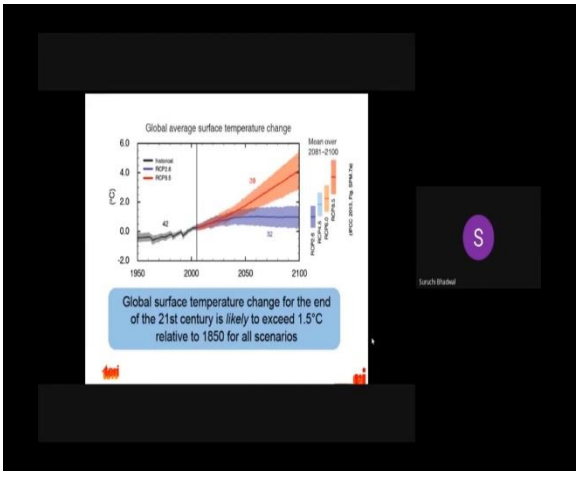
m rise in sea level. In 21st century, the projection may be increase in global mean temperature by 1.1 to 6.40 C, sea level increase in 0.09 to 0.88 m and also decrease in northern hemisphere snow cover.

- Increase in emission of GHG will increase the global mean temperature. This led to climate change impacts like severe change in rainfall pattern, evapotransition rates, increase in humidity and rise in sea level by 2100.
- The rate of change of increase in global mean temperature will be high and in India, it is predicted that increase in temperature may be 5 to 70 C by 2100. This in turn creates more impact on energy demand for cooling system and also health issues due to more dry days.
- Due to global warming, India will face change in rainfall pattern as a climate change impact which in turn brings a difficulty like floods, channelizing the rainwater, etc. Due to nonuniform rainfall will also lead to no rainfall in some region which causes droughts and water scarcity.
- The rate of change in sea level was doubled in a decade when compared to 30-40 years. As per the IPCC report, it is projected that increase in 40 cm of sea level in India have impacts like land loss and 13-94 million people will be flooded.
- Human induced Climate change will bring impacts in all sector especially in Agriculture, Energy, Coastal areas, biodiversity etc. The more vulnerable sector is agriculture sector in which yields and production are to be affected.
- Also, change in weather will cause direct health impacts by extreme events like heat wave, flood and storms and indirect health impacts by infectious disease.

- Based on these impacts, need to prioritize the action on state policy and planning for the successful implementation of mainstream the policy towards the climate change perspective.







Summary of Webinar 1:

With the increasing global attention on climate change, governments are requesting more consistent and strategic technical support on how to address climate change and access related funds. Mainstreaming climate issues in development policy addresses to integrate adaptation and mitigation issues in overall development policy planning to ensure long-term sustainability of investments as well as to reduce the sensitivity of development activities to both today's and tomorrow's climate. Therefore, new climate policy therefore needs to address the conflicts in institutional mandates and strengthen the agency for coordinating climate change so as to facilitate mainstreaming climate change into development policies.

2. CLIMATE CHANGE WEBINAR SERIES – WEBINAR 2

On 8th September 2020 at 11.00 A.M. to 01.00 P.M. Puducherry Climate Change Cell hosted a webinar titled "**Implementation of INDCs: Advancing Mitigation and Adaptation Actions for Climate Change**"

Dr. R. Sagaya Alfred, Senior Scientific Officer, DSTE has delivered the keynote speech. He mentioned about why Paris Agreement and Intended Nationally Determined Contributions (INDCs) constituted and how other parties committed to limit the rise in global temperature. About India's commitment of cutting emissions intensity by 33 to 35 percent below 2005 levels and generating 40 percent of its electricity from non-fossil-fuel sources by 2030. Particularly in U.T. of Puducherry working on revision of SAPCC with the aim of monitoring and evaluation targets of adaptation and mitigation methods including INDCs for next 10 to 15 years.

Ms. Neha Pahuja, Reserch Fellow, The Energy Research Institute, New Delhi delivered first lecture session of the webinar on the title "The current state of play in climate negotiations". She highlighted the following points

- As per the Paris Agreement all the countries committed their climate goal called Intended National Determined Contribution (INDCs) to limit the global temperature below 1.5 degrees Celsius. But these NDCs are need to be revised for every 5 year and the enhanced NDCs should be progressive based on Global stock take.
- India has also committed their NDCs based on the Paris Agreement and we are in implementation stage, based on global stock take these India's NDCs would be revised by 2023.

- But due to emission gap, it is not possible to limit the global temperature with the current policies by 2030. With the current policies there is 90% chances to rise in global temperature by 2^0 Celsius and 33% chances to rise in global temperature by 3 degree Celsius. So, all the countries were in pressure to enhance their NDCs.
- India's important three INDCs were the emission intensity by 33 to 35%, renewable based energy by 40% i.e. 175 GW and addition carbon sink by 2.5 to 3 billion tonnes of CO2 by 2030.
- India's GHG emission per capita was one third of the global average and lowest among G20 countries. In order to decrease the overall emission, energy sector need to be concentrated.
- India's present policies focuses on energy efficient technology and sustainable growth of renewable energy to reduce the climate issues. But International financial support and technology transfer would accelerate these actions.
- India mainstreaming climate action by framing NAPCC and all the states prepared SAPCC in line with the national plan in 2009. Taking State specific circumstances into consideration again SAPCC was in progress of revision.

Ms. Swati Pillai, Research Associate, The Energy Research Institute, New Delhi delivered second lecture session of the webinar on the title "States as vehicle to implement INDC". She highlighted the following points

- Based on NAPCC, formulation of SAPCC need to be different for every States and U.T.s based on Vulnerability Assessment, Adaptation & Mitigation methods. The perfect financial approach and Capacity Building are required to implement the different interventions.

- From SAPCC 1.0, different key challenges were faced like lack of clarity in Medium Term & Long-term climate change action plans, inadequate financial resources and lack of co-ordination & communication from different ministries. It also requires to sensitize the line departments/agencies to implement the state specific climate change interventions effectively.
- Revision of SAPCC 2.0 should be based on new NDCs and key lessons learned SAPCC 1.0 from all the 32 States. Also, MoEF&CC has common framework for the revision of State Action Plan on Climate Change to implement the states specific climate action.
- Revision of Puducherry SAPCC is being prepared by conducting consultation meeting with the nodal departments under each mission by understanding the key priorities of departments with regard to climate action and by identifying new actions with respect to climate change.
- Climate profile of U.T. of Puducherry like temperature, rainfall, sea level etc., has been studied to implement the specific climate action. Also, sectors vulnerable to climate change has been identified to assess integrated vulnerability based on bio-physical, socio economic and institutional vulnerabilities.
- Sectors like agriculture, ground water, health and coastal areas are more vulnerable due to climate change in U.T. of Puducherry. Based on this assessment, adaptation and mitigation strategies has been adopted to formulate the climate change action.
- The main challenge due to Climate Change, U.T. of Puducherry facing is depletion of groundwater and intrusion of seawater in the groundwater. To address this

crucial challenge, need to manage the surface water bodies for improving the condition of water resources.

- As a state specific climate action, Puducherry is planning to mitigate vehicular emission by electrification of public transport. Approaching to develop State EV policy, to set up charging infrastructure, procurement of electric buses and to monitor the performances.

Mr. Prasoon Singh, Associate Fellow, The Energy Research Institute, New Delhi delivered third lecture session of the webinar on the title “Introducing FEWS; Flood Early Warning Systems”. He highlighted the following points

- In natural disaster 90% of the events are related to hydro-meteorological hazards which causes 75% of economic losses in various parts of the country.
- Climatology of India’s profile have significant evidences on increasing extremes like rainfall, droughts and hot days homogeneously. The hydro-meteorological disaster mostly happening in North-east states and part of Bihar in India. Due to this changes, 7 billion hectare of agriculture land are flood prone.
- Change in climate would impact the climatology of India like average increase in consecutive more hot days, 10 to 30 % increase in rainfall, expecting more dry and wet days in different parts of the country, regional sea level rise in appr. 2.0 mm/year, frequency & intensity of cyclones are high in eastern coast and rapid warming of Arabian sea.
- To reduce the disaster, we need to create climate resilient infrastructure in coastal states by early warning for evacuation and communication to the people. It is

possible by technological development like modelling the disaster for whole earth system. For example, IMD predicting the cyclone hit areas earlier to 7 to 5 days.

- Flood Early Warning System (FEWS): The main purpose of FEWS is to issue warning with sufficient lead time and response mechanism. It has four inter-related components

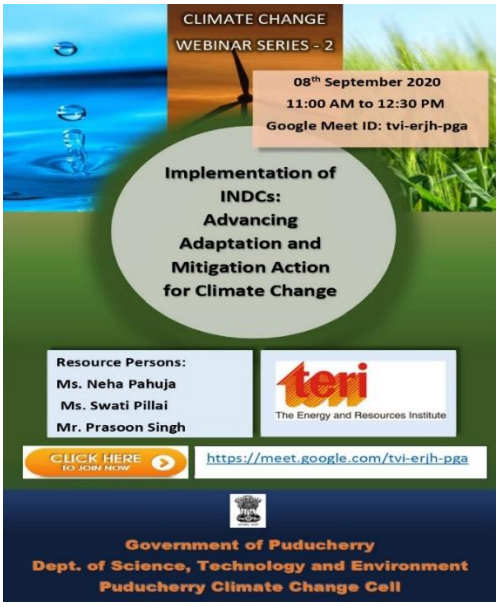
  1. To assess the risk on particular geographical location based on the database.

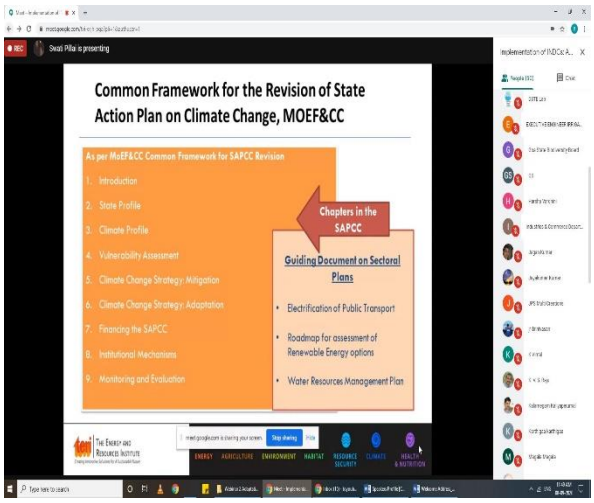
  2. Monitoring hazards of the situation of modelling components based on the forecast details and severity of the particular disaster.

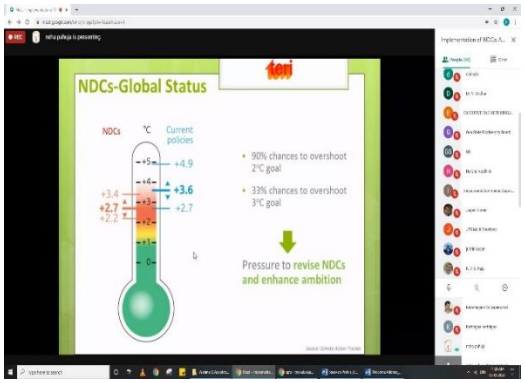
  3. Information need to be disseminated to concerned departments for their mitigating actions.

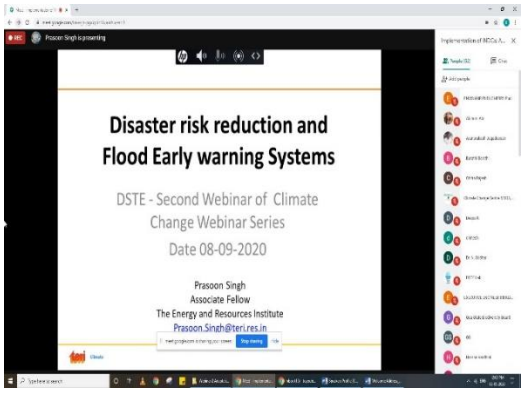
  4. It also requires community response mechanism for immediate action by training and capacity building.

- Based on the timeline like short term based on weather forecasts, medium term based on seasonal to inter-annual climate forecasts and long term based on decadal climate trend analysis we can able develop our hydro-meteorological forecasting & climate modelling and to predict climate projection.
- A case study in Guwahati: Based on hourly basis IMD rainfall data hydro dynamic simulation is developed to predict the flood in different location of the city. This kind of system would help in managing urban floods and identifying areas prone to flood. It is also able to predict 3 days earlier of flood.









Summary of Webinar 2:

India's contribution to the problem of climate change is limited but its actions are fair and ambitious. The current policy framework also includes a favorable environment for a rapid increase in renewable energy, move towards low carbon sustainable development pathway and adapting to the impacts of climate change. It represents the highest possible efforts as evident from the multiple initiatives of the Government of India. Accordingly, India's development plans will continue to lay a balanced emphasis on economic development and environment.

3. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 3

On 21st September 2020 at 11.00 A.M. to 01.00 P.M. Puducherry Climate Change Cell hosted a webinar titled "**Climate Change: Net Zero Emission Pathways**".

The welcome note and keynote speech were delivered by Mr. K. Kalamegam, Environmental Engineer, DSTE. He mentioned about Zero Emission Day and to stabilize global temperature at any level, 'net' CO_2 emissions would need to be reduced to zero. This means the amount of CO_2 entering the atmosphere must equal the amount that is removed. Achieving a balance between CO_2 'sources' and 'sinks' is often referred to as 'net zero' emissions or 'carbon neutrality'. The implication of net zero emissions is that the concentration of CO_2 in the atmosphere would slowly decline over time until a new equilibrium is reached, as CO_2 emissions from human activity are redistributed and taken up by the oceans and the land biosphere. This would lead to a near-constant global temperature over many centuries.

Dr. G. Renuka Devi, Associate Professor, EEE department, MVIT, Puducherry delivered the first lecture session of the webinar on the title "Exploring CO_2 reduction from Renewable Energy Sources". She highlighted the following points

- Earths getting warmer in the last 50 to 100 years due to anthropogenic activities, it leads to increase in average global temperature.
- When we burn fossil fuels, like gasoline and coal, deforestation as well as natural process such respiration and volcanic eruption carbon dioxide is produced and too much of carbon dioxide in the air makes Earth get warmer and warmer which leads to climate change.

- "Carbon foot print" is a measure of the total greenhouse gas emissions caused directly and indirectly by a person, organization or product and almost half of our carbon foot print is due to electricity. Therefore, generation of power from renewable sources are needed for sustainable development.
- India's installed power generation capacity from Non-renewable source is 62.1%, Renewable energy source is 23.8%, Hydro energy is 12.3% and Nuclear energy is 1.8%. It is expected to increase the power generation from Renewable energy source by 40% within 2030.
- By increasing deployment of renewable energy and energy efficiency and 70% of the emissions can be reduced globally by 2050 and also transport sectors need to adopt more bioenergy.
- Carbon foot print can be reduced by development of long-lasting, energy-efficient LED light bulbs because 17% of the annual electric usage is due to typical household lighting system.
- Uninterrupted Direct Current (UDC) technology presents a load management innovation to provide a limited but uninterrupted DC power supply to homes in India. Sasaram, Bihar has been chosen as the first city where Project UDC is to be implemented.
- Carbon reduction opportunities are energy efficiency, local power generation from solar panels, sustainable transport, grid decarbonization, reducing emission from waste and buying clean energy.

Mr. William Hall, Industrial Energy Efficiency & Sustainable Technology, Associate Fellow, TERI delivered the second lecture session of the webinar on the title “Achieving net-zero emissions for Puducherry: Applying lessons from around the world”. He highlighted the following points

- Net zero emission target is to achieve a balance between CO2 emission sources and sinks must be equal to zero. Emissions should be reduced from the key sectors like power, agriculture, land use, industry, transport and buildings.
- By 2100 it is expected to increase the global GHG emission by ~170 GtCO2/year based on the current policies of all countries. Particularly, in India the project is about ~4500 MtCO2/year by 2030.
- Net-zero target is a scientific imperative to achieve significant emissions reduction as fast as possible and ambitious goal into action.
- Already 2 countries have achieved, 6 countries target in law, 3 countries proposed legislation and 12 countries with policy document for Net-zero target.
- Carbon Neutrality Coalition was launched in September 2019 at the United Nations Climate Action Summit to accelerate commitments.
- Net-zero can be achieved by enhanced energy efficiency in electricity sector, shifting agriculture practices in agriculture & land use sector, shifting to low carbon fuels in Industrial sector, prioritizing electric vehicles in transport sector and retrofitting in building sector.
- In Puducherry, electricity, transport and building are the major sector which emits GHG. Net-zero can be achieved in these sectors by zero additional cost with a high emission pathway which lead to positive action on climate change.

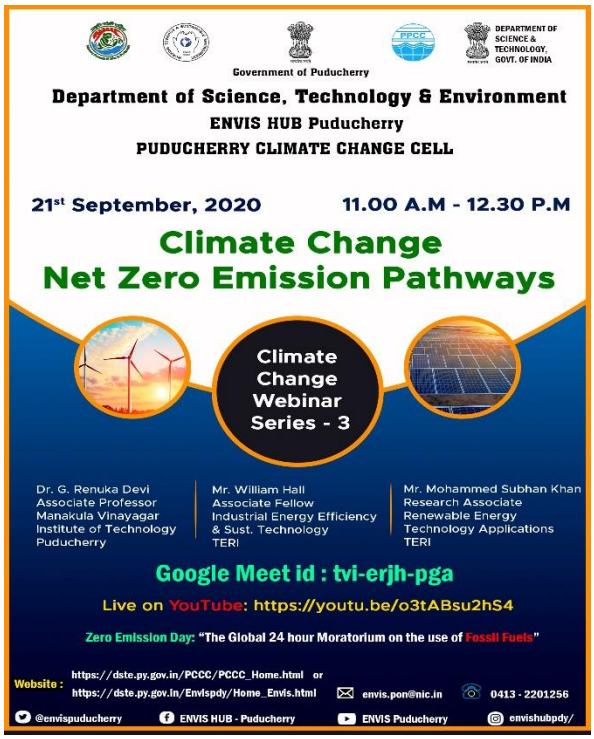
- In order to achieve the net-zero in Puducherry it is necessary to assess the scale of current and projected emission in each major sector, to develop a solutions to cut emissions by consulting with stakeholders, to formulate the net-zero pathway plan for the intended actions and expected timelines of activity and to establish legal / institutional backing for enshrine emission reduction targets in law.

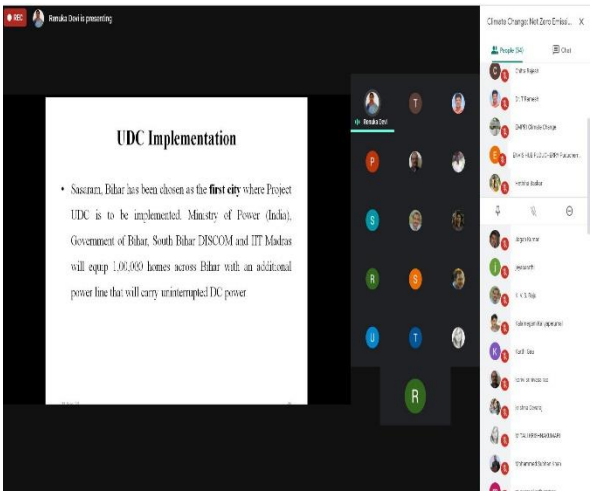
Mr. Mohammed Subhan Khan, Renewable Energy Technology Applications, Research Associate, TERI delivered the third lecture session of the webinar on the title “Clean Energy Transition through Solar Photovoltaics in India- A Way Forward”. He highlighted the following points

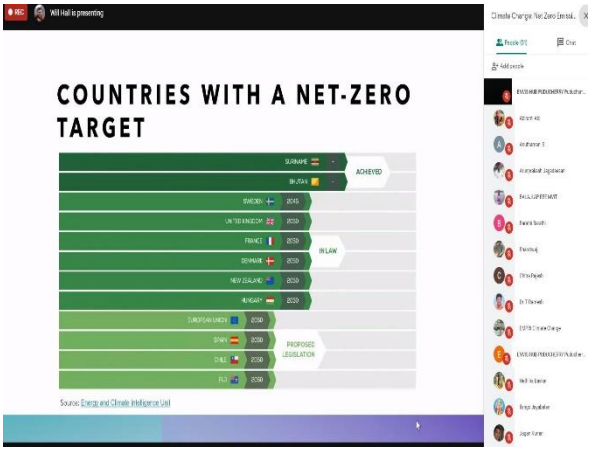
- As per the Electricity scenario of India 62.1 % power is generated from non-renewable energy sources which in turn emits 784 Million tonnes of CO_2. So it is necessary to cut down the emission in electricity sector by generating power using renewable energy source.
- Total energy requirement to India is ~1300 Billion Units. In order to achieve this annual energy demand only 1300 Sq. Km area is required for solar panel installation.
- In India industrial tariff for a consumer in different states is around Rs. 6.5/- per unit of electricity and domestic consumer tariff also eventually increasing over the year. But Solar tariff is brought down to Rs. 3.5 – 4/- per unit of electricity by a lot of innovation in solar technology and efforts of GoI.
- Photo Voltaic (PV) system will be quite successful in India because India lies in the solar belt of the world. We have huge potential for solar installation and solar power

generation. Also, solar generated power reduces transmission losses due to its decentralized distribution nature.

- Solar Roof top system comprises of four major components like Photovoltaic (PV) Module, Solar inverters, Mounting systems and Cables. Benefits of this system are reduced cost, no emission & noise generation, provide clean energy jobs to the people and requires minimum maintenance.
- Solar rooftop system has minimum losses and also address the demand side issues by storage system. It has direct financial benefits like availing incentives from Government of India, but this Central Financial Assistance depends on benchmark cost.
- Types of Solar PV system like Off-grid and On-grid system were explained with their net-metering and gross-metering systems. Industrial consumer mostly adopts Third party Solar Power Purchase Agreement (PPA) by lending their property to third party system and purchase power from them with mutual agreement.







Summary of Webinar 3:

Limiting global warming to 1.5°C above pre-industrial levels would require major reductions in greenhouse gas emissions in all sectors. But different sectors are not independent of each other, and making changes in one can have implications for another. For example, if we as a society use a lot of energy, then this could mean we have less flexibility in the choice of mitigation options available to limit warming to 1.5°C. If we use less energy, the choice of possible actions is greater – for example, we could be less reliant on technologies that remove carbon dioxide (CO2) from the atmosphere.

4. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 4

On 10th December 2020 at 04.00 P.M. to 05.30 P.M. Puducherry Climate Change Cell hosted a webinar titled "**Water Mission: System to Monitor and Evaluate Performance and Socio-Economic Impacts of Water Resource Management Projects**"

Dr. R. Sagaya Alfred, Senior Scientific Officer, DSTE has delivered the keynote speech. He mentioned about the theme based out on the Water Mission of the National and the State Action Plan on Climate Change and also one of the Action Points under the Puducherry Water Policy is to evolve a System to Monitor and Evaluate Performance and Socio-Economic Impacts of Water Resource Management Projects.

Dr. K. Srinivasamoorthy, Professor, Department of Earth Science, Pondicherry University delivered the presentation on the title "System to Monitor and Evaluate Performance and Socio-Economic Impacts of Water Resource Management Projects". He highlighted the following points

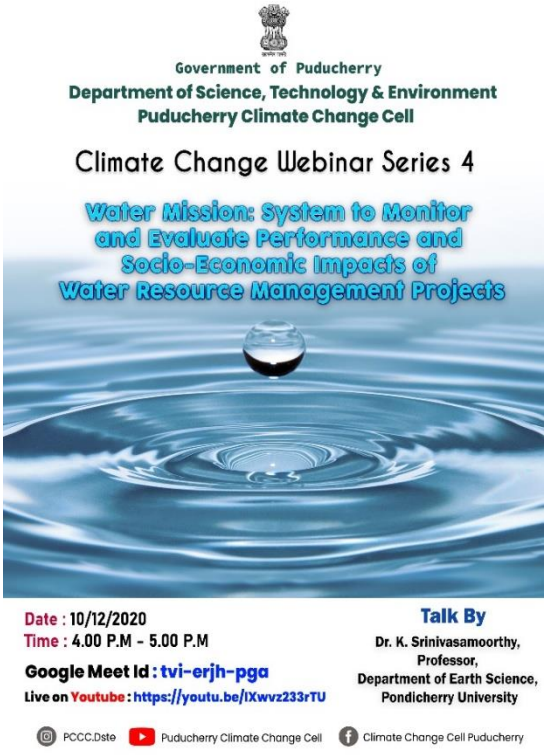
- India is already lacking in water resources and in order to quantify the water resources our Government has taken measure like Integrated Water Resource Management (IWRM). The main objective of this scheme is to rejuvenate all the tanks and ponds and providing pure water to all stake holders.
- National Water Balance gives the information about monitoring, management and security of the water resources like surface water body and ground water body. Based on the water availability and water demand per capita is calculated.
- Climate Change characterize the water year cycle. Suppose the precipitation is high and there will be surplus water and during lower precipitation, ground water would

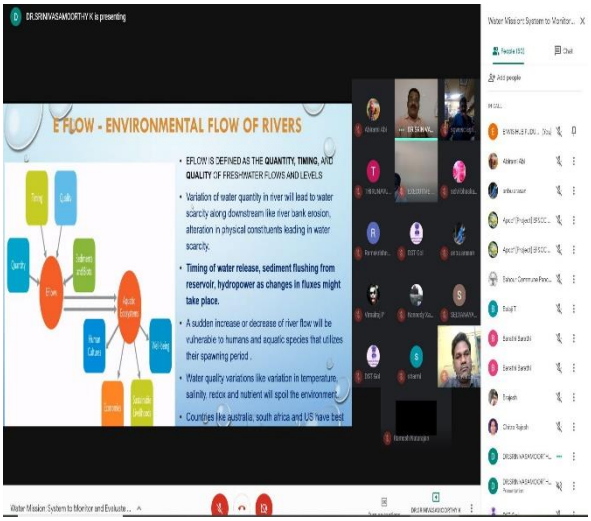
tapped or depleted for a particular year. So, Climate change impacts the ground water and also influences the surface flow.

- E-flow of Water: Environment flow plays major role in river basin and it has impact on human and aquatic animals in downstream. Sudden flow of water is vulnerable to the environment around the river basin.
- Water Management is required to quantify the surface water and ground water with respect to water availability and water demand. Water budget method depends on inflow, storage and outflow of the system. The monitoring of water resources is need for modelling, fore-casting and warning of water availability and water demand.
- In Puducherry, it is shallow aquifer and to recharge the shallow aquifer it takes only in years wherein deep aquifer takes century to recharge the ground water.
- The water budgeting particularly saline water intrusion is measured by different techniques like resistive-electrode method, Geo-specific technique and Submarine Ground Water. SDG is used to isolate the recharge zone by modelling to prepare Water Audit report. Ministry of Jal Shakti is regularly updating water audit report of Pre-monsoon and Post-monsoon.
- IWRM should be taken from the local level to benefit all the stakeholder. In macro level it helps to improve the water level in river and lakes, in meso level it helps to improve local ecological system and in micro level it helps to improve uniform hydrological unit.
- Monitoring and Evaluation of water management system involves two important criteria one is water should be made available to all general public and another is

quality of water should be good. For monitoring effective data set should be collected from all the stakeholders and evaluation has to be done using all the available data.

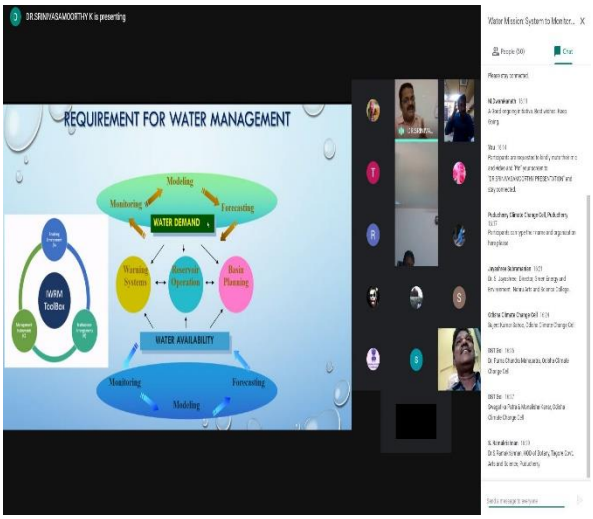
- Monitoring water cycle should be legislative and public should be made aware of the techniques applied for the management of water system in order to improve the better management of water in the local level.
- Risk assessment of socio-economic have to be done by analyzing the topics like aquaculture, hunting, Nature study, bird watching, environmental values etc., In Puducherry, many national hydrology projects has been executing to improve socio-economic values of water management.





Climate Change Webinar Series - Webinar 4

Water Mission: System to Monitor and Evaluate Performance and Socio-Economic Impacts of Water Resource Management Projects



Summary of Webinar 4:

Not only will climate change affect the function and operation of existing water infrastructure and institutions, but, additionally, current frameworks may not be robust enough to cope with climate change impacts. Hence, effective water governance is seen as essential to build adaptive capacity in communities to manage future climatic uncertainty and stress.

5. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 5

On 6th January 2021 at 11:00 A.M. to 12:30 P.M. Puducherry Climate Change Cell hosted a webinar titled **"Climate Modeling and Climate Change Projections for the U.T. of Puducherry**".

Dr. S. Dinesh Kannan, Director (DSTE) – cum – State Nodal Person (PCCC) delivered the keynote address. He mentioned about the revision of SAPCC by engaging UNEP and TERI as the technical partners, PCCC has acquired weather data from 1976 to 2018 from the IMD and carried out long term trend analysis of Temperature and Rainfall data for Puducherry and Karaikal regions.

Mr. Saurabh Bhardwaj, Fellow and Area Convener, Centre for Climate Modelling, TERI, New Delhi delivered his lecture and he highlighted the following points to all key stakeholders about What is modelling and Climate Modelling, why it is acts as an evidence for base policy in India.

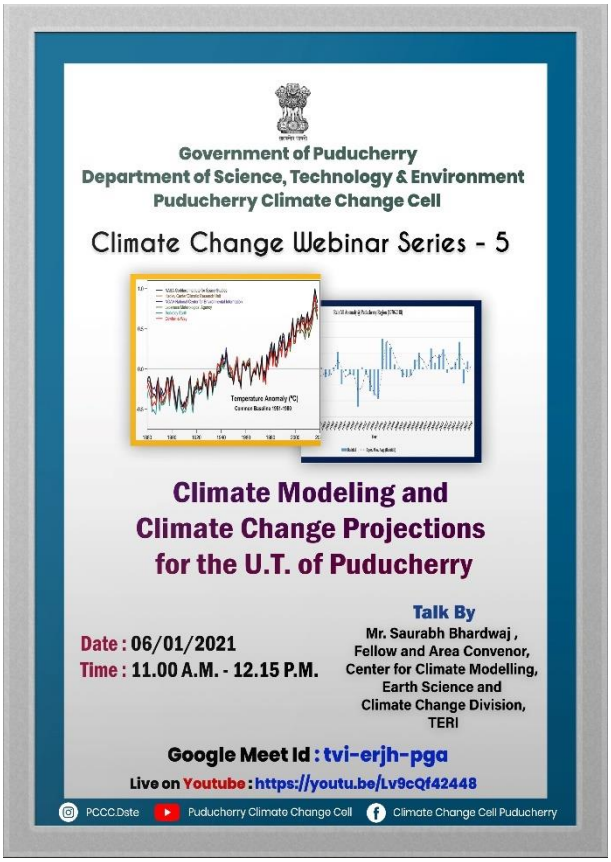
- Climate Change is a change in the statistical properties of Temperature and Rainfall with respect to time over a period of 30 years. In Climate system, interaction among the components are non-linear with nature and it leads to climate variability.
- Climate Modelling is simplified mathematical equation based on short- and long-term variation in system. Based on mathematical equation for a given inputs it is possible to project set of output. From the output the following points can be observed
    - To understand the climate process
    - To create plausible scenarios reflecting the current state of scientific understanding.
    - To plan for the future.

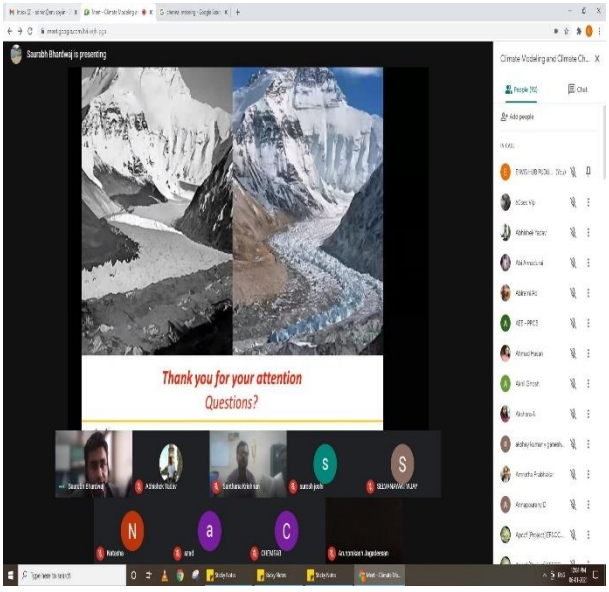
- If the interaction between the components are resolved and explained in one grid then it is possible to understand the basic global climate model varying with respect to time.
- Each grid has resolution, for more pixels need to provide more information layer. Global model resolution will have grid size of 25 Km. The climate profile has to be downscaled and regional impact assessment is done.
- Due to anthropogenic activities, net changes in system is more due to GHG emissions. After Industrial revolution, emission of CO2 is increased in the atmosphere and due to this Global Temperature also increased. IPCC has estimated that 95% of Global Warming is due to anthropogenic activities.
- The observational evidences of climate change are follows
- Gangotri glaciers is retreating at high rate, due to this freshwater flow became high. But the water capacity for next 500 years is drastically reduced. So, water security has been decreased in Himalayan areas.
- Due to extensive extreme rainfall patterns which has never been seen in 100 years leads to flooding in Kerala and Bihar. Because of this extreme event, loss of lives and property has occurred.
- Also Increase in Land surface temperature, Sea surface temperature, and Marine air temperature, Sea level rise, Sea-ice declining, Glacial mass declining, increase in humidity, Ocean warming etc. are evident of change in the climate event.
- India’s Temperature scenario
    - 13 out of 15 warmest years in the past 100 years, all come in last 15 years i.e. from 2002 to 2016
    - Last decade is the warmest i.e. 2001 to 2010.

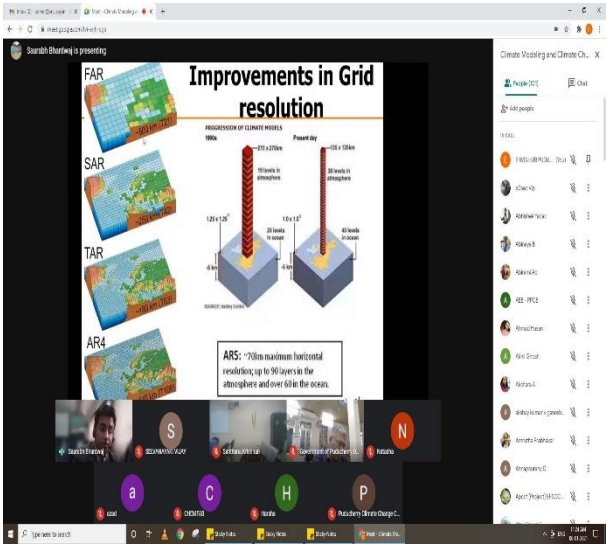
- India's rainfall scenario
  - In last 30 years, due to lots of warming years and rainfall has increased by 7%. But, the distribution of rainfall is uneven which leads to flooding in some place and drought in some other place.
  - It is projected that average rainfall may increase but no. of rainy days may decrease.
  - More no. of rainfall in less no. of days leads to flooding and drought. As per modelling projection in Heat map, Himalayas will warmer at faster rate.
- Puducherry climate Scenario
  - It is analyzed that there is increase in annual hot days and decrease in annual cold nights. Because of decrease in minimum average temperature it is projected that interseasonal variability rainfall will be high.
  - In last 38 years i.e. from 1980-2018, 44 tropical cyclones have crossed Bay of Bengal. Out of 44, 28 were severe cyclonic storm during the months October, November and December. The Modelling projects that more extensive cyclones are to be occurred in East-Coast.
  - Due to increase in Global Sea level at the rate of 1.3 mm/year and warming in sea surface leads to more cyclones. Because of this effect, storm have been increased in last 10 years
- Future Climate Analysis for Puducherry
  - Change in minimum average temperature more that maximum temperature.
  - Annual average rainfall and Monsoon rainfall may be increased in all the districts.

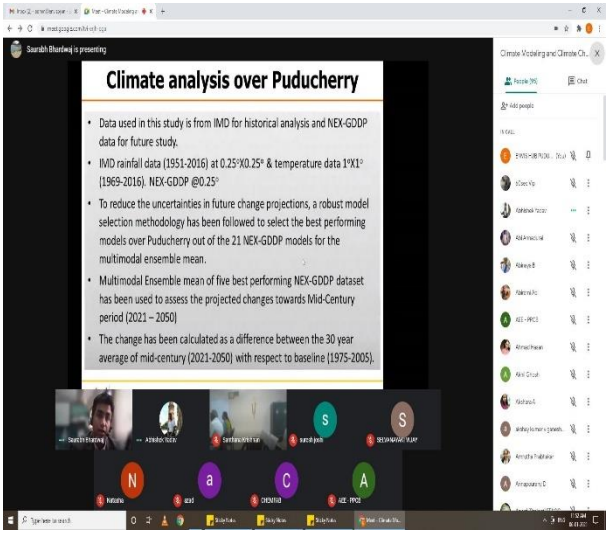
- High density of heavy rainfall will be more in Puducherry and Yanam than Karaikal and Mahe.
- Annual rainfall variability is increased by 2 to 6 %. The extreme rainfall would be increased in Mahe.

- Need for climate modelling
  - Increased demand from climate sensitive business and stakeholders
  - Regional state action plans to combat climate change
  - Identification of local level risk assessment









Summary of Webinar 5:

Climate projections are typically presented for a range of plausible pathways, scenarios, or targets that capture the relationships between human choices, emissions, concentrations, and temperature change. The detailed emphasis on the trends of the prominent Climate parameter viz., Temperature and Rainfall variation have been discussed. In addition to that, trends and projections on the meteorological extreme events, cyclones, and sea level rise pertaining to the regions of the U.T. of Puducherry.

6. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 6

On 28th January 2021 at 04:00 P.M. to 05:30 P.M. Puducherry Climate Change Cell hosted a webinar titled "**Climate Change Vulnerability Assessment for the U.T. of Puducherry**".

Dr. S. Dinesh Kannan, Director (DSTE) – cum – State Nodal Person (PCCC) delivered the keynote address. He mentioned that Vulnerability Assessment would support in formulating robust adaptation strategies for climate actions and in integrating climate change concerns in regional planning processes. In continuation to this, Puducherry Climate Change Cell has carried out the Regional Level Climate Change Vulnerability Assessment as a part of the National Level Capacity Building imitative of the Department of Science and Technology, Govt. of India.

Ms. Suruchi Bhadwal, Senior Fellow, Earth Science and Climate Change Division, TERI, New Delhi delivered her first lecture on the title "**Climate Change Impacts and Vulnerabilities**". She highlighted the following points on How Vulnerability Assessment is conducted in the context of Policy-making and Adaptation planning

- The whole climate system comprises of atmosphere, terrestrial, hydrosphere and cyrosphere. Change in any component will have effect on other components in the climate system, this impacts on different sectors like socio-economic, agriculture, etc.
- Due to uneven distribution of radiation, this will cause more effect in Tropical region and lesser in Polar and Temperate region. Because of this consequences, cooling and heating application may increase which leads to increase in GHG in the atmosphere.
- Anthropogenic activities like Electricity generation, Transportation, Industries, Commercial, Residential etc., are the sources of GHG.

- Land Use, Land Use Change and Forestry (LULUCF) – Forest has been converted into different forms. Basically, forests are carbon sink, by converting forest into agriculture or other land forms, leads to release the CO2 in the atmosphere.
- As per IPCC report, by increase in 0.7^0 C of global mean temperature in 20th century have impacts of climate change like decrease in snow cover & ice content, 0.1 to 0.2 m rise in sea level. In 21st century, the projection may be increase in global mean temperature by 1.1 to 6.40 C, sea level increase in 0.09 to 0.88 m and also decrease in northern hemisphere snow cover.
- Increase in emission of GHG will increase the global mean temperature. This led to climate change impacts like severe change in rainfall pattern, evapotransition rates, and increase in humidity and rise in sea level by 2100.
- The rate of change of increase in global mean temperature will be high. In India, it is predicted that increase in temperature may be 5 to 7^0 C by 2100. This in turn creates more impact on energy demand for cooling system and also health issues due to more dry days.
- Due to global warming, India will face change in rainfall pattern as a climate change impact which in turn brings a difficulty like floods, channelizing the rainwater, etc. Due to non-uniform rainfall will also lead to no rainfall in some region and high rainfall in some other region. This effect causes droughts and water scarcity and urban flooding respectively.
- The rate of change in sea level was doubled in a decade when compared to 30-40 years. As per the IPCC report, it is projected that increase in 40 cm of sea level in India have impacts like land loss and 13-94 million people will be flooded.

- Human induced Climate change will bring impacts in all sector especially in Agriculture, Energy, Coastal areas, biodiversity etc. The more vulnerable sector is agriculture sector in which yields and production are to be affected.
- Also, change in weather will cause direct health impacts by extreme events like heat wave, flood and storms and indirect health impacts by infectious disease.
- Understanding of the regional and micro level aspects of climate change will help to address the vulnerability of people with more accuracy.

Mr. K. Kalamegam, Environmental Engineer, DSTE, Puducherry delivered his second lecture on the title "**Regional Vulnerability Assessment for the U.T. of Puducherry**". He highlighted the following points on How Regional Vulnerability Assessment has been done in the U.T. of Puducherry and vulnerability profile ranking was discussed.

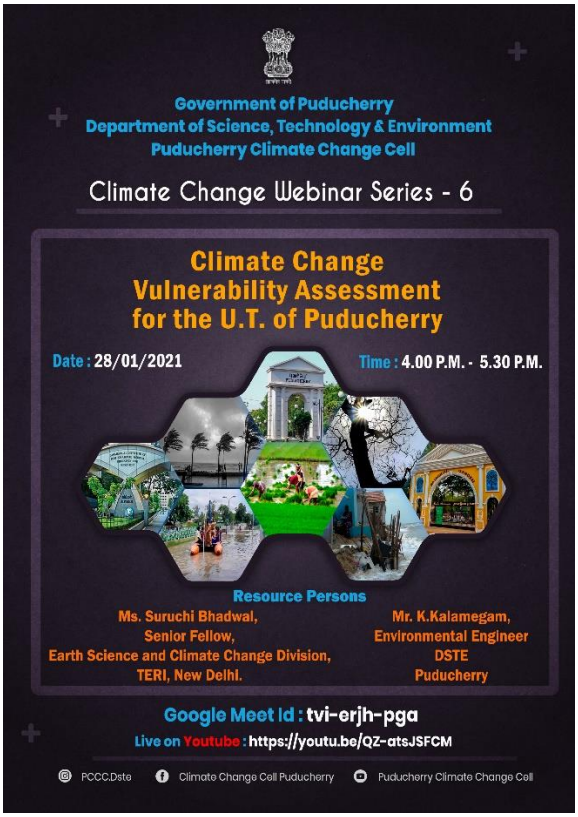
- The main objective of Climate Change Vulnerability study in Puducherry Union Territory is to assess the regional level risks posed by climate change and to identify the measures to adapt to climate change impacts.
- The study has been conducted at the regional level based on the Common Framework and Methodology prepared by IISc Bangalore for the DST supported IHCAP project.
- Study was conducted using Indicator based approach. Integrated Vulnerability Assessment was conducted by choosing 18 Indicators under following categories
    - Socio economic
    - Bio physical
    - Institutional Infrastructure
    - Health

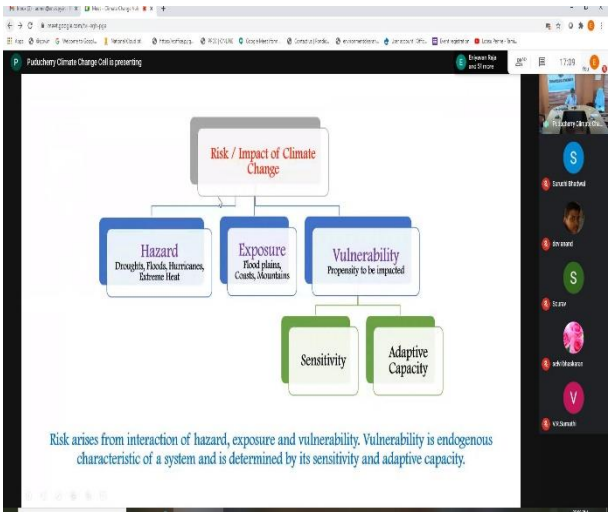
- Risk arises from interaction of hazard, exposure and vulnerability. Vulnerability is endogenous characteristic of a system and is determined by its sensitivity and adaptive capacity.
- To assess climate change vulnerability the necessary 12 steps has been detailed and following these steps different indicators were identified for regional level analysis in the U.T. of Puducherry. Based on the regional vulnerability index value vulnerability ranking has been given as follows and drivers of vulnerability of these four regions is also identified.

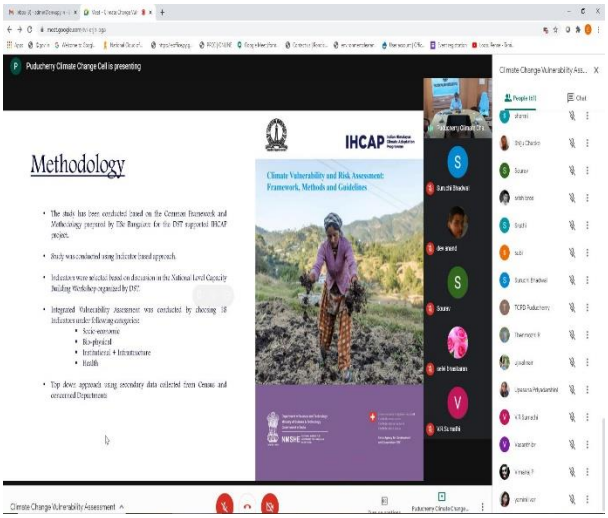
Region	Vulnerability Index	Vulnerability Ranking
Karaikal	0.55	1
Puducherry	0.51	2
Mahe	0.48	3
Yanam	0.43	4

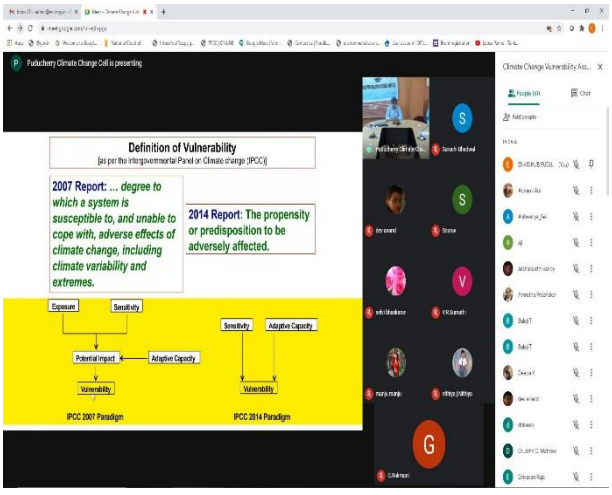
Climate Change Webinar Series - Webinar 6

Climate Change Vulnerability Assessment for the U.T. of Puducherry









Summary of Webinar 6:

Climate change is a growing challenge which directly and indirectly impacts several sectors like agriculture, livestock, forests, water and human health. The coastal regions like Puducherry are much more likely to be affected by the vagaries of Climate Change like rising sea level. In order to address the latest developments in Climate Change international binding agreements like NDCs and SDGs, Puducherry Climate Change Cell is preparing the Revised State Action Plan on Climate Change. Climate Change Vulnerability Assessment is one of the important chapters of the SAPCC report. Vulnerability Assessment would support in formulating robust adaptation strategies for climate actions and in integrating climate change concerns in regional planning processes. TERI, New Delhi and UNEP have been engaged as technical partners for preparing this SAPCC Report.

Besides, the Puducherry Climate Change Cell has also carried out the Regional Level Climate Change Vulnerability Assessment as a part of the National Level Capacity Building imitative of the Department of Science and Technology, Govt. of India

7. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 7

On 2nd February 2021 at 11.00 A.M. to 12.30 P.M. Puducherry Climate Change Cell hosted a webinar titled “Biodiversity and Climate Change”

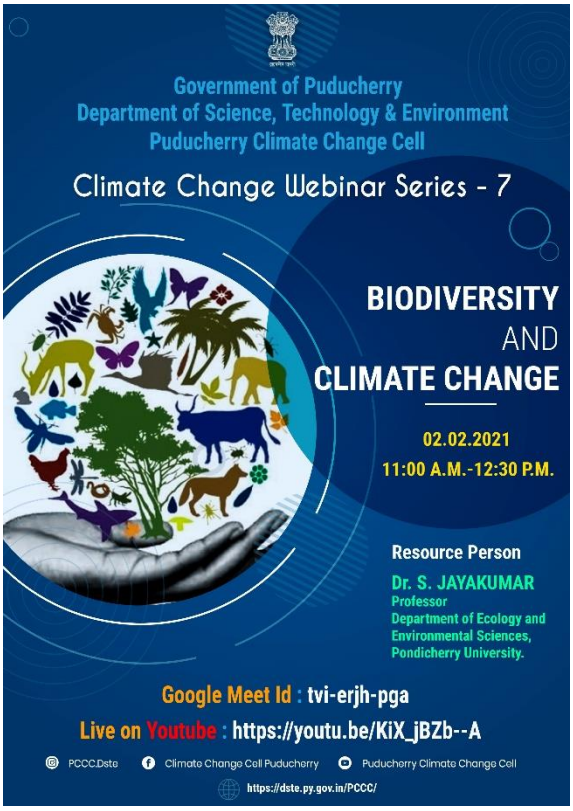
Dr. S. Dinesh Kannan, IFS, Director (DSTE) – cum – State Nodal Person (PCCC) has delivered the Opening Remarks. He mentioned about in the last fifty years, due to human activities biodiversity is dropping fast everywhere which is catastrophic for nature and ourselves. Species that lack diversity are more vulnerable to fluctuations caused by Climate Change, diseases or habitat fragmentation. Also, he stated to focus on the importance of biodiversity and the threats posed by climate change to the existing biodiversity.

Dr. S. Jayakumar, Professor, Department of Ecology and Environmental Sciences, Pondicherry University delivered the lecture session. He highlighted the following points

- India is one of the 17 mega biodiversity countries of the world. In India we have 21.64 % of forest cover, it contains approximately 45,000 species of Flora and 90,000 species of Fauna.
- India consists of 8% of the all the recorded species on the planet. India is also home to around 60,000 insect species, 2500 fish species and 460 reptile species, 1200 bird species, 400 mammal species.
- For healthy environment it is necessary to maintain the healthy eco-system. Eco-system comprises of five major attributes
    - Attribute of structure
        - Exchange of energy between physical environment and living community
    - Attribute of function

        - It includes air, water, soil, nutrients. etc.,
    - Attribute of complexity
        - High level of biological integration
    - Attribute of interaction and interdependency
        - Change in any one will result in a subsequent change in all the others
    - Attribute of temporal change
        - Not static, entire structure and function of an ecosystem undergo change over time
- Importance of Biodiversity are
    - Healthy Environment
    - Healthy Ecosystem
    - Proper Ecosystem function
        - Water purification
        - Air purification
        - Nutrient cycling
        - Soil erosion control
        - Supply of wood and other products
        - Climate regulation
    - Wild genetic resources
    - Medicinal values

- Due to increase in GHG in atmosphere, it increases the global mean temperature. This leads to extreme events like extensive flood, severe drought, heat waves, cold waves, severe storms, etc.,
- Since, all the biological events of every organism are dependent on Season. Season depends on the temperature and humidity of air.
- For example highly Sensitive plant like Cocklebur (Xanthium pennsylvanicum): This plant will never flower in days of 16 hours or more—it just vegetates, and grows to an enormous size. But if it has just one day 15 hours long or less, it starts flowering, and goes on doing so even if the days revert to 16 hours.
- Due to Climate Change and impacts on biodiversity are
    - Change in season affects
        - Species – affects climate envelope of all species
        - Plants – seed germination, establishment, growth, flowering, pollination and seed dispersal, ultimately population
        - Birds and insects – migration, egg laying and breeding
        - Animals – reduced food, increased competition, reduction in population size
    - Endemic species – Around 20% of all species are categorized as endemic but 10% are threatened at present.
        - Red listed species are more vulnerable.
        - It affects Ecosystem structure and function
        - Change in climate cannot favor all the species


Government of Puducherry
Department of Science, Technology & Environment
Puducherry Climate Change Cell
Climate Change Webinar Series - 7
BIODIVERSITY
AND
CLIMATE CHANGE
02.02.2021
11:00 A.M.-12:30 P.M.
Resource Person
Dr. S. JAYAKUMAR
Professor
Department of Ecology and Environmental Sciences, Pondicherry University.
Google Meet Id : tvi-erjh-pga
Live on Youtube : https://youtu.be/KiX_jBZb--A
PCCC.Dste
Climate Change Cell Puducherry
Puducherry Climate Change Cell
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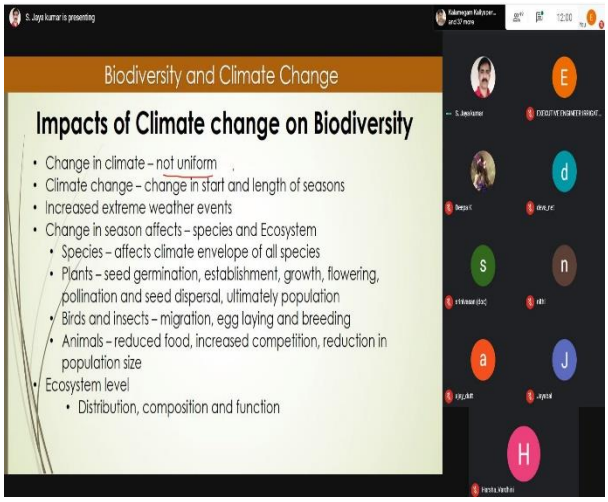
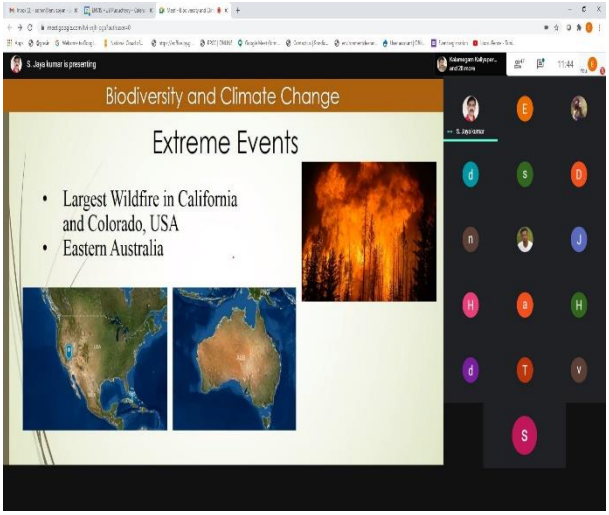
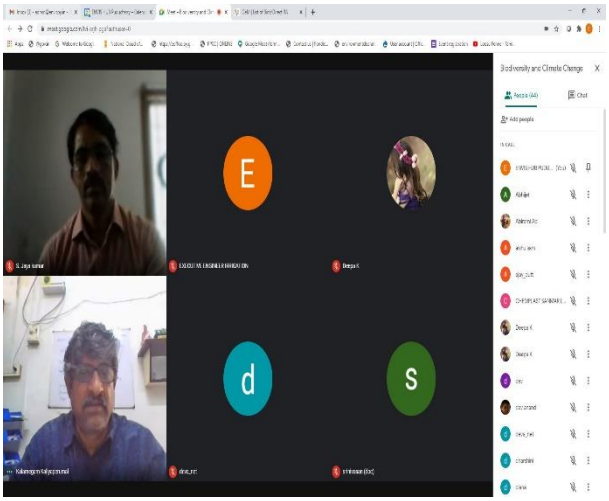

Biodiversity and Climate Change
Impacts of Climate change on Biodiversity
Change in climate – not uniform
Climate change – change in start and length of seasons
Increased extreme weather events
Change in season affects – species and Ecosystem
Species – affects climate envelope of all species
Plants – seed germination, establishment, growth, flowering, pollination and seed dispersal, ultimately population
Birds and insects – migration, egg laying and breeding
Animals – reduced food, increased competition, reduction in population size
Ecosystem level
Distribution, composition and function


Biodiversity and Climate Change
Extreme Events
Largest Wildfire in California and Colorado, USA
Eastern Australia



Summary of Webinar 7:

We need forests across 1/3rd of the land surface to sequester the carbon and keep the climate stable. We need millions of pollinators and billions of soil organisms and mega tons of planktons to keep the food we eat in supply. We need strange plant and deepened jungles to create our medicines and coral reefs and mangrove swamps to protect our coast that we depend upon. We have started working on Climate Change, but biodiversity lose is an important issue as well and the phenomenon of Climate Change and biodiversity shall always be looked upon as cross-cutting issues.

8. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 8

On 16th January 2021 at 04:00 P.M. to 05:30 P.M. Puducherry Climate Change Cell hosted a webinar titled "**CO_2 Sequestration and Climate Mitigation – An Industrial Orientation**".

Dr. S. Dinesh Kannan, Director (DSTE) – cum – State Nodal Person (PCCC) delivered the opening remarks. He mentioned that the increase in atmospheric CO_2 from about 280 ppm to more than 414 ppm over the last 250 years is the main driver of global warming and climate change. There is large opportunity to reduce the CO_2 concentration in the atmosphere by enhancing the rates of removal of the atmospheric CO_2 through carbon sequestration.

Dr. Susheela Negi, Scientist E, SPLICE - Division, Department of Science and Technology, Govt. of India, New Delhi delivered her special address on the title "**CO_2 Sequestration and Climate Mitigation: R & D approaches**". She highlighted the following points like achievements, opportunities and gaps in the Carbon Sequestration research area

- Carbon-di-oxide is important GHG is nature but which greatly exceeds the natural range of the last 650,000 years. Carbon dioxide is regarded as one of the main greenhouse gases that is causing global warming and forcing climate change.
- CO_2 has been increasing continuously and due to this global temperature has also increasing correspondingly. From the year 1880 to 2020 global surface temperature is increasing exponentially and this leads to impacts like severe drought, heat waves, cold waves, severe storms, extensive rainfall etc.,
- The evolution of papper moth in black color which is not seen in this color before 1880. It implies the direct impact of climate change.

- GHG from different sectors are due to human induced activities. In order to cope up with the indirect and sustainable development, Carbon Capture Utilization and Storage (CCUS) is one of the best option.
- CCUS encompasses methods and technologies to remove CO_2 from the flue gas and from the atmosphere followed by recycling the CO_2 for utilization and determining safe and permanent storage options.
- Government of India has launched many initiative researches on carbon sequestration which includes terrestrial & Agro-forestry sequestration, Bio-algae Sequestration, Carbon capture process development like adsorption, absorbents, nan porous material, carbon composite material, of carbon, Geological storage and CO_2 utilization.
- According to International Energy Agency (IEA) published a report in 2013, CCS greatly contribute to emissions reduction from all industrial processes.
- CCUS involves in process like
    - Carbon capture
        - Pre-Conversion capture
        - Post-Conversion capture
        - Oxy-fuel combustion capture
        - Sequestration by algae and forestation
    - Carbon storage
        - Geological storage
        - Ocean
        - Mineralization

- Carbon Utilization
  - Direct Utilization
  - Chemical from CO_2
  - Enhanced oil and Coal-bed methane recovery (EOR & ECBM)
  - Desalination
  - Biofuels from Algae

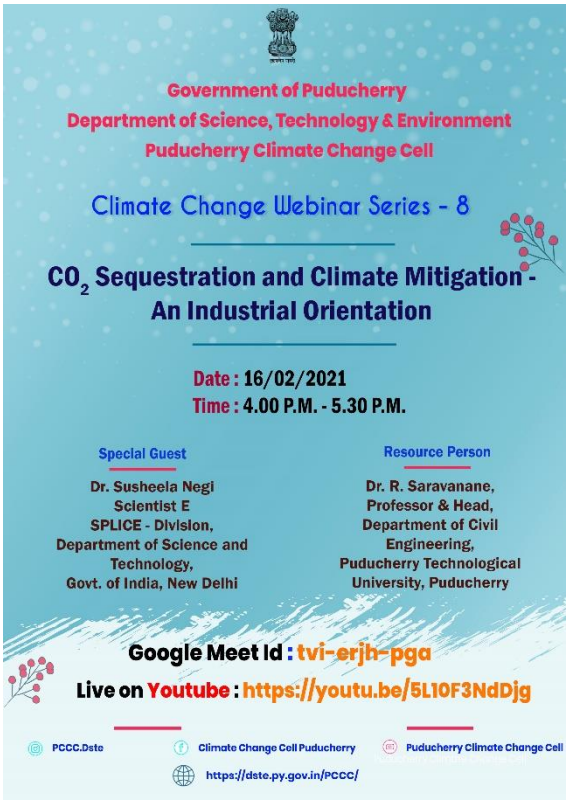
- All India Coordinated Programme on CO_2 sequestration has covered 8 states in the North eastern region of India and Carbon sequestration in Agriculture, forest and other land use sector is considered important in view of the short term low cost. Ministry of Earth Science focusing on ocean CO_2 sequestration.
- Storage has associated technical, safety, logistic and legal concerns and issues such as high capital costs are the gaps in this area.
- CCUS is one of the identified innovation challenges in the Mission Innovation Programme, a global initiative of 24 countries and the European Union to accelerate the global clean energy innovation. DST, GoI has 19 funded R&D projects in the area CCUS partnering with 13 MI countries.

Dr. R. Saravanane, Professor and Head, Department of Civil Engineering, Puducherry Technological University, Puducherry delivered his second technical presentation on the title "**CO2 Sequestration and Climate Mitigation – An Industrial Orientation**". He highlighted the following points on How Regional Vulnerability Assessment has been done in the U.T. of Puducherry and vulnerability profile ranking was discussed.

- CO2 Sequestration in Neyveli Lignite Corporation India Limited (NLCIL) has been done by removing CO2 from the flue gas which includes Sox, NOx etc.

- Major sources of CO_2 emission in India are Transport and Thermal power plants using coal as a fuel.
- In India there are 143 Thermal Power Plant which generated electricity by using coal as a fuel. 60% of energy demand is met by coal.
- It is necessary to sequester the CO_2 released from the power sector. Some of the methods are Chemical treatment, Physical Adsoption, Membrane Separation and Biological Sequestration.
- Sequestration of CO_2 and production of Biofuel form flue gas of Thermal Power Plant project was done by Pondicherry Engineering College in 2013 and the project involves
    - Amount of Lignite processed
    - Power generation
    - Flue gas emission
    - Sewage plant characteristics
    - Algal growth in water bodies and ponds and vegetative cover over the township.

The case study in NLC was explained in detail and the results were discussed.


Government of Puducherry
Department of Science, Technology & Environment
Puducherry Climate Change Cell
Climate Change Webinar Series - 8
CO2 Sequestration and Climate Mitigation - An Industrial Orientation
Date : 16/02/2021
Time : 4.00 P.M. - 5.30 P.M.
Special Guest
Dr. Susheela Negi
Scientist E
SPLICE - Division,
Department of Science and Technology,
Govt. of India, New Delhi
Resource Person
Dr. R. Saravanane,
Professor & Head,
Department of Civil Engineering,
Puducherry Technological University, Puducherry
Google Meet Id : tvi-erjh-pga
Live on Youtube : https://youtu.be/5L10F3NdDjg
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Climate Change Cell Puducherry
Puducherry Climate Change Cell
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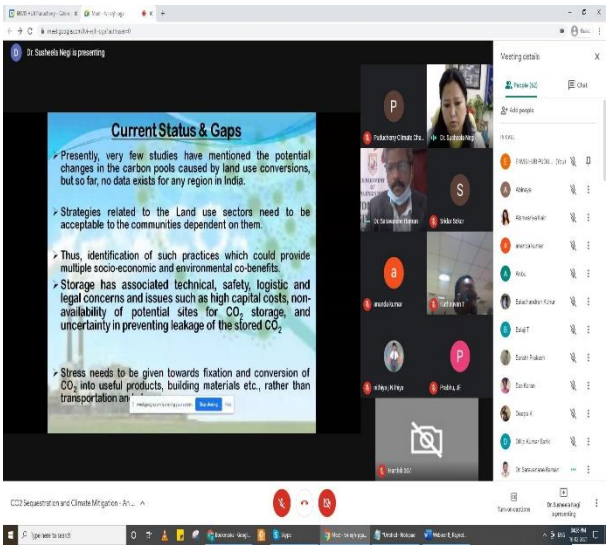
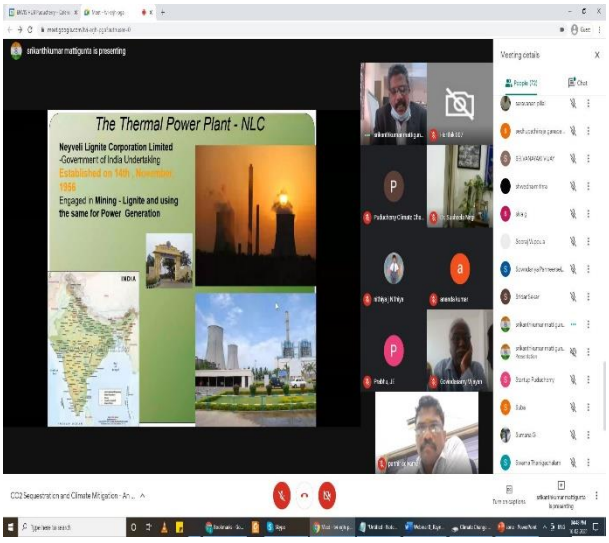
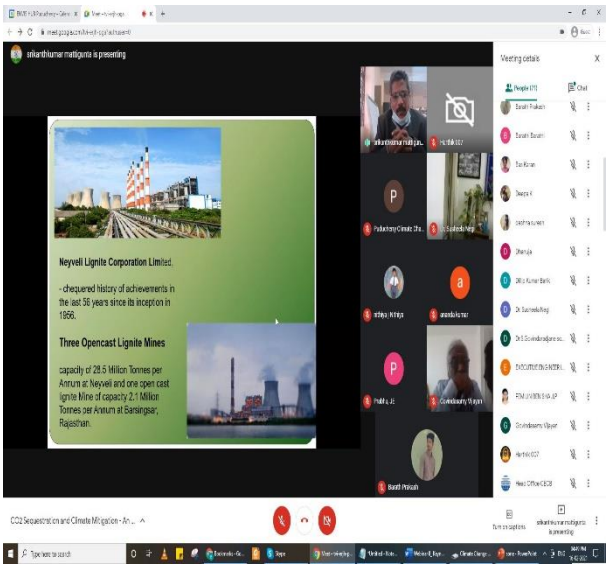

Dr Susheela Negi is presenting
Current Status & Gaps
Presently, very few studies have mentioned the potential changes in the carbon pools caused by land use conversions, but so far, no data exists for any region in India.
Strategies related to the Land use sectors need to be acceptable to the communities dependent on them.
Thus, identification of such practices which could provide multiple socio-economic and environmental co-benefits.
Storage has associated technical, safety, logistic and legal concerns and issues such as high capital costs, non-availability of potential sites for CO2 storage, and uncertainty in preventing leakage of the stored CO2
Stress needs to be given towards fixation and conversion of CO2 into useful products, building materials etc., rather than transportation an


srilanthkumar mattigunta is presenting
The Thermal Power Plant - NLC
Neyveli Lignite Corporation Limited
-Government of India Undertaking
Established on 14th , November, 1956
Engaged in Mining - Lignite and using the same for Power Generation
INDIA


srilanthkumar mattigunta is presenting
Neyveli Lignite Corporation Limited
- chequered history of achievements in the last 56 years since its inception in 1956.
Three Opencast Lignite Mines
capacity of 28.5 Million Tonnes per Annum at Neyveli and one open cast lignite Mine of capacity 2.1 Million Tonnes per Annum at Barsingsar, Rajasthan.

Summary of Webinar 8:

Several technologies are available now to decarbonize industries and achieve net zero emission. In our own Puducherry we have a Chlor-alkali Industry which has established a Carbon Sequestration Plant. The plant produces Soda Ash from the flue gas coming from the Thermic Fluid Heaters. About 600 MT/Year of CO2 is captured and converted into Soda Ash in this plant.

9. CLIMATE CHANGE WEBINAR SERIES - WEBINAR 9

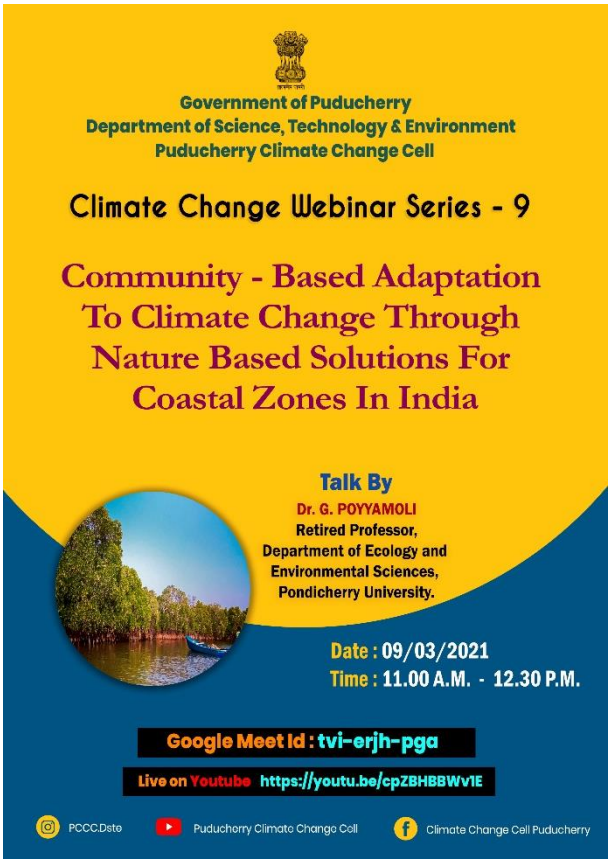
On 9th March 2021 at 11.00 A.M. to 12.30 P.M. Puducherry Climate Change Cell hosted a webinar titled “Community-Based Adaptation (CbA) to Climate Change through Nature based solutions (NbS) for coastal zones in India”.

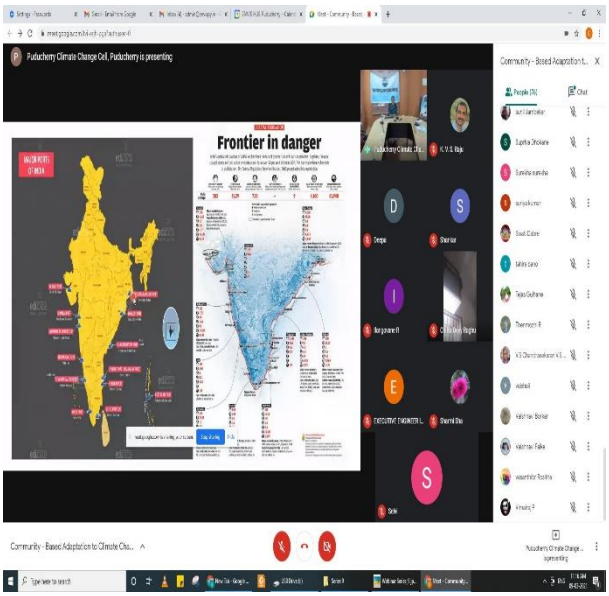
Dr. S. Dinesh Kannan, IFS, Director (DSTE) – cum – State Nodal Person (PCCC) delivered the Opening Remarks. In the opening remarks, the Director highlighted that Nature-based solution in coastal zones is an empirical approach in disaster risk reduction and in climate change adaptation and mitigation. He emphasized that the role of coastal based natural features such as lagoons, estuaries, beaches and mangroves as nature-based solutions for climate–vulnerable communities and how these ecosystems serve as natural buffers in reducing the hydro-meteorological disasters such as cyclones, storm surges, sea waves, tidal surges, tidal floods, coastal erosion and sea level rise.

Dr. G. Poyyamoli, Professor, Department of Ecology and Environmental Sciences, Pondicherry University delivered the lecture session. He highlighted the following points

- In this lecture, the speaker brought out statistically the coastal vulnerabilities pertaining to the Indian scenario and that pertains to the U.T. of Puducherry.
- The speaker then brought out the causes that leads to these vulnerabilities such as the coastal flooding / inundation, Sea Level Rise, Marine resource depletion, beach erosion etc.
- Following this, the constituents of vulnerability viz., Exposure, Sensitivity and Adaptivity were discussed.

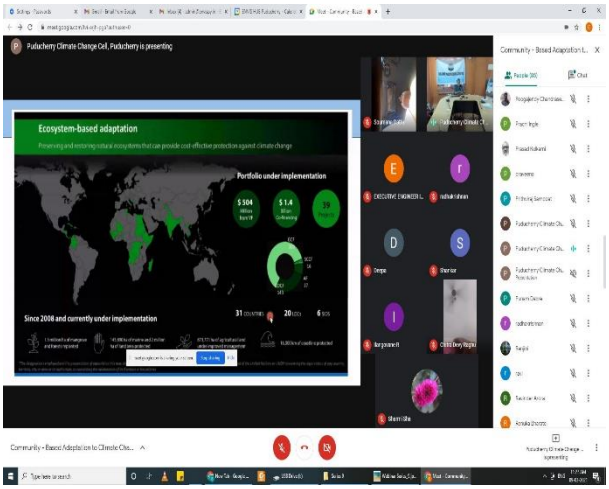
- Then the speaker introduced the potential Nature based solution methodologies from diverse perspectives such as changes in infrastructure, livelihood pattern etc.
- Several examples and case studies of nature based solution methodologies that are adapted in global, national and regional level were discussed.
- The 8 “Criteria of Nature Based Solution” were elaborated by the speaker.
- Subsequently, the speaker also discussed the co-benefits of adapting Nature based Solution in a way that it helps Disaster Risk Reduction and additional benefits like flooding and coastal erosion.

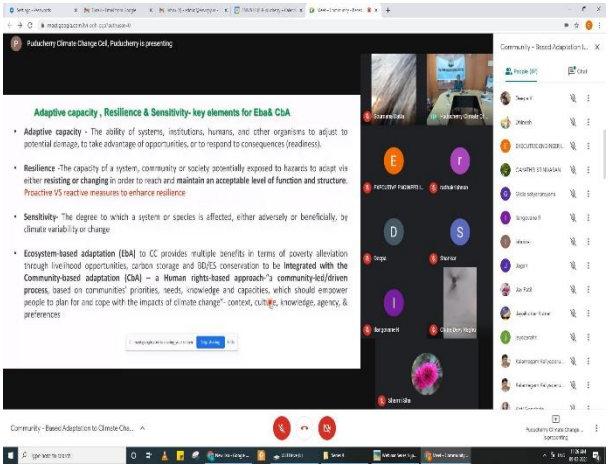




Climate Change Webinar Series - Webinar 9

Community-Based Adaptation (CbA) to Climate Change through Nature based solutions (NbS) for coastal zones in India





Summary of Webinar 9:

With the rising coastal based climate threats and vulnerabilities, adaptation strategies of diverse caliber are the need of the present and the future, one such strategies being the Community Based Adaptation through Nature Based Solutions. Nature based Solutions may be implemented with the full engagement and consent of indigenous people and local communities in a way that respects their cultural and ecological rights; and the chosen nature-based solutions should be explicitly designed to provide measurable benefits for biodiversity.

DEPARTMENT OF SCIENCE & TECHNOLOGY
Ministry of Science & Technology
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