CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU

SUSTAINABLE AGRICULTURE

Capacity Building Programme

REPORT

MARCH 2024

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

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

TEAM – CLIMATE STUDIO

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		Dr. A. Ramachandran Emeritus Professor, CCCDM & Member, Chief Minister's Governing Council on Climate Change
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		Dr. R. Malarvizhi, Project Associate
SUSTAINABLE AGRICULTURE:		**Dr. S. Pavithrapriya,** Project Scientist
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ACKNOWLEDGEMENT

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

We express our sincere gratitude to the Department of Agriculture, Government of Tamil Nadu, for their invaluable support in nominating participants for the capacity building program. Furthermore, we would like to extend our heartfelt appreciation to all the participants who attended the program, enriching it with their presence.

We humbly acknowledge the insightful contributions and expertise of We humbly acknowledge Prof. Dr. R. Velraj, the Honourable Vice Chancellor, Anna University, Prof.Dr. K.P. Jaya, Head of the Department, Department of Civil Engineering, Dr. K. Palanivelu, Professor, CCCDM, Dr. R. Saravanan, Professor, CWR & adjunct faculty of CCCDM, Anna University, Thiru. S. Sankarasubramaniyan, Deputy Director of Agriuclture (Training), Department of Agriculture, Government of Tamil Nadu, Dr. S. Nagoor Ali Jinnah, Former Chief General Manager, NABARD; Dr. K. Alagusundharam, Chief Executive Officer, Tamil Nadu Food Processing & Agri Export Promotion Corporation (TNAPEx); Dr. N. K. Sathyamoorthy, Professor & Head, Agro Climate Research Centre, Tamil Nadu Agricultural University; Dr. A. Merlin Sheela, Associate Professor (Sr. Grade), Centre for Environmental Studies, Anna University, Chennai; and Dr. R. Rengalakshmi, Director, Ecotechnology, MSSRF. Their valuable inputs have significantly enhanced the program's quality and effectiveness

We sincerely thank other Project Staff and Administrative Staff of CCCDM for their continuous support towards the successful execution of the capacity building programme.

ABOUT THE PROGRAMME

The Capacity Building Program on Climate Risk Assessment and Adaptation Plan of Tamil Nadu – Agriculture was designed and implemented to enhance the capability of stakeholders to assess and manage climate-related risks to agriculture. To address this, capacity building programs are essential for equipping agriculture department staff with the knowledge and skills necessary to assist farmers in adapting to a changing climate. These programs can include training on climate-smart agricultural practices, the use of weather forecasting tools, and techniques for assessing and mitigating climate-related risks. By investing in the professional development of agriculture department staff, governments and organizations can play a crucial role in building resilience within the agricultural sector and ensuring sustainable food production for future generations. This proactive approach will not only benefit farmers and rural communities but also contribute to global efforts to combat climate change.

Climate Studio at CCCDM

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

Program Components

These programs can include training on climate risk and vulnerability assessment in the agriculture sector, the use of crop modeling software, and techniques for assessing and adapting climate change risks. By investing in the professional development of agriculture department staff, governments and organizations can play a crucial role in building resilience within the agricultural sector and ensuring

sustainable food production for future generations. This proactive approach will not only benefit farmers and rural communities but also contribute to global efforts to combat climate change. As a part of the project on agriculture risk assessment of Tamil Nadu. The Knowledge dissemination was done through the capacity building programme to create awareness of climate change impacts on agriculture for the policymakers.

Training Module

The capacity building programme "Training Manual" on the topic of Climate Risk Assessment and Adaptation Plan of Tamil Nadu – Agriculture has been released by Dr. Nagoor Ali Chinna, Former Chief General Maanger, NABARD, Dr. Kurian Joseph, Professor and Director, CCCDM, Dr. K. Palanivelu, Professor CCCDM, were present. This training manual equips Assistant Directorate of Agriculture and Agriculture Officers from the Department of Agriculture, Govt. of Tamil Nadu with the skills to assess climate risk on river on agriculture in Tamil Nadu.

TechnicalSession

Prof. Dr. Kurian Joseph, *Director of the Centre for Climate Change and Disaster Management at Anna University, Chennai, shared insights on "Climate Risk and Sustainable Agriculture." He provided a detailed explanation of the Sustainable Development Goals, particularly focusing on Zero Hunger (SDG-2). The discussion underscored how a sustainable food system integrates economic, social, and environmental considerations to ensure food security and nutrition for future generations. He*

emphasized the significance of addressing food waste throughout the production, handling, processing, distribution, and consumption stages. The challenges in sustaining the food system include the preservation of biodiversity, addressing climate change, and safeguarding the environment for environmental sustainability. Social sustainability involves ensuring food affordability and promoting a healthier diet, while economic sustainability encompasses providing income for farmers and creating job opportunities to enhance economic status. He highlighted the importance of striving towards the goal of achieving Zero Hunger and promoting sustainable food production. Additionally, he outlined the impact of agriculture and climate risk, along with adaptive measures required in agriculture due to climate change.

Prof. Dr. A. Ramachandran, *Emeritus Professor, Centre for Climate Change and Disaster Management, Anna University ensured that the programme would instigate the real-time methodology to assess the climate risks to Agriculture and how to enhance the adaptation strategies. He carried over the programme with the lecture on "Climate Change Impacts on Natural Resources in Tamil Nadu". He briefed the climate variability trends on the future period with a brief on IPCC reports and its inter-disciplinary approaches to managing the climate change impacts on a global scale that fits in with the state of Tamil Nadu. He highlighted the vulnerability of natural resources and linked the Sustainable Development Goals (SDG). He insisted on the futuristic adaptation measures of agriculture with indigenous knowledge on farmer perception.*

*T**hiru. S. Shankarasubramaniyan,** the Deputy Director of the Commissionerate of Agriculture in Chepauk, Chennai, delivered a presentation titled "Status of Agriculture in Tamil Nadu." In his presentation, Shankarasubramaniyan provided an overview of the current state of agriculture in the state of Tamil Nadu. He emphasized the importance of aligning agricultural practices and policies with three specific Sustainable Development Goals (SDGs) set by the United Nations. The first goal, SDG 1 (No Poverty), aims to end poverty in all its forms everywhere. Shankarasubramaniyan highlighted the role of agriculture in reducing poverty by providing a stable source of income and employment for a significant portion of the population in Tamil Nadu.The second goal, SDG 2 (Zero Hunger), focuses on ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture. Shankarasubramaniyan discussed the challenges faced by the agricultural sector in Tamil Nadu in meeting the food demands of the growing population and ensuring that everyone has access to nutritious*

and sufficient food. The third goal, SDG 13 (Climate Action), calls for urgent action to combat climate change and its impacts. Shankarasubramaniyan emphasized the need for adopting climate-resilient agricultural practices in Tamil Nadu to mitigate the effects of climate change on crop production, water availability, and overall food security. In summary, Thiru. S. Shankarasubramaniyan's presentation highlighted the current status of agriculture in Tamil Nadu and stressed the importance of aligning agricultural practices with the Sustainable Development Goals of No Poverty, Zero Hunger, and Climate Action to ensure a sustainable and resilient agricultural sector in the state.

Prof. Dr. N. K. Sathyamoorthy, *Professor & Head, Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore explained the "Climate Change Adaptation Plan for Agriculture" lecture. provides valuable insights into the challenges and opportunities faced by the agricultural sector in Tamil Nadu due to climate change. His focus on incorporating organic matter amendments such as leaf green manure, vermicompost, and panchamitham as adaptation strategies underscores the significance of adopting sustainable practices to bolster resilience against climate change. These organic amendments play a crucial role in enhancing soil health, improving water retention capacity, and increasing nutrient availability, ultimately leading to improved crop productivity and reduced susceptibility to climate extremes.*

Dr. R. Rengalakshmi, *Director of Ecotechnology at MSSRF, imparted insights into the practical implementation of climate change adaptation measures in agriculture within Kolli Hills and the Thiruvannamalai district. She emphasized the significance of various elements such as farm ponds, agroforestry, community seed banks, and advanced weather and pest forecasting systems in the realm of agriculture. Integrated agroforestry, a key adaptation strategy, has been successfully employed in Kolli Hills, resulting in the transformation of 1000 acres of barren land into productive agro-forestry areas. The farmers in Kolli Hills have diversified their cultivation to include crops such as jackfruit, mango, cashew, lime, orange, coffee, pepper, clove, and silver oak. Dr. Rengalakshmi also delved into additional adaptation strategies like greening the hillocks, providing picture-based risk management services, and implementing ecosystem-based adaptation methods.*

Dr. S. Nagoor Ali Jinnah, *former Chief General Manager at NABARD, imparted his knowledge on climate adaptation initiatives and opportunities for the agriculture sector. He highlighted the importance of the 4 Es—Earth, Economy, Equity, and Ethics—and the 3 Ps—Productivity, Price, and*

in climate-resilient agriculture. He emphasized the water stress in Tamil Nadu, noting that 96% of surface water is already exploited, with 68% of blocks in the state classified as overexploited. Dr. Jinnah advocated for climate-smart agriculture as a means to build resilience among farmers, sustainably increase agricultural production and incomes, and reduce greenhouse gas emissions. He elaborated on various adaptation interventions and the availability of international funds to support these efforts. He also provided examples of NABARD-funded projects across India that are focused on climate-proofing watersheds, promoting climate-smart agriculture for sustainable livelihoods, enhancing the capacity of small and marginal farmers, and conserving coastal resources.

***Prof. Dr. K. Alagusundaram**, Chief Executive Officer of the Tamil Nadu Food Processing & Agri Export Promotion Corporation (TNAPEx), delivered a presentation on climate change adaptation strategies for agriculture. He provided an overview of the current state of agriculture and climate change conditions in Tamil Nadu. He also elaborated on the necessary adaptation measures that farmers and agricultural departments should implement to address climate change challenges.*

***Prof. Dr. A. Merlin Sheela,** Associate Professor, Centre for Environmental Studies, Anna University shared the knowledge on "Climate change impacts on Agriculture and food supply". She gives an introduction about Earth energy budget, Milankovitch cycle, atmosphere and green house gas emission. She briefed the global challenges for Agriculture and food security and emphasized the El Nino Southern Oscillation impacts on global yields of major crops. She highlighted the precision agriculture and adaptation strategies.*

***Dr. R. Geetha,** Project Scientist and **Ms. S. Sathyapriya**, Project Associate specializing in Climate Modeling at CCCDM, Anna University, delivered an informative presentation. She provided insights into climate modeling and future projections. Geetha discussed the Intergovernmental Panel on Climate Change (IPCC) reports, highlighting the socio-economic pathways outlined in the Sixth Assessment Report (AR6). Additionally, she explained global climate models and the concept of downscaling, shedding light on the anticipated climate variability. This included projected changes in temperature and rainfall patterns for three distinct time periods: near-term (2021-2050), mid-century (2051-2080), and end-century (2081-2100).*

***Dr. L. Balaji,** Project Scientist , **Dr. R. Malarvizhi,** Project Associate in Water resources at CCCDM, Anna University and **Mr. S. N. Ahamed Ibrahim**, Project Associate in Sustainable Habitat at CCCDM, Anna University, shared the Climate Risks and Vulnerability Assessment of River Basins in*

Tamil Nadu. She delivered the hydrological behavior of 17 river basins was modeled using an appropriate hydrological model under the SSP2-4.5 scenario. Flood and drought assessments were conducted for these 17 river basins, focusing on critical sub-basins under district-specific threat, incorporating indigenous knowledge to develop concomitant adaptation strategies.

Dr. S. Pavithrapriya *and* ***Mr. P. Praveenkumar,*** *from CCCDM at Anna University, Chennai, led a session focused on "Risk and Vulnerability Assessment on Agriculture." Based on crop yield and cultivable to identify the cropping zone in Rice, Maize, Sorghum, Blackgram and Groundnut. The simulated the crop yield for future period projected impacts on major crops in the region. The discussion also explored the varieties utilized and projected crop yields using a Crop Simulation Model. Additionally, the presentation provided a comprehensive overview of risk assessment methodologies based on the IPCC Assessment report, emphasizing the importance of conducting risk assessments. The presentation also delved into the components of risk, including Hazard, Exposure, and Vulnerability (Sensitivity and Adaptive Capacity), explaining each component in detail.*

Dr. S. Pavithrapriya, *Project Scientist and* ***Mr. P. Praveenkumar,*** *Project Associate, Agriculture, Centre for Climate Change and Disaster Management, Anna University, Chennai discoursed the lecture on "DSSAT crop simulation model". This interactive session featuring the DSSAT crop simulation model, a detailed discussion took place on the changes in crop yield on a district-wise basis using an interactive portal. The session included demonstrations of DSSAT tools, encompassing crop management, genetic coefficients, weather, and soil. The various components of the crop module, from the sowing stage to harvest, were elucidated during the presentation. Participants actively engaged in a hands-on DSSAT modeling session, utilizing their respective district-specific data to run the model and analyze the generated outputs.*

Outcomesand Impacts

Knowledge dissemination is the primary outcome of this project where the training manual was released and distributed through this programme. The success of four capacity-building programmes that have covered all 36 districts of Tamil Nadu across Tamil Nadu, excluding Chennai and the Nilgiris, attended the programme. It has helped to get insight into the climate change and agriculture risk assessment. The program aimed to equip participants with the knowledge and scientific methods to

assess climate change risks to agriculture. Fifty-Nine participants from 36 districts September 21-22, 2023, October 12-13, 2023, November 9-10, 2023, and February 22-23, 2024

The Key Outcomes of the Capacity Building Progamme are

- *Understanding the fundamentals of climate change and climate change impact*
- *Conceptualizing vulnerability, hazard, exposure and risk*
- *Interactive exercise on Crop model on climate risk assessment of Agro climatic Zone of Tamil Nadu*

TABLE OF CONTENTS

Report on the Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu- Agriculture September 21 & 22, 2023

` *The Centre for Climate Change and Disaster Management, Anna University with financial support from the Department of Environment and Climate Change, Government of Tamil Nadu has conducted a two-day Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu- Agriculture" on September 21st & 22nd 2023 to Deputy Director of Agriculture and Agriculture Officers at Climate Studio, Conference Hall. Fourteen participants from Chengalpattu, Coimbatore, Cuddalore, Erode, Kanchipuram, Kanyakumari, Ariyalur, Krishnagiri, Perambalur, Sivangai, Thanjavur, Theni, Thiruvannamalai and Thiruvarur. attended the training programme.*

Training Programme Proceedings

The inaugural function of the training programme on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu" was on September 21st, 2023. Prof. Dr Kurian Joseph, Director, Centre for Climate Change and Disaster Management, Anna University, Chennai welcomed all the participants of the capacity building programme. He gave an outline of the Operationalization of Climate Studio and highlighted the importance of agriculture and its climate risks.

The two-days training programme had nine technical sessions of 45 minutes duration each with lectures delivered by eminent speakers who are experts in the field, academicians and agriculture sector officials. Followed by a practical training of more than three hours at the laboratory, Climate Studio.

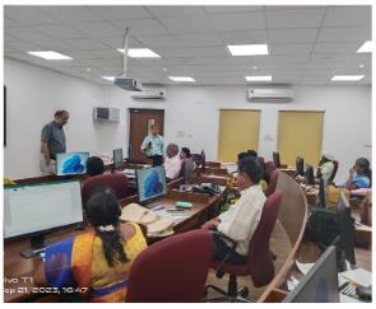
Dr. Kurian Joseph, Director, Centre for Climate Change and Disaster Management, Anna University welcomed the Chief guests and participants for the valedictory session of two days capacity building programme. Prof. Dr. A. Ramachandran, Emeritus Professor, CCCDM, Anna University has presided over the programme by welcoming the chief guest and participants as the representative of this programme. Dr. K. Alagusundaram, delivered the valedictory address and empowered this training programme and shared the NICRA project , Dr. K. Palanivelu, Professor, Centre for Climate Change and Disaster Management, Anna University thanked the members on the dais, the organisers, and the participants and wished the programme great success.

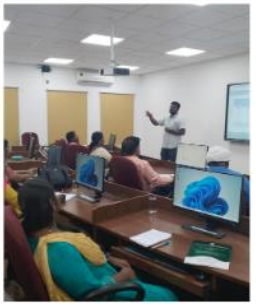
CAPACITY BUILDING PROGRAMME

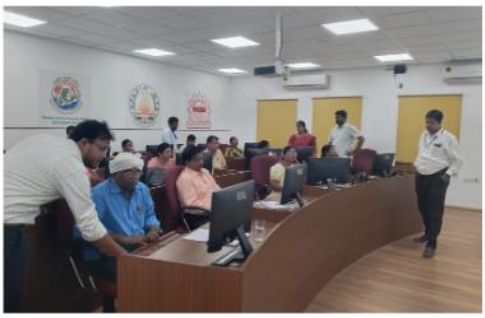
CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

under OPERATIONALIZATION OF CLIMATE STUDIO

21 & 22 September 2024







Organized by

Centre for Climate Change and Disaster Management,
Anna University

Supported by

Department of Environment and Climate Change,
Government of Tamil Nadu

Report on the Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu- Agriculture October 12 & 13 2023

Introducton

` The Centre for Climate Change and Disaster Management, Anna University with financial support from the Department of Environment and Climate Change, Government of Tamil Nadu has conducted a two-day Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu-Agriculture" on October 12 & 13 2023 to Agriculture Officers at Climate Studio, Conference Hall. Fifteen participants from Ariyalur, Cuddalore, Erode, Kallakurichi, Krishnagiri, Mayiladuthurai, Perambalur, Ranipet,Thanjavur,Thiruvannamalai,Thiruvarur,Thoothukudi,Tirupathur,Villupuram, Viruthunagar attended the training programme.

Training Programme Proceedings

Prof. Dr Kurian Joseph, Director, Centre for Climate Change and Disaster Management, Anna University, Chennai welcomed all the participants of the capacity building programme. He gave an outline of the Operationalization of Climate Studio and highlighted the importance of agriculture and its climate risks. The two-days training programme had ten technical sessions of 45 minutes duration each with lectures delivered by eminent speakers who are experts in the field, academicians and agriculture sector officials. Followed by a practical training of more than three hours at the laboratory, Climate Studio.

During the valedictory session of the two-day capacity building program, Dr. Kurian Joseph, the Director of the Centre for Climate Change and Disaster Management at Anna University, extended a warm welcome to the esteemed chief guests and participants. Prof. Dr. R. Nagendran, Expert Member (Retd.), National Green Tribunal, delivered the valedictory address, he empowered this training programme and shared the agriculture importance and impact of climate change Expressing his gratitude, Dr. K. Palanivelu, Professor at the Centre for Climate Change and Disaster Management, Anna University, commended the dignitaries on the dais, the organizers, and the participants, wishing the program resounding success.

Climate Risk Assessment and Adaptation Plan of Tamil Nadu - AGRICULTURE (12-13 October 2023)

Capacity Building Programme - Supported by Department of Environment and Climate Change, Government of Tamil Nadu
Organized by Centre for Climate Change and Disaster Management, Anna University

Report on the Capacity Building Program

Climate Risk Assessment and Adaptation Plan of Tamil Nadu- Agriculture November 9 & 10, 2023

Introduction

` *The Centre for Climate Change and Disaster Management, Anna University with financial support from the Department of Environment and Climate Change, Government of Tamil Nadu has conducted a two-day Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu-Agriculture" on November 9 & 10, 2023 to Agriculture Officers at Climate Studio, Conference Hall. Fifteen participants from Ariyalur, Cuddalore, Erode, Kallakurichi, Krishnagiri, Mayiladuthurai,Perambalur,Ranipet,Thanjavur,Thiruvannamalai,Thiruvarur,Thoothukudi,Tirupathur and Viruthunagar attended the training programme.*

Prof. Dr Kurian Joseph, *Director, Centre for Climate Change and Disaster Management, Anna University, Chennai welcomed all the participants of the capacity building programme. He gave an outline of the Operationalization of Climate Studio and highlighted the importance of agriculture and its climate risks. The two-day training program comprised nine technical sessions, each spanning 45 minutes, featuring lectures delivered by eminent speakers who are experts in their respective fields, including academicians and officials from the agricultural sector. Subsequently, participants engaged in a practical training session lasting more than three hours at the Climate Studio laboratory.*

Training Programme Proceedings

During the valedictory session of the event, ***Prof. Dr. Kurian Joseph,*** *Director of the Centre for Climate Change and Disaster Management (CCCDM) at Anna University, warmly welcomed the esteemed dignitaries and all the participants in attendance. The session commenced with two participants sharing their feedback and experiences from the comprehensive program.* ***Prof. R. Murugesan,*** *Professor, IRS presides the programme highlighting the importance of agriculture and water resources climate change challenges.* ***Dr. Nagoor Ali Jinnah****, Former Chief General Manager, NABARD delivered the valedictory address, shared the valuable knowledge and fund available for NABARD.* ***Dr. K. Palanivelu,*** *Professor, CCCDM expressed gratitude to the guests, participants, and the CCCDM team for their efforts in addressing climate change and promoting sustainable agricultural practices through the successful program.*

CAPACITY BUILDING PROGRAMME

CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

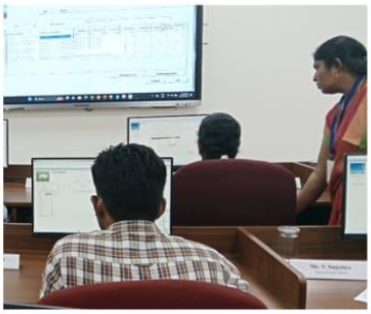
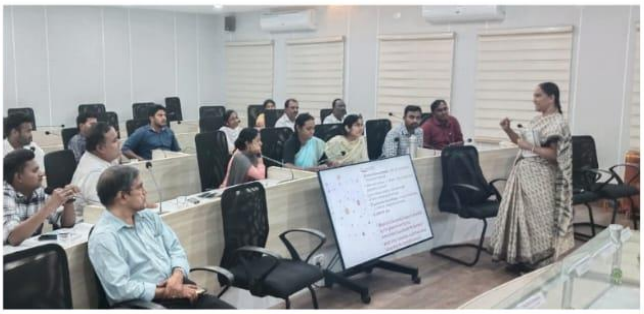
under OPERATIONALIZATION OF CLIMATE STUDIO

9 & 10 November 2023








Organized by

Centre for Climate Change and Disaster Management,
Anna University

Supported by

Department of Environment and Climate Change,
Government of Tamil Nadu

Report on the Capacity Building Program Climate Risk Assessment and Adaptation Plan of Tamil Nadu- Agriculture February 22 & 23, 2024

Introduction

The Centre for Climate Change and Disaster Management, Anna University with financial support from the Department of Environment and Climate Change, Government of Tamil Nadu has conducted a two-day Capacity Building Program on "Climate Risk Assessment and Adaptation Plan of Tamil Nadu-Agriculture" on February 22 & 23, 2024 to Agriculture Officers at Climate Studio, Conference Hall. Fifteen participants from Ariyalur, Cuddalore, Erode, Kallakurichi, Krishnagiri, Mayiladuthurai, Perambalur,Ranipet,Thanjavur,Thiruvannamalai,Thiruvarur,Thoothukudi,Tirupathur,Villupuram, Viruthunagar attended the training programme.

Training Programme Proceedings

Prof. Dr. K. Palanivelu, *Professor, Centre for Climate Change and Disaster Management, Anna University, Chennai welcomed all the participants of the capacity building programme. He gave an outline of the Operationalization of Climate Studio and highlighted the importance of agriculture and its climate risks. The two-day training program comprised nine technical sessions, each spanning 45 minutes, featuring lectures delivered by eminent speakers who are experts in their respective fields, including academicians and officials from the agricultural sector. Subsequently, participants engaged in a practical training session lasting more than three hours at the Climate Studio laboratory.*

During the valedictory session of the event, ***Prof. Dr. Kurian Joseph****, Director of the Centre for Climate Change and Disaster Management (CCCDM) at Anna University, warmly welcomed the esteemed dignitaries and all the participants in attendance. The session commenced with two participants sharing their feedback and experiences from the comprehensive program.* ***Dr. A. Ramachandran*** *highlighting the importance of traditional crop varieties and indigenous agricultural practices for sustainable farming amid climate change challenges.* ***Thiru. S. Shankarasubramaniyan*** *delivered the valedictory address, shared the valuable knowledge he gained through the training program. He highlighted the crucial issue of overusing fertilizers in modern agricultural practices.* ***Dr. K. Palanivelu,*** *Professor, CCCDM expressed gratitude to the guests, participants, and the CCCDM team for their efforts in addressing climate change and promoting sustainable agricultural practices through the successful program.*

CAPACITY BUILDING PROGRAMME

CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

under OPERATIONALIZATION OF CLIMATE STUDIO

22&23 February 2024







Organized by

Centre for Climate Change and Disaster Management,
Anna University

Supported by

Department of Environment and Climate Change,
Government of Tamil Nadu

SUMMARY

These programs facilitated capacity building among officials from the agricultural department, equipping them with the necessary tools and knowledge to propose future adaptation actions at the district level. By drawing upon their understanding of existing challenges and local contexts, the officials were empowered to develop targeted strategies tailored to the specific needs of their respective regions. The training sought to foster a collaborative environment where participants could actively engage, exchange insights, and collectively contribute to enhancing the resilience of agricultural systems in the face of climate change.

Ultimately, by equipping participants with a comprehensive knowledge base and cutting-edge scientific tools, these training programs aimed to empower stakeholders to develop and implement effective strategies. This approach not only addressed the immediate impacts of climate change on agriculture but also laid the foundation for long-term sustainability and resilience, ensuring food security and the well-being of farming communities in the face of a changing climate.

Improving crop productivity involves implementing crop management practices like efficient water, soil nutrient management, and integrated pest management. Adopting micro-irrigation, fertigation, drought/flood resistant varieties, and high-yielding crop varieties is crucial. Soil conservation through agroforestry, organic farming, minimum tillage, mulching, and integrated farming systems is essential. Water conservation can be achieved through farm ponds, rainwater harvesting, mulching, and growing water-efficient crops. Climate profiling agronomic practices like crop rotation, changing sowing dates, direct seeded rice, and mixed cropping build resilience. Intensive cultivation, optimum fertilizer use, soil fertility enhancement with organic manures, and integrated nutrient management promote sustainable agriculture. Implementing these strategies holistically can boost productivity while conserving resources and adapting to climate change.

ANNEXURE-I

NOMINATION LETTER,

ATTENDANCE SHEET

&

REGISTRATION FORM

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 1 (September 21, 2023)	
INAUGURAL SESSION	
9:30 – 9.45 A.M	**REGISTRATION**
9.45 – 10:00 A.M	**Welcome Address** **Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University, Chennai
10:00 – 11:00 A.M	**Climate Change impact on Natural resources in Tamil Nadu** **Prof. Dr. A. Ramachandran D.Sc.** Emeritus Professor, CCCDM, Anna University, Chennai
11:00 – 11:15 A.M	**TEA BREAK**
TECHNICAL SESSIONS	
SESSION – I: Status of Agriculture in Tamil Nadu	
11:15 – 12:15 P.M	**Thiru. S. Sankarasubramanian,** Deputy Director of Agriculture
SESSION – II: Climate Change Impact on agriculture and food supply	
12:15– 1:15 P.M	**Dr. A. Merlin Sheela,** Associate Professor, Centre for Environmental Studies, Anna University, Chennai
1:15 – 2:15 P.M	**LUNCH**
SESSION – III: Climate Modelling and Projection	
2:15 – 3:00 P.M	**Dr R. Geetha,** Project Scientist- Climate Modeling, CCCDM, Anna University & **Mrs. K. Sathyapriya,** Project Associate, Climate Modeling, CCCDM, Anna University
SESSION – IV: Climate Risk on water resources in Tamil Nadu	
3:00 - 3:45 P.M	**Dr. L. Balaji,** Project Scientist-Water resources, CCCDM, Anna University & **Dr. R. Malarvizhi Project** Associate-Water resources, CCCDM, Anna University
3:45 – 4.00 P.M	**TEA BREAK**
SESSION – V: Risk and Vulnerability Assessment on Agriculture & Demonstration of crop modelling- Cereals	
4.00 – 5.00 P.M	**Dr. S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

Day 2 (September 22, 2023)	
SESSION – VI: Climate Risk and Sustainable Agriculture	
9:30 – 11:00 A.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University, Chennai
11:00 – 11:15 A.M	**TEA BREAK**
SESSION – VII: Risk and Vulnerability Assessment on Agriculture - Millets, Pulses & Interactive Portal - Hands-on Training at Climate Studio	
11:15 – 1:15 P.M	**Dr S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai
1:15 – 2.15 P.M	**LUNCH**
SESSION – VIII: Climate Change Adaptation Plan for Agriculture	
2:15 – 3.15 P.M	**Dr. N. K. Sathyamoorthy** Professor & Head Agro Climate Research Centre Tamil Nadu Agricultural University Coimbatore-641 003
SESSION –IX: Case studies - Climate change Adaptation in Agriculture	
3:15 – 4.00 P.M	**Dr.R. Rengalakshmi** Director, Ecotechnology, MSSRF
4.00 – 4.15 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.15 - 5.00 P.M	

வேளாண்மை மற்றும் உழவர் நலத்துறை

அனுப்புநர்
முனைவர். இல. சுப்பிரமணியன். இ.ஆ.ப.,
வேளாண்மை ஆணையர்,
சேப்பாக்கம், சென்னை–5.

பெறுநர்
இயக்குநர்,
சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றம்,
தரைதளம் பனகல் கட்டிடம்,
சைதாபேட்டை, சென்னை – 15.

கடித எண். பொது2/ 5218 /2023 , நாள்: 07.09.2023

அய்யா/அம்மையீர்,

பொருள்: வேளாண்மை – சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றத்துறை காலநிலை ஸ்டுடியோவின் "செயல்பாடு திறன் மேம்பாட்டு திட்டம்" தொடர்பாக இரண்டு நாட்கள் பயிற்சிக்கு வேளாண்மை துணை இயக்குனர் விபரம் தெரிவித்தல் –தொடர்பாக

பார்வை: சுற்றுச்சூழல் மற்றும் கால் நிலை மாற்றம் துறை இயக்குனர் அவர்களின் கடித எண் P4/1829/19, DOE&Sec/22, நாள் 17.05.2023.

.....

பார்வையில் காணும் கடிதத்தில் கோரியவாறு, சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றங்கள் காலநிலை ஸ்டுடியோவின் செயல்பாடு திறன் மேம்பாட்டு திட்டம் தொடர்பாக இரண்டு நாட்கள் பயிற்சியில் கலந்து கொள்ள வேண்டி பின்வரும் வேளாண்மை துணை இயக்குநர்கள் பெயர், கைபேசி எண் மற்றும் மின்னஞ்சல் முகவரி விவரம் இக்கடித்துடன் இணைத்து அனுப்பி வைக்கப்படுகிறது.

இணைப்பு– மேற்கூறியவாறு

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

நகல்
இயக்குநர் (CCCDM),
அண்ணா பல்கலைக்கழகம்,
சென்னை–25

//ஆணைப்படி//

7.9.23
வேளாண்மை துணை இயக்குநர்
(பல்வகை)

07/09/23

வ. எண்	பணிபுரியும் அலுவலகம் மாவட்டம்	வேளாண்மை துணை இயக்குநர்களின் பெயர்	கைபேசி எண்	மின்னஞ்சல் முகவரி
1	வேளாண்மை இணை இயக்குநர், செங்கல்பட்டு	திரு. ர. அசோக், வேளாண்மை இணை இயக்குநர்	9842995622	jdachengalpattu@gmail.com
2	வேளாண்மை இணை இயக்குநர், கோயம்புத்தூர்	திருமதி. ரா. புனிதா, வேளாண்மை துணை இயக்குநர் (ம. தி)	9965588226	Jdacoimbatore2023@gmail. com
3	வேளாண்மை இணை இயக்குநர், கடலூர்	திருமதி. ஜெ, உலகம்மை, முருகக்கனி, வேளாண்மை துணை இயக்குநர், (மா தி)	9443229175	Pticud01@gmail.com
4	வேளாண்மை இணை இயக்குநர், ஈரோடு	எம். சாந்தமணி, வேளாண்மை துணை இயக்குநர் (மா. ஆ. நே.உ)	9865237053	agrierd@gmail.com
5	வேளாண்மை இணை இயக்குநர், காஞ்சிபுரம்	திரு. பிரின்ஸ் கிளாமண்ட் வேளாண்மை துணை இயக்குநர்	9444829648	jdagrikpm2021@gmail.com
6	வேள்ாண்மை இணை இயக்குநர், கன்னியாகுமரி	திரு. M.L. வாலி, வேளாண்மை துணை இயக்குநர் (திட்டம்)	9442364328	Jdagri2021@gmail.com
7	வேளாண்மை இணை இயக்குநர், கிருஷ்ணகிரி	திரு. கே. சீனிவாசன், வேளாண்மை துணை இயக்குநர் (உபநி)	9842792313	Paagri2013@gmail.com
8	வேளாண்மை இணை இயக்குநர், பெரம்பலூர்	திருமதி. பொ. ராணி வேளாண்மை துணை இயக்குநர் (மா. ஆ. நே.உ)	8825631615	Hemashok1997@gmail.com
9	வேளாண்மை இணை இயக்குநர், சிவகங்கை	திருமதி. எம். செல்வி, வேளாண்மை துணை இயக்குநர், (நுண்ணீர் பாசனம்)	9443997708	seedssvg@gmail.com
10	வேளாண்மை இணை இயக்குநர், தஞ்சாவூர்	திரு. எஸ். ஈஸ்வர் வேளாண்மை துணை இயக்குநர், (உபநி)	9445170257	Misvg2021@gmail.com
11	வேளாண்மை இணை இயக்குநர், தேனி	திருமதி. டா. சாந்தி வேளாண்மை துணை இயக்குநர் (உபநி)	9443677227	Jdaagritnj1@gmail.com
12	வேளாண்மை இணை இயக்குநர், திருப்பத்தூர்	திருமதி. சி. பச்சையப்பன் வேளாண்மை துணை இயக்குநர்	8072245916	jdatirupathur@gmail.com
13	வேளாண்மை இணை இயக்குநர், திருவண்ணாமலை	திரு.சீ.ஏழுமலை வேளாண்மை துணை இயக்குநர் (மத்திய அரசு திட்டம்)	9445920885	agritvmalai@gmail.com
14	வேளாண்மை இணை இயக்குநர், திருவாரூர்	திருமதி.ஒ.விஜயலெட்சுமி வேளாண்மை துணை இயக்குநர் (மத்திய அரசு திட்டம்)	9894402347	jdathiruvarur@gmail.com
15	வேளாண்மை இணை இயக்குநர், அரியலூர்	திரு.கபூவலிங்கம் வேளாண்மை துணை இயக்குநர் (மாவட்ட ஆட்சியரின் நேர்முக உதவியாளர்)	7010670907	paagriariyalur@gmail.com

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

//ஆணைப்படி//

9.9.23

வேளாண்மை துணை இயக்குநர்
(பல்வகை)

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
"Operationalization of Climate Studio"
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
21st & 22nd September 2023
on

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU-AGRICULTURE

REGISTRATION FORM

S. No	Name	Designation	District	Phone number	Email id	Signature
1	T. Sheela	Agriculture Officer	Chengalpattu	9444854244	adamkmcng@gmail.com	
2	D. Punitha	Deputy Director of Agriculture	COIMBATORE	9965588226	jdacoimbatore2023@gmail.com	21/09/23
3	J. Ulagammai Murugakkani	Deputy Director of Agriculture	Cuddalore	9443229175	ptlcudol@gmail.com	21/09/2023
4	M. Santhamani	Deputy Director of Agriculture	Erode	9865237053	paagrierd@gmail.com	21/08/23
5	R. Kaviyaselvi	Agriculture Officer	Kanchipuram	7538875960	ddaftckpm@gmail.com	21/9/23
6	M.R. Vani	Deputy Director of Agriculture	Kanyakumari	8300157815	mrv7941@gmail.com.	21/9/23
7	K. Srinivasan	Deputy Director of Agriculture	Krishnagiri	98427 92313	agri.pa.krishnagiri@gmail.com	21.9.23
8	P. Rani	Deputy Director of Agriculture	Perambalur	8825631615	paagripltr@gmail.com	21/9/23
9	M. Selvi	Deputy Director of Agriculture	SIVAGANGAI	9629555530	jdasvg@gmail.com.	21/9/23
10	S. Eswar	Deputy Director of Agriculture	Thanjavur	9445170257	jdaagritnj@gmail.com	
11	T. Shanthi	Deputy Director of Agriculture	Theni	9443677227	atmatheni@gmail.com	

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU-AGRICULTURE

REGISTRATION FORM

S. No	Name	Designation	District	Phone number	Email id	Signature
12	C. Pachaiyappan	Deputy Director of Agriculture	—			
13	S. Elumalai	Deputy Director of Agriculture	Tiruvannamalai	9445920885	bsceluma1ai@gmail.com	
14	O. Vijayalakshmi	Deputy Director of Agriculture	Thiruvarur	9894402347	jdathiruvarur@gmail.com	
15	G. Poovalingam	Deputy Director of Agriculture	Ariyalur	7010670907	poovalingam001@gmail.com	

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
"Operationalization of Climate Studio"
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
21st & 22nd September 2023
on

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

ATTENDANCE SHEET

S. No	Name	Designation	21/09/2023		22/09/2023	
			FN	AN	FN	AN
1	R. Kaviyaselvi	Agricultural Officer, Farmers Training center, Kanchipuram.	21/9/23	21/9/23	22/9/23	22/09/23
2	D. PUNITHA	Deputy Director of Agriculture, Coimbatore	21/09/23	21/09/23	22/09/23	22/09/23
3	J. ULAGAMMAI MURUGAVISANI	DDA SPTL CCC Cuddalore.	21/9/2023	21/9/2023	22/9/2023	22/9/2023
4	M. R. Vani	DDA, Schemes Kanyakumari dist.	21/9/23	21/9/23	22/9/23	22/9/23
5	G. Poovalingam	DDA. PA. to Dt. collector Ariyalur	21.9.23	21-9-23	22.9.23	22-9-23
6	O. VIJAYALAKSHMI	DDA (GOI) Thiruvarur	21/9/2023	21/9/2023	22/9/2023	22/9/2023
7	S. Elumalai.	DDA (GOI) Tiruvannamalai	21/9/2023	21/9/23	22/9/23	22/9/23
8	M. Santhamani	DDA PA Agri collectorate, Erode	21/9/23	21/9/23	22/9/23	22/9/23
9	K. SRINIVASAN	DDA FTC Krishnagiri	21.9.23	21.9.23	22/9/23	22/9/23
10	S. ESWAR	DDA (Gen) Thanjavur				

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
"Operationalization of Climate Studio"
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
21st & 22nd September 2023
on

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

ATTENDANCE SHEET

S.No	Name	Designation	21/09/2023		22/09/2023	
			FN	AN	FN	AN
11	M. Selvi	Deputy Director of Agriculture (MI)	21/9/23	21/9/23	22/9/23	22/9/23
12	P. SHANTHI	Deputy Director of Agriculture (PTC), Theni	21/09/23	21/09/23	22/09/23	22/9/23
13	T. SHEELA	Agricultural officer Maduranthakam, chengalpattu	21/9/23	21/9/23	22/9/23	22/9/23
14	P. Rani.	Deputy Director of Agri / PIA Agri) Perambalur	21/9/23	21/9/23	22/9/23	22/9/23
15						

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 1 (October 12, 2023)	
INAUGURAL SESSION	
9:30 – 9.45 A.M	**REGISTRATION**
9.45 – 10:00 A.M	**Welcome Address** **Prof.Kurian Joseph** Director, CCCDM, Anna University, Chennai
TECHNICAL SESSIONS	
SESSION – I: Climate Change Impacts on Natural resources in Tamil Nadu	
10:00 – 11:00 A.M	**Prof. Dr. A. Ramachandran D.Sc.** Emeritus Professor, CCCDM, Anna University, Chennai
11:00 – 11:15 A.M	**TEA BREAK**
SESSION II Status of Agriculture in Tamil Nadu	
11:15 – 12:15 P.M	**Nominee from** Directorate of Agriculture, Chepauq, Chennai
SESSION – III: Climate Risk and Sustainable Agriculture	
12:15– 1:15 P.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University, Chennai
1:15 – 2:15 P.M	**LUNCH**
SESSION – IV: Climate Modelling and Projection	
2:15 – 3:00 P.M	**Dr R. Geetha,** Project Scientist- Climate Modeling, CCCDM, Anna University & **Mrs. K. Sathyapriya,** Project Associate, Climate Modeling, CCCDM, Anna University
SESSION – V: Risk and Vulnerability Assessment on Agriculture & Demonstration of crop modelling- Cereals	
3:00 - 3:45 P.M	**Dr S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai
3:45 – 4.00 P.M	**TEA BREAK**
SESSION – VI: Case studies - Climate change Adaptation in Agriculture	
4.00 – 5.00 P.M	**Dr.R. Rengalakshmi** Director, Ecotechnology, MSSRF

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 2 (October 13, 2023)	
SESSION – VII: Risk and vulnerability Assessment on Agriculture	
9:30 – 10:30 A.M	**Dr. K. Alagusundharam**, Chief Executive Officer, Tamil Nadu Food Processing & Agri Export Promotion Corporation (TNAPEx)
SESSION – VIII: Climate Change Impact on agriculture and food supply	
10:30-11:15 A.M	**Dr. A. Merlin Sheela**, Associate Professor (Sr. Grade), Centre for Environmental Studies, Anna University, Chennai
11:15 – 11:30 A.M	**TEA BREAK**
SESSION –IX: Climate Risk on water resources in Tamil Nadu	
11:30-12:00 A.M	**Dr L. Balaji, Project Scientist**-Water resources, CCCDM, Anna University **&** **Dr. R. Malarvizhi Project Associate**-Water resources, CCCDM, Anna University
SESSION –X: Risk and Vulnerability Assessment on Agriculture - Millets, Pulses	
12:00-1:15 A.M	**Dr. S. Pavithrapriya** Project Scientist-Agriculture, CCCDM, Anna University, Chennai **&** **Mr. P. Praveenkumar** Project Associate-Agriculture, CCCDM, Anna University, Chennai
1:15 – 2.15 P.M	**LUNCH**
SESSION – X: Interactive Portal - Hands-on Training at Climate Studio	
2:15 – 3.30 P.M	**Dr. S. Pavithrapriya** Project Scientist-Agriculture, CCCDM, Anna University, Chennai **&** **Mr. P. Praveenkumar** Project Associate-Agriculture, CCCDM, Anna University, Chennai
3.00 – 3.30 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.15 - 5.00 P.M	

வேளாண்மை மற்றும் உழவர் நலத்துறை

அனுப்புநர்
முனைவர். இல. சுப்பிரமணியன். இ.ஆ.ப.,
வேளாண்மை ஆணையர்,
சேப்பாக்கம், சென்னை–5.

பெறுநர்
இயக்குநர்,
சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றம்,
தரைதளம் பனகல் கட்டிடம்,
சைதாபேட்டை, சென்னை – 15.

கடித எண். பொது2/ 5218 /2023 , நாள்: 06.10.2023

அய்யா/அம்மையீர்,

பொருள்: வேளாண்மை – சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றத்துறை காலநிலை ஸ்டுடியோவின் "செயல்பாடு திறன் மேம்பாட்டு திட்டம்" தொடர்பாக இரண்டு நாட்கள் பயிற்சிக்கு வேளாண்மை அலுவலர் விபரம் தெரிவித்தல் – தொடர்பாக.

பார்வை: சுற்றுச்சூழல் மற்றும் கால் நிலை மாற்றம் துறை இயக்குனர் அவர்களின் கடித எண் P4/1829/19, DOE&Sec/22, நாள் 17.05.2023 மற்றும் 29.09.2023.

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பார்வையில் காணும் கடிதத்தில் கோரியவாறு, சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றங்கள் காலநிலை ஸ்டுடியோவின் செயல்பாடு திறன் மேம்பாட்டு திட்டம் தொடர்பாக இரண்டு நாட்கள் பயிற்சியில் கலந்து கொள்ள வேண்டி பின்வரும் வேளாண்மை அலுவலர் பெயர், கைபேசி எண் மற்றும் மின்னஞ்சல் முகவரி விவரம் இக்கடிதத்துடன் இணைத்து அனுப்பி வைக்கப்படுகிறது.

இணைப்பு– மேற்கூறியவாறு

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

நகல்
இயக்குநர் (CCCDM),
அண்ணா பல்கலைக்கழகம்,
சென்னை–25

//ஆணைப்படி//

6.10.23

வேளாண்மை துணை இயக்குநர்
(பல்வகை)

06/10/23

வ. எண்	பணிபுரியும் அலுவலகம் மாவட்டம்	வேளாண்மை அலுவலர் பெயர்	கைபேசி எண்	மின்னஞ்சல் முகவரி
1	வேளாண்மை இணை இயக்குநர், தர்மபுரி	திரு. கே. மணிவண்ணன் வேளாண்மை அலுவலர்	9865543110	adagripld@gmail.com
2	வேளாண்மை இணை இயக்குநர், சேலம்	திருமதி. கார்த்திகாயினி வேளாண்மை அலுவலர்	9940213160	adasalem2020@gmail.com
3	வேளாண்மை இணை இயக்குநர், திருச்சி	திரு. கௌதம் வேளாண்மை அலுவலர்	8778342617	agripullampadi@gmail.com
4	வேளாண்மை இணை இயக்குநர், நாகப்பட்டினம்	செல்வி. ந. பிரவீணா வேளாண்மை அலுவலர்	9677816715	ptlnagai@gmail.com
5	வேளாண்மை இணை இயக்குநர், இராமநாதபுரம்	திரு. உ. அம்பேத்குமார் வேளாண்மை அலுவலர்	9952842093	adaramnad22@gmail.com
6	வேளாண்மை இணை இயக்குநர், வேலூர்	திரு. எம். தியாகு வேளாண்மை அலுவலர்	9944599180	Vlr.jda@gmail.com
7	வேளாண்மை இணை இயக்குநர், கரூர்	திருமதி. T. காஞ்சனா வேளாண்மை அலுவலர்	7402296857	adagriculture.krr@gmail.com
8	வேளாண்மை இணை இயக்குநர், புதுக்கோட்டை	செல்வி. சி. சிவசங்கரி வேளாண்மை அலுவலர்	9943819096	atmapdkmki@gmail.com
9	வேளாண்மை இணை இயக்குநர், திருநெல்வேலி	திருமதி.என்.சண்முகாசிகா வேளாண்மை அலுவலர்	9442472312	ada_kalakad@yahoo.in
10	வேளாண்மை இணை இயக்குநர், தென்காசி	திரு. செ. மணிமொழியன் வேளாண்மை அலுவலர்	9677365699	jdagritenkasi@gmail.com
11	வேளாண்மை இணை இயக்குநர், திருப்பூர்	திரு. சுனில் கௌசிக் வேளாண்மை அலுவலர்	8778248584	adappmt@gmail.com
12	வேளாண்மை இணை இயக்குநர், திருவள்ளூர்	திரு. சி. முனியப்பன் வேளாண்மை அலுவலர்	6380763879	adasvm67@gmail.com
13	வேளாண்மை இணை இயக்குநர், திண்டுக்கல்	திரு. எஸ். திவாகர் வேளாண்மை அலுவலர்	7904633221	adavdsr@gmail.com
14	வேளாண்மை இணை இயக்குநர், மதுரை	திருமதி. எம். கனிமொழி வேளாண்மை அலுவலர்	9787104021	jdagrimdu@gmail.com
15	வேளாண்மை இணை இயக்குநர், நாமக்கல்	திரு. கே. ரஞ்சித் ராஜா வேளாண்மை அலுவலர்	8903671579	adappm@gmail.com

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

//ஆணைப்படி//

6.10.23

வேளாண்மை துணை இயக்குநர்
(பல்வகை)

06/10/23

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
12th & 13th October 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

ATTENDENCE SHEET

S.NO.	Name	Designation	12/10/2023		13/10/2023	
			FN	AN	FN	AN
8	Ambeth Kumar. U	Agricultural Officer				
9	Karthikayini. B	Agricultural Officer				
10.	Gautham. M	Agricultural Officer				
11.	~~Sanmugasika. N~~ SHUNMUGA SPRIYA. N	Agricultural Officer				
12.	Manimozhian. S	Agricultural Officer				
13.	Sunil Kousik. J	Agricultural Officer				
14.	Muniyappan. C	Agricultural Officer				
15.	Singaravel.S	Agricultural Officer				

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
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12th & 13th October 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

ATTENDENCE SHEET

S.NO.	Name	Designation	12/10/2023		12/10/2023	
			FN	AN	FN	AN
1.	Manivannan. K	Agricultural Officer	12/10/23	12/10/23	13/10/23	13/10/23
2.	Thivakar. S	Agricultural Officer				
3.	Kanchana. D T Ms	Agricultural Officer	12/10/23	12/10/23	13/10/23	13/10/23
4.	Kanimozhi. M	Agricultural Officer	12.10.23	12.10.23	13.10.23	13.10.23
5.	Praveena. N	Agricultural Officer	12/10/23	12/10/23	13/10/23	13/10/23
6.	Ranjith Raj. K	Agricultural Officer	12/10/23	12/10/23	13/10/23	13/10/23
7.	Sivasankari. C	Agricultural Officer	12/10/23	12/10/23	13/10/23	13/10/23

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 1 (November 9, 2023)	
INAUGURAL SESSION	
9:30 – 9.45 A.M	**REGISTRATION**
9.45 – 10:00 A.M	**Welcome Address** **Prof.Kurian Joseph** Director, CCCDM, Anna University, Chennai
TECHNICAL SESSIONS	
SESSION – I: Climate Change Impacts on Natural resources in Tamil Nadu	
10:00 – 11:00 A.M	**Prof. Dr. A. Ramachandran D.Sc.** Emeritus Professor, CCCDM, Anna University, Chennai
11:00 – 11:15 A.M	**TEA BREAK**
SESSION II Status of Agriculture in Tamil Nadu	
11:15 – 12:15 P.M	**Thiru. S. Sankarasubramaniyan,** Deputy Director, Directorate of Agriculture, Chepauk, Chennai
SESSION – III: Climate Risk and Sustainable Agriculture	
12:15– 1:15 P.M	**Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University, Chennai
1:15 – 2:15 P.M	**LUNCH**
SESSION – IV: Climate Modelling and Projection	
2:15 – 3:00 P.M	**Dr R. Geetha,** Project Scientist- Climate Modeling, CCCDM, Anna University & **Mrs. K. Sathyapriya,** Project Associate, Climate Modeling, CCCDM, Anna University
SESSION – V: Climate Risk on water resources in Tamil Nadu	
3:00 - 3:45 P.M	**Dr L. Balaji, Project Scientist**-Water resources, CCCDM, Anna University **&** **Dr. R. Malarvizhi Project Associate-**Water resources, CCCDM, Anna University
3:45 – 4.00 P.M	**TEA BREAK**
SESSION – VI: Risk and Vulnerability Assessment on Agriculture & Demonstration of crop modelling- Cereals	
4.00 – 5.00 P.M	**Dr S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 2 (November 10, 2023)	
SESSION – VII: Climate Change Impact on agriculture and food supply	
9:30 – 10:30 A.M	**Dr. A. Merlin Sheela**, Associate Professor (Sr. Grade), Centre for Environmental Studies, Anna University, Chennai
SESSION – VIII: Risk and Vulnerability Assessment on Agriculture - Millets, Pulses	
10:30-11:00 A.M	**Dr. S. Pavithrapriya** Project Scientist-Agriculture, CCCDM, Anna University, Chennai **&** **Mr. P. Praveenkumar** Project Associate-Agriculture, CCCDM, Anna University, Chennai
11:00 – 11:15 A.M	**TEA BREAK**
SESSION –IX: Interactive Portal - Hands-on Training at Climate Studio	
11:15-12:15 A.M	**Dr. S. Pavithrapriya** Project Scientist-Agriculture, CCCDM, Anna University, Chennai **&** **Mr. P. Praveenkumar** Project Associate-Agriculture, CCCDM, Anna University, Chennai
SESSION –X: Case studies - Climate change Adaptation in Agriculture	
12:00-1:15 A.M	**Dr.R. Rengalakshmi** Director, Ecotechnology, MSSRF
1:15 – 2.15 P.M	**LUNCH**
SESSION – X: Climate Adaptation intiatives and Opportunities for Agriculture Sector	
2:15 – 3.30 P.M	**Dr. S. Nagoor Ali Jinnah** Former Chief General Manager, NABARD
3.30 – 4.00 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.00 - 5.00 P.M	

வேளாண்மை மற்றும் உழவர் நலத்துறை

அனுப்புநர்
முனைவர். இல. சுப்பிரமணியன். இ.ஆ.ப.,
வேளாண்மை ஆணையர்,
சேப்பாக்கம், சென்னை–5.

பெறுநர்
இயக்குநர்,
சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றம்,
தரைதளம் பனகல் கட்டிடம்,
சைதாபேட்டை, சென்னை – 15.

கடித எண். பொது2/ 5218 /2023 , நாள்: 02.11.2023

அய்யா/அம்மையீர்,

பொருள்: வேளாண்மை – சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றத்துறை காலநிலை ஸ்டுடியோவின் "செயல்பாடு திறன் மேம்பாட்டு திட்டம்" தொடர்பாக இரண்டு நாட்கள் பயிற்சிக்கு வேளாண்மை அலுவலர் விபரம் தெரிவித்தல் – தொடர்பாக.

பார்வை: சுற்றுச்சூழல் மற்றும் கால் நிலை மாற்றம் துறை இயக்குனர் அவர்களின் கடித எண் PCCCDM/CS/Capacity Building/Agriculture/2023, நாள் 19.10.2023.

.....

பார்வையில் காணும் கடிதத்தில் கோரியவாறு, சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றங்கள் காலநிலை ஸ்டுடியோவின் செயல்பாடு திறன் மேம்பாட்டு திட்டம் தொடர்பாக 09.11.2023 மற்றும் 10.11.2023 ஆகிய இரண்டு நாட்கள் பயிற்சியில் கலந்து கொள்ள வேண்டி பின்வரும் வேளாண்மை அலுவலர் பெயர், கைபேசி எண் மற்றும் மின்னஞ்சல் முகவரி விவரம் இக்கடிதத்துடன் இணைத்து அனுப்பி வைக்கப்படுகிறது.

இணைப்பு– மேற்கூறியவாறு

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

நகல்
இயக்குநர் (CCCDM),
அண்ணா பல்கலைக்கழகம்,
சென்னை–25

//ஆணைப்படி//

2.11.23
வேளாண்மை துணை இயக்குநர்
(பல்வகை)

02/11/23

வ. எண்	பணிபுரியும் அலுவலகம் மாவட்டம்	வேளாண்மை அலுவலர் பெயர் (திருவாளர்கள்)	கைபேசி எண்	மின்னஞ்சல் முகவரி
1	வேளாண்மை இணை இயக்குநர், அரியலூர்	க. சுப்பிரமணியன் வேளாண்மை அலுவலர்	8072646160	jdaariyalur@gmail.com
2	வேளாண்மை இணை இயக்குநர், கடலூர்	A ஆதவன் வேளாண்மை அலுவலர்	7904014247	adacud2023@gmail.com
3	வேளாண்மை இணை இயக்குநர், ஈரோடு	K.E. சிவபிரகாஷ் வேளாண்மை அலுவலர்	9489490095	adagopi123@gmail.com
4	வேளாண்மை இணை இயக்குநர், கள்ளக்குறிச்சி	A. பாபு வேளாண்மை அலுவலர்	9789488334	adakkivpm@gmail.com
5	வேளாண்மை இணை இயக்குநர், கிருஷ்ணகிரி	S. பிரியதஷ்ணி வேளாண்மை அலுவலர்	8754320752	jdakrishnagiri2018@gmail.com
6	வேளாண்மை இணை இயக்குநர், மயிலாடுதுறை	வி.சுகன்யா வேளாண்மை அலுவலர்	8072220767	adasirkali@gmail.com
7	வேளாண்மை இணை இயக்குநர், பெரம்பலூர்	A.சண்முக சுந்தரம் வேளாண்மை அலுவலர்	9677799938	jdapblr@gmail.com
8	வேளாண்மை இணை இயக்குநர், இராணிபேட்டை	R.அசோக் வேளாண்மை அலுவலர்	8870932819	ranipetjda@gmail.com
9	வேளாண்மை இணை இயக்குநர், தஞ்சாவூர்	D.கண்ணன் வேளாண்மை அலுவலர்	9095581534	pdatmatnj@gmail.com
10	வேளாண்மை இணை இயக்குநர், திருவண்ணாமலை	S. பிரியங்கா வேளாண்மை அலுவலர்	8610105879	adakpt12@gmail.com
11	வேளாண்மை இணை இயக்குநர், திருவாரூர்	R.சுரேஷ் குமார் வேளாண்மை அலுவலர்	8754629397	adandm2010@gmail.com
12	வேளாண்மை இணை இயக்குநர், தூத்துக்குடி	S.ரோஹித் ராஜ் வேளாண்மை அலுவலர்	8056764148	adattn2021@gmail.com
13	வேளாண்மை இணை இயக்குநர், திருப்பத்தூர்	S.வேலு வேளாண்மை அலுவலர்	9489923724	adamadhanur@gmail.com
14	வேளாண்மை இணை இயக்குநர், விழுப்புரம்	விஜயகுமார் வேளாண்மை அலுவலர்	8838270265	adakoliyanur2@gmail.com
15	வேளாண்மை இணை இயக்குநர், விருதுநகர்	A. அருள் மொழி வேளாண்மை அலுவலர்	9790650934	adakariyapatti@gmail.com

ஒம்/– இல.சுப்பிரமணியன்
வேளாண்மை ஆணையர்

//ஆணைப்படி//

2-11-23

வேளாண்மை துணை இயக்குநர்
(பல்வகை)

02/11/23

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
22nd & 23rd February 2024
CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
1.	S. Tamilmani	Agricultural Officer	Ariyalur	7502821228	thamizhbreeder12@gmail.com	
2.	D. Ayyappan	Agricultural Officer	Chengalpattu	9655193684	ayyappan.tamirasu@gmail.com.	
3.	I. Jayanthi	Agricultural Officer	Cuddalore	8754249075	jayheartmn@gmail.com	
4.	M. Jeevakala	Agricultural Officer	Dharmapuri	9865754526	jeevakalaagri@gmail.com	
5.	N. Ponnurasan	Agricultural Officer	Kallakurichi	9585185309	Ponspaddy@gmail.com	
6.	C. Bharathi	Agricultural Officer	Kanchipuram	7639846418	bharathi98chinna@gmail.com	
7.	A. Aero Soniya Fred	Agricultural Officer	Krishnagiri	8248455322	aerosonia@gmail.com	22.2.2024

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
22nd & 23rd February 2024
CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
8.	V. Kalaiselvan	Agricultural Officer	Namakkal	8610071491.	Vkalai2612@gmail.com	22/02/2024
9.	T. Venkateswaran	Agricultural Officer	Perambalur	8807529574	vishnuagri24@gmail.com	22/2/24
10.	A. Sathiyaseelan	Agricultural Officer	Ranipet	9843510679	sathiyaseelan subhashini@g.mail.com	
11.	A. Anbalagan	Agricultural Officer	Salem	9489240427	a.anbu20@gmail.com	22/2/24
12.	C. Kavitha	Agricultural Officer	Thiruvallur	9578709246	Kavisek2004@gmail.com	22/02/24
13.	A. Vasanthakumar	Agricultural Officer	Tiruvannamalai	8248323903	Vasanthakumar1903199@gmail.com	22/02/24
14.	M. Thiyagu	Agricultural Officer	Vellore	9944599180	saossluovlr@gmail.com	22/02/24
15.	R. Prabhusankar	Agricultural Officer	Villupuram	9786224913	Sankarpbt@gmail.com	22/02/2024

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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

9th and 10th November 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Email ID	Phone No.	Signature
1.	K.Subramanian	Agricultural Officer, Ariyalur	o/o Joint director of agriculture Ariyalur Dt. 621704	jdaariyalur@gmail.com	8072646160	
2.	A.Aathavan	Agricultural Officer, Cuddalore	O/o Assistant Director of Agriculture cuddalore (DT)	adacud2023@gmail.com	7904014247	9/11
3.	K.E. Sivaprakash	Agricultural Officer, Erode	O/o Assisstant Director of Agriculture Gobichettipalayam Erode (Dt)	adagopi123@gmail.com	9489490095	9/11/23
4.	A. Babu	Agricultural Officer, Kallakurichi	O/o Assistant Director of Agricultural Kallakurichi Kallakurichi (Dt)	adakkivpm@gmail.com	9789488334	9/11/23
5.	S.Priyatharsini	Agricultural Officer, Krishnagiri	O/o Joint director of Agriculture Integrated Agri complex Krishnagiri	jdakrishnagiri2018@gmail.com	8754320752	
6.	V.Suganya	Agricultural Officer, Mayiladuthurai	O/o Assistant Director of Agriculture, Sirkali Mayiladuthurai (dt)	adasirkali@gmail.com	8072220767	9/11/23
7.	A.Shanmugasundaram	Agricultural Officer, Perambalur	O/o Joint director of Agriculture Integrated Agri Complex. Perambalur	jdapblr@gmail.com	9677799938	

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

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9th and 10th November 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Email ID	Phone No.	Signature
8.	R. Ashok	Agricultural Officer, Ranipet	O/o Assistant director of Agriculture, Arakkonam block.	.ranipetjda@gmail.com	8870932819	09/11/23
9.	D.Kannan	Agricultural Officer, Thanjavur	O/o. Joint Director of Agriculture, Kattuthottam Thanjavur	pdatmatnj@gmail.com	9095581534	09/11/2023
10.	S.Priyanka	Agricultural Officer, Thiruvannamalai	O/o Assistant Director of Agriculture, Kilpennathur Tiruvannamalai - 604 601	adakpt12@gmail.com	8610105879	9/11/23
11.	R. Sureshkumar	Agricultural Officer, Thiruvarur	O/o Asst. Director of Agriculture. Naadamangalam Thiruvarur - 614404	adandm2010@gmail.com	8754629397	09/11/2023
12.	~~S. Rohith Raj~~ S. Rohithraj	Agricultural Officer, Thoothukudi	O/o Assitant Director of Agriculture Thoothukudi @ Pudukottai	adattn2021@gmail.com	8056764148	09/11/2023
13.	S. Velu	Agricultural Officer, Tirupathur	O/o ASST. Director of Agriculture Madhanur Block Thirupathur 635 804	adamadhanur@gmail.com	9489923724	9.11.23
14.	M.Vijay	Agricultural Officer, Villupuram	O/O Assistant Director of Agriculture, Kandamangalam Villupuram - 605102.	adakdm.tnvpm@gmail.com	86103 44221	09/11/23.
15.	A. Arulmozhi	Agricultural Officer, Viruthunagar	O/o Assistant director of Agriculture, Kariapatti Virudhunagar - 626106.	adakariyapatti@gmail.com	9790650934	9/11/23.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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9th and 10th November 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

ATTENDANCE SHEET

S.NO.	Name	Designation	09/11/2023		10/11/2023	
			FN	AN	FN	AN
1.	S. Priyatharsini	Agricultural officer				
2.	R. Suresh kumar	Agricultural officer				
3.	D. Kannan	Agricultural officer	09/11/2023	09/11/2023	10/11/2023	10/11/2023
4.	K.E. Sivaprakash	Agricultural officer	9/11/23	9/11/23	10/11/23	10/11/23
5.	A. Arulmozhi	Agricultural Extension Officer	9/11/23.	9/11/23.	10/11/23	10/11/23.
6.	S. Priyanka	Agricultural officer	9/11/23	9/11/23	10/11/23	10/11/23
7.	M. Vijay	Agriculture officer	9/11/23.	9/11/23.	10/11/23	10/11/23.

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT

Operationalization of Climate Studio

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

9th and 10th November 2023

CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

ATTENDANCE SHEET

S.NO.	Name	Designation	09/11/2023		10/11/2023	
			FN	AN	FN	AN
8.	A. Aathavan	Agricultural officer	9/11	9/11	10/11	10/11
9.	A. Shanmugasundaram	Agricultural officer	9.11.23	9.11.23	10.11.23	10.11.23
10.	K. Subramanyan	Agril. officer (RO)	9.11.23	9/11/23	10/11/23	10/11/23
11.	A. Babu	Agril. officer	9/11/23	9/11/23	10/11/23	10/11/23
12.	S. VEW	Agrl. officer	09.11.23	09.11.23	10.11.23	10.11.23
13.	R. ASHOK.	Agri officer	09/11/23	09/11/23	10/11/23	10/11/23
14.	V. Suganya	Agricultural officer	9/11/23	9/11/23	10/11/23	10/11/23
15.	S. Rohithraj	Agricultural Officer	09/11/2023	09/11/2023	10/11/2023	10/11/2023

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

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

Agenda

Day 1 (Feburary 22, 2024)	
INAUGURAL SESSION	
9:30 – 9.45 A.M	**REGISTRATION**
9.45 – 10:00 A.M	**Welcome Address** **Prof. Dr. Kurian Joseph** Director, CCCDM, Anna University, Chennai
TECHNICAL SESSIONS	
SESSION – I: An Outlook of Climate Change Research in Tamil Nadu	
10:00 – 11:00 A.M	**Prof. Dr. A. Ramachandran D.Sc.** Emeritus Professor, CCCDM, Anna University, Chennai
11:00 – 11:30 A.M	**TEA BREAK**
SESSION – II: Status of Agriculture in Tamil Nadu	
11:30 – 12:30 P.M	**Thiru. S. Sankarasubramaniyan,** Deputy Director, Directorate of Agriculture
SESSION – III: Climate Modelling and Projection	
12:30– 1:30 P.M	**Dr. R. Geetha, Project Scientist- Climate Modeling, CCCDM, Anna University &** **Mrs. K. Sathyapriya, Project Associate, Climate Modeling, CCCDM, Anna Unive**
1:30 – 2:30 P.M	**LUNCH**
SESSION – IV: Climate Risk and Sustainable Agriculture	
2:30 - 3:30 P.M	**Prof. Dr. Kurian Joseph,** Director, CCCDM, Anna University, Chennai
3:30 – 4.00 P.M	**TEA BREAK**
SESSION – V: Risk and Vulnerability Assessment on Agriculture & Demonstration of crop modelling- Cereals	
4.00 – 5.00 P.M	**Dr. S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr. P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN
TAMIL NADU - AGRICULTURE

Day 2 (Feburary 23, 2024)	
SESSION – IV: Climate Risk on water resources in Tamil Nadu	
9:30 – 10:30 A.M	**Dr L. Balaji,** Project Scientist-Water resources, CCCDM, Anna University **&** **Dr. R. Malarvizhi Project Associate**-Water resources, CCCDM, Anna University
SESSION – VII: Risk and Vulnerability Assessment on Agriculture - Millets, Pulses &	
10:30-11:15 AM	**Dr S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai
11:15 – 11:30 A.M	**TEA BREAK**
SESSION – VIII: Interactive Portal - Hands-on Training at Climate Studio	
11:30 – 1:30 P.M	**Dr S. Pavithrapriya** Project Scientist, CCCDM, Anna University, Chennai & **Mr P. Praveenkumar** Project Associate, CCCDM, Anna University, Chennai
1:30 – 2.30 P.M	**LUNCH**
2:30 – 3.30 P.M	**Feedback and Interactive session with participants**
3.30 – 4.00 P.M	**TEA BREAK**
VALEDICTORY SESSION & CERTIFICATE PRESENTATION: 4.00 - 5.00 P.M	

வேளாண்மை மற்றும் உழவர் நலத்துறை

அனுப்புநர்
திரு. பா.முருகேஷ் ,இ.ஆ.ப.,
வேளாண்மை இயக்குநர்,
சேப்பாக்கம், சென்னை-5.

பெறுநர்
இயக்குநர்,
சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றம்.
தரைதளம் பனகல் கட்டிடம்,
சைதாபேட்டை, சென்னை – 15.

கடித எண். பொது 2/ 5218 /2023 , நாள்: 20.02.2024

அய்யா/அம்மையீர்,

பொருள்: வேளாண்மை – சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றத்துறை காலநிலை ஸ்டுடியோவின் "செயல்பாடு திறன் மேம்பாட்டு திட்டம்" தொடர்பாக இரண்டு நாட்கள் பயிற்சிக்கு வேளாண்மை அலுவலர் விபரம் தெரிவித்தல் – தொடர்பாக.

பார்வை: சுற்றுச்சூழல் மற்றும் கால் நிலை மாற்றம் துறை இயக்குனர் அவர்களின் கடித எண் CCCDM/CS/Capacity Building/Agriculture/2024, நாள். 09.02.2024.

.....

பார்வையில் காணும் கடிதத்தில் கோரியவாறு. சுற்றுச்சூழல் மற்றும் காலநிலை மாற்றங்கள் காலநிலை ஸ்டுடியோவின் செயல்பாடு திறன் மேம்பாட்டு திட்டம் தொடர்பாக 22.02.2024 மற்றும் 23.02.2024 ஆகிய இரண்டு நாட்கள் பயிற்சியில் கலந்து கொள்ள வேண்டி பின்வரும் வேளாண்மை அலுவலர் பெயர், கைபேசி எண் மற்றும் மின்னஞ்சல் முகவரி விவரம் இக்கடிதத்துடன் இணைத்து அனுப்பி வைக்கப்படுகிறது.

இணைப்பு- மேற்கூறியவாறு

ஒம்/- பா.முருகேஷ்
வேளாண்மை இயக்குநர்

நகல்
இயக்குநர் (CCCDM),
அண்ணா பல்கலைக்கழகம்,
சென்னை-25

//ஆணைப்படி//

வேளாண்மை கூடுதல் இயக்குநர்
(அயம்வாம்)

வ. எண்	பணிபுரியும் அலுவலகம் மாவட்டம்	வேளாண்மை அலுவலர் பெயர் (திருவாளர்கள்)	கைபேசி எண்	மின்னஞ்சல் முகவரி
1	வேளாண்மை இணை இயக்குநர், அரியலூர்	S. தமிழ்மணி வேளாண்மை அலுவலர் ஜெயங்கொண்டம் வட்டாரம்	7502821228	adajkmblock@gmail.com
2	வேளாண்மை இணை இயக்குநர், செங்கல்பட்டு	D. ஐயப்பன் வேளாண்மை அலுவலர் பவுஞ்சூர் வட்டாரம்	9655193684	adapvjr2021@gmail.com
3	வேளாண்மை இணை இயக்குநர், கடலூர்	I. ஜெயந்தி வேளாண்மை அலுவலர் மேல்புவனகிரி வட்டாரம்	8754249075	adambvg2024@gmail.com
4	வேளாண்மை இணை இயக்குநர், தர்மபுரி	M. ஜீவகலா வேளாண்மை அலுவலர் பாப்பிரெட்டிபட்டி வட்டாரம்	9865754526	adapapagri2023@gmail.com
5	வேளாண்மை இணை இயக்குநர், கள்ளக்குறிச்சி	N. பொன்னுராசன் வேளாண்மை அலுவலர் கள்ளக்குறிச்சி வட்டாரம்	9585185309	adakkivpm@gmail.com
6	வேளாண்மை இணை இயக்குநர், காஞ்சிபுரம்	C. பாரதி வேளாண்மை அலுவலர் காஞ்சிபுரம் வட்டாரம்	7639846418	adasirukaveripakkam2022@gmail.com
7	வேளாண்மை இணை இயக்குநர், கிருஷ்ணகிரி	A. ஏரொ சோனியா ஃபெரட் வேளாண்மை அலுவலர் கிருஷ்ணகிரி வட்டாரம்	8248455322	jdakrishnagiri2018@gmail.com
8	வேளாண்மை இணை இயக்குநர், நாமக்கல்	V. கலைசெல்வன் வேளாண்மை அலுவலர் நாமக்கல் வட்டாரம்	8610071491	adaagrinkl@gmail.com
9	வேளாண்மை இணை இயக்குநர், பெரம்பலூர்	T. வெங்கடேஷ்வரன் வேளாண்மை அலுவலர் பெரம்பலூர் வட்டாரம்	8667000272	jdapblr@gmail.com
10	வேளாண்மை இணை இயக்குநர், இராணிப்பேட்டை	A. சத்தியசீலன் வேளாண்மை அலுவலர் அரக்கோணம் வட்டாரம்	9843510679	vlr.ararkonam@gmail.com
11	வேளாண்மை இணை இயக்குநர், சேலம்	P. புஷ்பராணி வேளாண்மை அலுவலர் சேலம் வட்டாரம்	9095020951	adasalem2020@gmail.com
12	வேளாண்மை இணை இயக்குநர், திருவள்ளூர்	C. கவிதா வேளாண்மை அலுவலர் திருவள்ளூர் வட்டாரம்	9578709246	agritlr@gmail.com
13	வேளாண்மை இணை இயக்குநர், திருவண்ணாமலை	வசந்தகுமார் வேளாண்மை அலுவலர் ஜமுனாமரத்தூர், போளூர் வட்டாரம்	8248323903	agritvm@nic.in
14	வேளாண்மை இணை இயக்குநர், வேலூர்	M. தியாகு வேளாண்மை அலுவலர் வேலூர் வட்டாரம்	9944599180	vlr.jda@gmail.com
15	வேளாண்மை இணை இயக்குநர், விழுப்புரம்	R. பிரபுசங்கர் வேளாண்மை அலுவலர் ஓலக்கூர் வட்டாரம்	9786224913	adaolakkur2022@gmail.com

ஒம்/- பா.முருகேஷ்
வேளாண்மை இயக்குநர்

//ஆணைப்படி//

வேளாண்மை கூடுதல் இயக்குநர்
(அயம்வாம்)

CENTRE FOR CLIMATE CHANGE AND DISASTER MANAGEMENT
Operationalization of Climate Studio
Funded by Department of Environment and Climate Change, Government of Tamil Nadu
22nd & 23rd February 2024
CAPACITY BUILDING PROGRAM ON CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU AGRICULTURE

REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
1.	S. Tamilmani	Agricultural Officer	Ariyalur	7502821228	thamizhbreeder12@gmail.com	
2.	D. Ayyappan	Agricultural Officer	Chengalpattu	9655193684	ayyappan.durairasu@gmail.com.	
3.	I. Jayanthi	Agricultural Officer	Cuddalore	8754249075	jayheartmn@gmail.com	
4.	M. Jeevakala	Agricultural Officer	Dharmapuri	9865754526	jeevakalaagri@gmail.com	
5.	N. Ponnurasan	Agricultural Officer	Kallakurichi	9585185309	Ponspaddy@gmail.com	
6.	C. Bharathi	Agricultural Officer	Kanchipuram	7639846418	bharathi98chinna@gmail.com	
7.	A. Aero Soniya Fred	Agricultural Officer	Krishnagiri	8248455322	aeroSonia@gmail.com	22.2.2024

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REGISTRATION FORM

S.NO.	Name	Designation	Office Address	Phone No.	Email ID	Signature
8.	V. Kalaiselvan	Agricultural Officer	Namakkal	8610071491.	Vkalai2612@gmail.com	22/02/2024
9.	T. Venkateswaran	Agricultural Officer	Perambalur	8807529574	vishnuagri24@gmail.com	22/2/24
10.	A. Sathiyaseelan	Agricultural Officer	Ranipet	9843510679	sathiyaseelan subhashini@g.mail.com	
11.	A. Anbalagan	Agricultural Officer	Salem	9489240427	a.anbu20@gmail.com	22/2/24
12.	C. Kavitha	Agricultural Officer	Thiruvallur	9578709246	Kavisek2004@gmail.com	22/02/24
13.	A. Vasanthakumar	Agricultural Officer	Tiruvannamalai	8248323903	Vasanthakumar1903199@gmail.com	22/02/24
14.	M. Thiyagu	Agricultural Officer	Vellore	9944599180	saossluovlr@gmail.com	22/02/24
15.	R. Prabhusankar	Agricultural Officer	Villupuram	9786224913	Sankarpbt@gmail.com	22/02/2024

ANNEXURE-II

FEEDBACK FROM PARTICIPANTS

CAPACITY BUILDING PROGRAMME

CLIMATE RISK ASSESSMENT AND ADAPTATION PLAN OF TAMIL NADU - AGRICULTURE

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Training Evaluation

Please tick according to the performance: (✓)

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

Other comments
Please write your comments regarding this training:

Excellent: Dr குரியன் ஜோசப். Director

1) V. good. by Programme organizers. Dr. S. பழனிவேலன் Project Scientist

2) Mr. P. [illegible] - Project Associate.

3) Dr. தீபா. Dr. [illegible]

4) Dr. R. Geetha.

5) Dr. ராமச்சந்திரன். Retd Prof.

அனைத்து supporting staff.

Photographer.

அனைத்து SWG. company staffs.

Attendance [illegible] அனைவருக்கு [illegible]

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Other comments
Please write your comments regarding this training:

This training equipped us with a overview of Climate Risk assessment which is a little new subject to us. The adaptation plan needs a more practical exposure. Training duration can be increased in future. With these two days training the full effort has be done by the faculty. Thank you all.

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Other comments
Please write your comments regarding this training:

This training is really wonderful. and it will be very useful for the farming community and well as the whole world if it is properly followed or adapted.

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

Other comments
Please write your comments regarding this training:

Free Boarding & Lodging may be provided to Location proximity for Training period.

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

Other comments
Please write your comments regarding this training: Excellent. Well Organised training programme. Trainers are good. Overall co-ordination and arrangements are good.

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

Other comments
Please write your comments regarding this training:

Very useful and timely given. But
We are at the verge of retirement (one or two years)
it will be given to the Agricultural Officers.

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

Other comments
Please write your comments regarding this training:

It is the first time training on this subject. Since it is a latest worldwide spoken field, it is very much useful for us to have updated knowledge in this subject for us.

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

Other comments
Please write your comments regarding this training:

This training help us to accomodate and Adapt for the climate risk. It is very new for me, and created interest more on this new aspect. My sincere thanks to all trainers who imparted training for us. Thanking you

(O. VIJAYALAKSHMI)

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

Other comments
Please write your comments regarding this training:

I enjoyed & learnt many things from this training on climate change impact.. I hope the DSSAT and SWAT model for Agril & water for climate would be more useful for the future / upcoming days. All the trainers very well taken the session very well.

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

Other comments
Please write your comments regarding this training:

It is more relevant to the present scenario of our climate change. The application side should be more focused. Overall the training is very usefull.

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

Other comments
Please write your comments regarding this training:

Hostel Regidence would have been arranged for All trainees.

Food and Snacks nice, All trainers are well equiped Satisfied with Trainig.

pendrive literature may be given for our future follow-up.

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

Other comments
Please write your comments regarding this training:

For the hands on exercise, the participants can bring details from the respective CES experiments in the district.

Technologies to be adopted to overcome Climate change and disaster are explained. We need to know the results of these technologies adopted in field level in large scale.

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

Other comments
Please write your comments regarding this training:

Wonderful learning Atmosphere.

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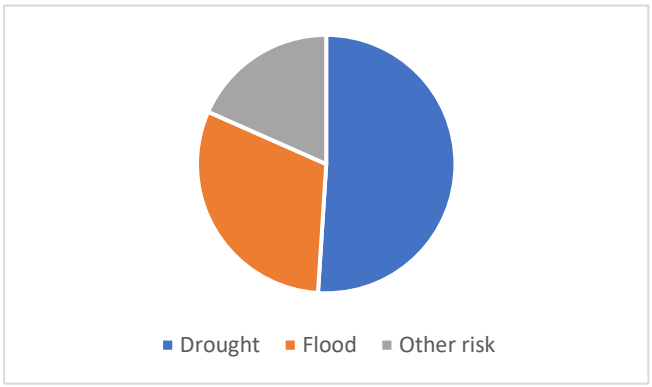
Training Venue and its Hospitality	1 (Excellent) ✓	2 (Good)	3 (Fair)	4 (Not Satisfactory)

Other comments
Please write your comments regarding this training:

Very useful and innovative

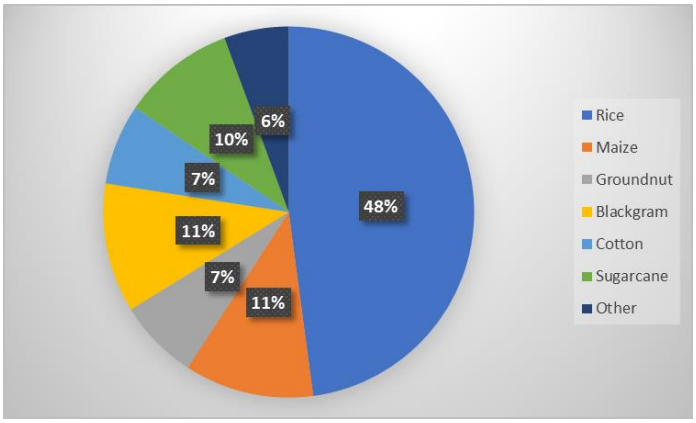
FEEDBACK –ADAPTATION ACTIONS AT DISTRICT LEVEL

1. *What are all the Climate risks affecting agriculture?*



Flood during the North east monsoon and drought during the south monsoon. Pest and disease due to flood and drought it affects the crop yield.

2. *Which crops are most affected by climate change in Tamil Nadu?*



Based on the participant's feedback, Rice is highly vulnerable to climate change followed by Maize, Black gram, Sugarcane, Groundnut and other crops (Redgram and vegetables)

3. *How to improve the productivity of crops at district level?*

1. Crop management practices- water, soil nutrient management. Fertilizer application dosage and IPM technologies
2. Optimum use of fertilizer, water, proper drainage facilities, integrated pest and disease management
3. Intensive cultivation

4. Micro irrigation, Fertigation
5. Drought and flood resistant varieties
6. Soil fertility improvement
7. Adopting high yielding varieties
8. Paddy alternate wetting and Drying, Direct seeded rice
9. Integrated nutrient & pest management & crop change
10. Sustainable agriculture

4. Soil conservation strategies followed at district level

1. Agroforestry, Organic farming
2. Minimum tillage, Soil cover, mulching
3. Integrated Farming system
4. Increase soil fertility through green manure crops and green leaf manure crops
5. Ploughing and raising bunds
6. Increased use of organic manures like leaf manures, growing high, spread rooted crops like vetiver in bunds to avoid erosion
7. Crop rotation, Soil amendments addition, optimum use of chemical fertilizers

8. Water conservation strategies followed at district level?

1. Constructing farm ponds and check dams as water management structures
2. Rain water harvesting
3. Mulching and percolation pond for ground water table rises
4. Interlinking of small lakes and rivers
5. Encouraging the growth of palm trees
6. Utilizing earthen bunds for water retention and growing water-efficient crops for water conservation
7. Micro irrigation

9. Climate profiling of agronomic practices followed at district level?

1. Crop rotation
2. Changing the sowing date
3. Changing the cropping pattern
4. Direct seeding of rice cultivation in Thanjavur, Madurai, Thiruvarur, Pudukkottai, Villupuram, Tirunelveli and Pudukkottai

5. Mixed cropping
6. Convert the rice to millets in Tirunelveli, Thiruvannamalai and Ariyalur
7. Maize and Pulses are converted into coconut plantation crop

10.What are the gaps in policies & programmes for climate risks related to agriculture?

1. Farmers unable to follow up the adaptation strategies
2. Develop policies and programs that are tailored to the specific needs of farmers
3. Create solutions that are context-specific and responsive to the diverse needs of farmers
4. Individual field level insurance
5. Strengthening the infrastructure of agricultural markets by providing more storage facilities, better transportation, and better communication systems. Enhancing the extension services provided to farmers, such as training, advice, and support.

11.Suggested future adaptation actions at district level?

1. Future assessment of weather-based prediction needed
2. Enhance awareness of climate change issues among all Tamil Nadu departments
3. Advanced weather forecasts should inform seasonal cropping programs to optimize crop selection and avoid the cultivation of flood-incompatible crops like millets, pulses, and oilseeds
4. Implementing and Monitioring of agricultural scheme in the Village-level.
5. Developing flood and drought tolerant varieties
6. Establish a climate management cell at the district level
7. Enhancing groundwater storage
8. Incorporating a multi-level cropping approach
9. Strategically rotating crops to enhance resilience to drought and flood stresses

*11.**Please write your comments regarding this training:***

1. More practical and models are interested and new and sessions was good
2. Good. But not enough time to deliver the message.
3. 5 days training is required to get the knowledge
4. Training is very useful; it gives an eye opener for the impact of climate changes in future agriculture
5. This training gave us a better awareness about climate change impacts
6. Very informative and need of the hour a good initiative

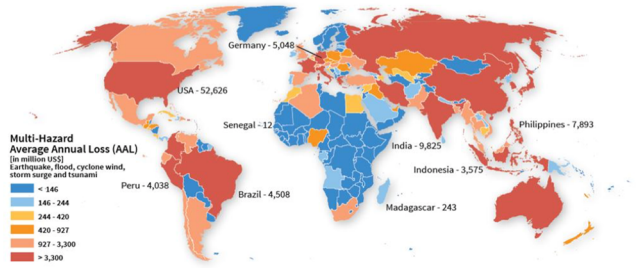
ANNEXURE-III

LECTURE DETAILS

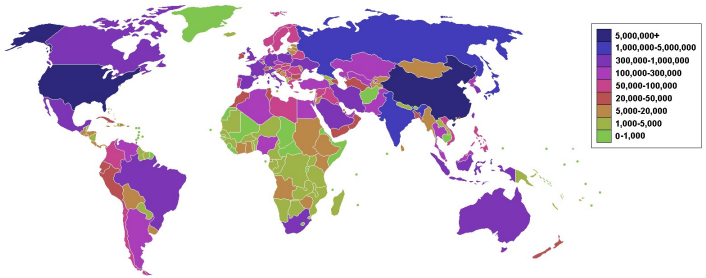
Climate change and Natural resources

Prof A.RAMACHANDRAN D.Sc
Anna University

Disasters and Risky world



Country wise CO_2 Emissions

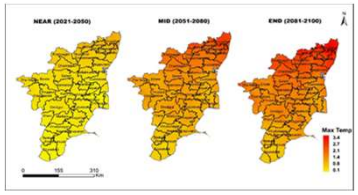


(In thousands of tonnes per annum)

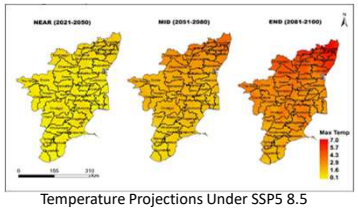
Origin of Problem - Increased GHGs

Period	Atmospheric Concentration		
	CO_2	Methane	NO_X
Before 1800 AD	280 PPM	750 PPB	270 PPB
1800 AD	300 PPM	775 PPB	280 PPB
2023 AD	420 PPM	1650 PPB	310 PPB

Maximum Temperature Projections for Tamil Nadu Under SSP2-4.5 (MID PATHWAYS) and SSP5 8.5 (BUSINESS AS USUAL) Scenarios



Temperature Projections Under SSP2 4.5



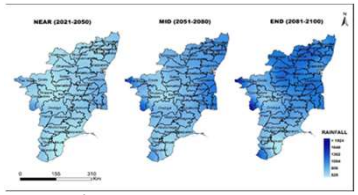
Temperature Projections Under SSP5 8.5 Scenario

Projection Period	Increase in Annual Maximum Temperature With reference to baseline (ºC)	
	SSP2 4.5 Scenario	SSP5 8.5 Scenario
Near Century (2021-2050)	0.4	0.6
Mid Century (2051-2080)	1.3	1.7
End Century (2081-2100)	1.7	3.5

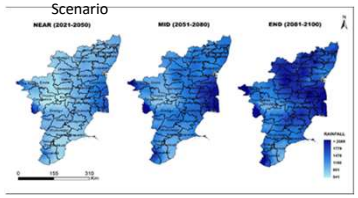
- The northern districts such as Chennai, Nagapattinam and Kanyakumari and Mayiladuthurai is projected to have maximum increase by the end of the century

5

Annual Rainfall Projections for Tamil Nadu Under SSP2-4.5 (MID PATHWAYS) and SSP5 8.5 (BUSINESS AS USUAL) Scenarios



Rainfall Projections Under SSP2 4.5 Scenario



Rainfall Projections Under SSP5 8.5

Projection Period	Increase in Annual Rainfall (%)	
	SSP2 4.5	SSP5 8.5
Near Century (2021-2050)	4	7
Mid Century (2051-2080)	11	18
End Century (2081-2100)	16	26

- The coastal districts such as Cuddalore, Nagapattinam and Kanyakumari and Mayiladuthurai is projected to have maximum increase by the end of the century

6

Final Vulnerability Assessment will be drawn indexing with SDG 231 Indicators under 17 Goals

- Water
  - Flood
  - Drought
  - Ground water depletion
- Agriculture
  - Crop yield
  - Crop shift
  - pest
- Forest & biodiversity
  - Species migration and shift
  - Forest fire
- Sea &Coastal
  - Sea level rise
  - Acidification
  - Salinity
  - Coastal ecosystem
- Health
  - Vector borne disease
  - Viral and bacterial disease
  - Heat stress







Conclusion

- Futuristic Adaptation Measures
- Flexible financial mechanism for Agriculture
- Dissemination of knowledge on climate change
- Farmers perception and Indigenous knowledge

CLIMATE RISKS AND SUSTAINABLE AGRICULTURE

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Sustainable Agriculture ???

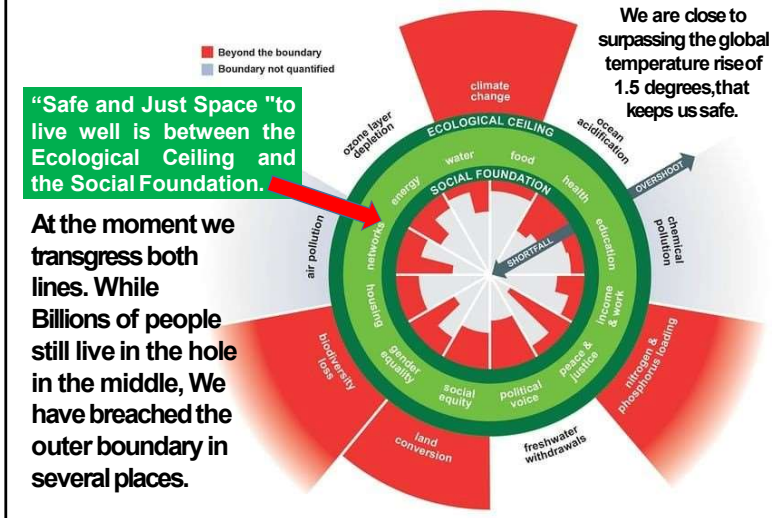
(Food and Agriculture Organisation (FAO, 1992)

"Ensures the basic nutritional requirements of present and future generations, qualitatively and quantitatively, while providing a number of other agricultural products.

Provides durable employment, sufficient income and decent living and working conditions

Maintains and, where possible, enhances the productive capacity of the natural resource base as a whole, and the regenerative capacity of renewable resources, without disrupting the functioning of basic ecological cycles and natural balances, or causing contamination of the environment.

Reduces the vulnerability of the agricultural sector to adverse natural and socio-economic factors and other risks



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

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

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

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

SDGs-A blueprint for a better world by 2030

UNITED NATIONS SUSTAINABLE DEVELOPMENT SUMMIT 2015
25-27 SEPTEMBER

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

A **sustainable food system** (SFS) is a **food system** that delivers **food** security and nutrition for all in such a way that the economic, social and environmental bases to generate **food** security and nutrition for future generations are notcompromised.

Food is lost or wasted along the entire value chain

Production	Handling and Storage	Processing and Packaging	Distribution and Market	Consumption
During or immediately after harvesting on the farm	After leaving the farm for handling, storage, and transport	During industrial or domestic processing and/or packaging	During distribution to markets, including at wholesale and retail markets	In the home or business of the consumer, including restaurants and caterers

Food loss and waste occurs more 'near the fork' in developed regions and more 'near the farm' in developing regions

Source: WRI analysis based on FAO. 2011. *Global food losses and food waste – extent, causes and prevention.* Rome: UN FAO.

WORLD RESOURCES INSTITUTE

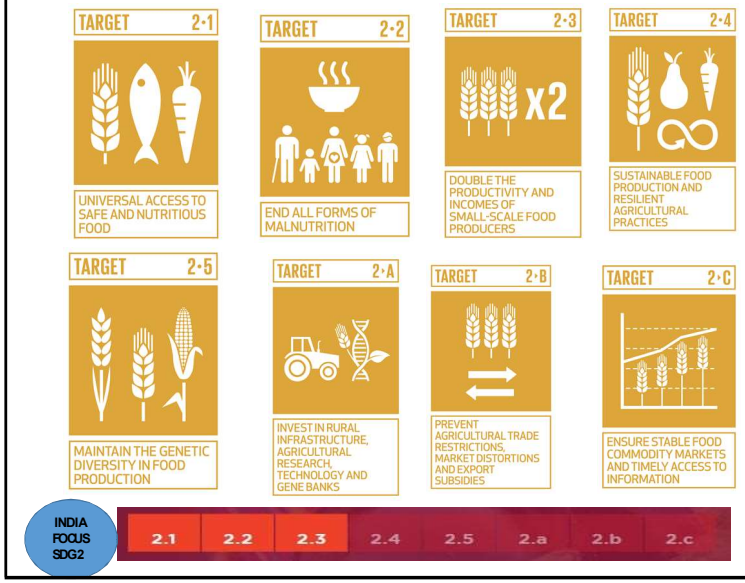
Challenges to Food System Sustainability

ENVIRONMENTAL SUSTAINABILITY	SOCIAL SUSTAINABILITY	ECONOMIC SUSTAINABILITY
• Tackling Climate Change • Protect the environment • Preserve biodiversity • Reduce food losses and waste • Bio-based Circular Economy	• Healthier diets – address underweight/ overweight • Food affordability • Social rights workers in food chain • Improve animal welfare	• Fairer incomes for farmers, fishers & aquaculture producers • New business & job opportunities • Just transition (Leave no one behind)

What you eat is healthy for you

What you eat supports local economy

What you eat has been produced in a way that minimises waste



SDG2 –Four national Level Indicators

National Level Indicators	2030 target	Current Status
Food Subsidy : Ratio of rural households covered under public distribution system to rural households where monthly income of highest earning member is less than Rs.5,000	1.29	1
Stunting: Percentage of children under age 5 years who are stunted	21.03	38.4
Anaemia among women: Percentage of pregnant women aged between 15 & 49 years are anaemic in India	23.5	50
Agricultural Productivity: Rice, wheat and coarse cereals produced annually per unit area (kg/Ha)	5,018	2509

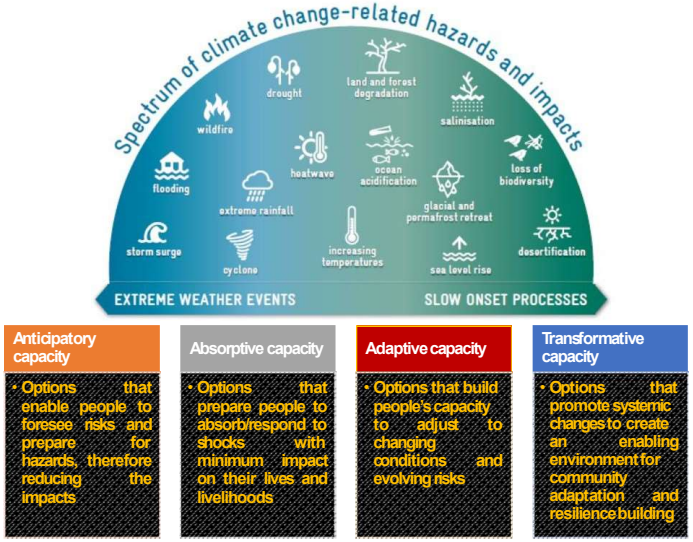
2030 Targets for sustainable food production

Reduce by 50% the overall use and risk of chemical pesticides and reduce use by 50% of more hazardous pesticides

Reduce nutrient losses by at least 50% while ensuring no deterioration in soil fertility; this will reduce use of fertilisers by at least 20%

Reduce sales of antimicrobials for farmed animals and in aquaculture by 50%

Achieve at least 25% agricultural land under organic farming and a significant increase in organic aquaculture



Climate Risk

= PROBABILITY OF A HARMFUL CLIMATE EVENT OR TREND x IMPACT

Hazard (likelihood x magnitude) x Exposure x Vulnerability

Sensitivity - Adaptive capacity

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

Building Agricultural Resilience

Enhanced understanding of the role of natural resource base (water and soil)

Understand Potential Exposures : Focus on extremes as well as mean changes

Understand Sensitivities :Define critical thresholds & interactions

Enhance Adaptive Capacity : Climate-ready crops & production systems

Agriculture and Climate Risk

Agriculture account for 17% of global GHG emissions.

Agriculture sector is both driving Global Warming and facing high risks linked to climate change.

Improving the resilience of agricultural systems to climate change requires protection of the natural resource base (water & soil) and development of new strategies, tools, and practices for adaptation

Increased Biotic Stresses Will Significantly Affect Agriculture

Insect pests

- Greater numbers, increased insecticide resistance
- Geographic ranges increases & decreases
- Imports from foreign sources

Pathogens

- Host-pathogen response changes (plants, insects, non-crop reservoirs)
- Cultural control measures may be less reliable
- Extreme events can spread

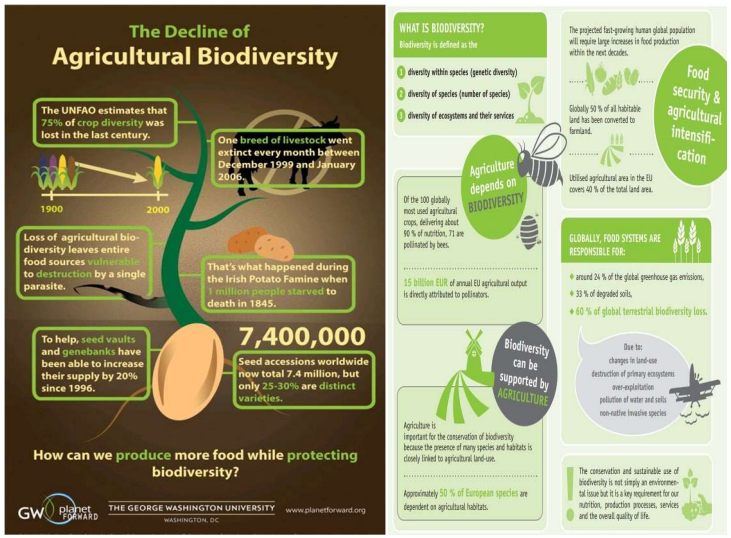
- **Weeds**
  - Increased vigor, herbicide resistance
  - Geographic range increases & decreases

Features of Modern Agricultural Systems

- **Favor large farms, new seed varieties,** crop **monocultures** and **mechanisation,** often at the expense of ecological principles.
- **Requires higher inputs of pesticides and herbicides** to guarantee against crop failure.
- **Reduces the amount of organic matter returned to the soil,** decreasing productivity over time, whilst the leaching of nutrients creates a vicious circle demanding more and more fertilisers
- **Water quality is affected by agricultural activities**, fertiliser and pesticide runoff, salinisation and alkalinisation, and through other toxic substances which bio-accumulate affecting human health.

AGRICULTURE -SUSTAINABILITY PROBLEMS

Socio-Economic Dislocations	Agricultural and agro-industrial residues	Mismanagement & Misuse of Technology
• Diminishing returns to intensive production • Unstability of the market • Unfair competition • Induced inequalities • Demographic dislocations • Health and safety hazards	• Excessive use of fertilizers and pesticides • Plastic and other debris in marine systems • Other toxic and non-toxic wastes	• Heavy use of inputs, energy and chemicals • Building of resistance in insect species • Elimination of natural enemies • Faulty construction and management of services • Faulty allocation of land



KEY PRINCIPLES FOR SUSTAINABILITY IN FOOD AND AGRICULTURE

- **Improve efficiency in the use of resources**
  - Optimizing water use in agriculture
  - Increasing nutrient use efficiency in crop production systems
  - Developing precision livestock production systems
  - Reducing food loss and waste throughout the supply chain.
- **Conserve, protect and enhance natural resources**
  - Reducing soil loss and degradation
  - Mobilizing genetic diversity for crop improvement
- **Enhance the resilience of people, communities and ecosystems, especially to climate change and market volatility**
  - Early and rapid detection and prevention of plant and animal diseases
  - Early and rapid detection of foodborne pathogens
- **Protect and improve rural livelihoods, equity, and social well-being**
  - Promote responsible and effective governance mechanisms

Increase productivity, employment and value addition in food systems

- Facilitate access to productive resources, finance and services
- Connect smallholders to markets
- Encourage diversification of production and income
- Build producers' knowledge and develop their capacities

Sustainable agriculture
Efficient use of inputs (Water)

- Improving water conservation and storage measures
- selection of drought tolerant crop species
- using reduced-volume irrigation systems
- managing crops to reduce water loss
- Selection of species and varieties that are well suited to the site and to conditions on the farm;
- Diversification of crops (including livestock) and cultural practices to enhance the biological and economic stability of the farm

- Flood irrigation
  - Simple and cheap
  - 50% of water wasted
- Drip irrigation
  - Low pressure and volume systems
  - Water applied directly to the root zone
  - Approx. 70% efficiency
- Spray irrigation
  - Up to 35% of water lost due to evaporation
- Low-energy spray irrigation
  - Nozzle very close to ground
  - Up to 90% efficiency

Sustainable agriculture
Efficient use of inputs (Soil)

- **Healthy soil is essential for the production of crops to feed** both humans and livestock. Excessive tillage, overgrazing, soil exposure, removal of organic matter and compression from machinery amongst many other factors combine to damage soil, **reducing its fertility**
- **Soil conservation**, some methods
  - **Terracing**
  - **Contour planting**
  - **Strip cropping** with **covercrop**
  - **Alley cropping, agroforestry**
  - **Windbreaks** or **shelterbeds**
  - **Conservation-tillage farming**
    - **No-till**
    - **Minimum tillage**

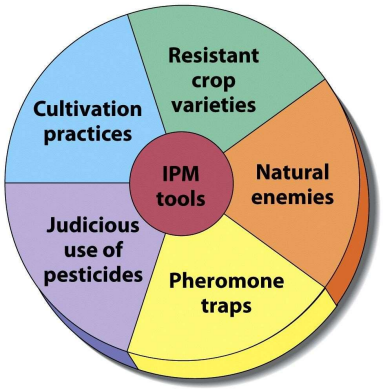
Preserving Soil Fertility

Organic fertilizers :

Animal manure, crop residue, bone meal and compost
Nutrient available to plants only as material decomposes
Slow acting and long lasting

Integrated Pest management Practices

Non-pesticidal management Practices



- Deep ploughing in the summer to expose the insect pupas so they dry in the sun.
- Use light traps and bonfires to attract moths
- Use of sticky boards to attract and catch insects that suck plant juice
- Hand-removing leaves on which many insect eggs have been laid.
- Setting pheromone traps (which use substances that attract insects)
- Using biological pesticides such as neem seed-kernel extracts and chilli–garlic extracts
- Planting trap crops such as castor and marigold.

Biological controls

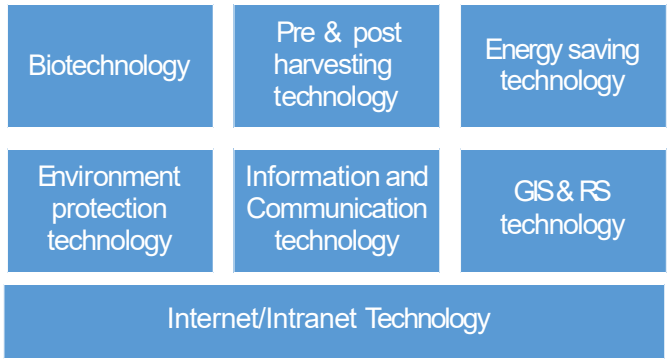
- A method of pest control that involves the use of naturally occurring disease organisms, parasites or predators to control pests is referred to as a *biological control*
- The pest species typically does not evolve genetic resistance to the biological control agent the same way it does to pesticides
- Nematodes and fungi as biological control agents
  - Nematodes are effective against mosquitoes, corn borers, weevils, grasshoppers, and locusts
- Problems with biological control
  - Attack of an unintended host
  - Make sure it does not become a pest itself

Spiders are Important Insect Predators

Technological innovations to achieve multiple wins

- **Yield enhancing technologies** (e.g. Remote sensing, precision agriculture)
- **Improved, climate-resilient varieties** (e.g. Drought Tolerant Maize)
- **Nutrition-driven and nutrition-sensitive technologies** (e.g. Biofortification)
- **Alternative proteins to reduce GHGs**, environmental impact, health risks
- **Gene editing** for seed improvements
- **Big data and analytics** to lower transaction costs, improve monitoring

Technologies for Sustainable Agricultural Development



Protect and Enhance Natural Resources

- Enhance soil health and restore land
- Protect water and manage scarcity
- Mainstream biodiversity conservation and protect ecosystem functions
- Reduce losses, encourage reuse and recycle, and promote sustainable consumption

Sustainable Farming Practices

Precision Agriculture	• GPS-guided tractors and drones for more efficient and targeted use of resources like water, fertilizers, and pesticides.
Improved Water Management:	• better irrigation systems, rainwater harvesting, and the adoption of drought-resistant crops. • water-saving techniques like drip irrigation and sensor-based soil moisture monitoring.
Climate-Smart Agriculture	• promoting climate-resilient crop varieties and reducing greenhouse gas emissions from agriculture.

Sustainable Farming Practices

Agroforestry	• Promote agroforestry practices that integrate trees and crops on the same land. • This approach can enhance biodiversity, sequester carbon, and provide additional sources of income for farmers.
Crop Diversity	• Encourage crop diversity to reduce monoculture farming, which deplete soil nutrients and increase vulnerability to pests and diseases
Regenerative Agriculture	• Support regenerative agriculture practices that focus on restoring and enhancing ecosystem health. This includes cover cropping, rotational grazing, and composting

Facilitate access to productive resources, finance and services

- Providing small-scale farmers with access to affordable, quality seeds and planting materials of suitable crop varieties.
- Bringing rural youth back into agriculture to be promoted by investing in mechanization and advanced technologies in rural locations.
- Reducing a community's reliance on distant markets, intermediaries and food price fluctuations to be met by decentralising access to resources, finance and technology.
- Producer organisations to help smallholders access an array of services, including improved market information and food safety guidelines, as well as focusing on value-added production and marketing.

Improve livelihoods and foster inclusive economic growth

- Empower people and fight inequalities
- Promote secure tenure rights for men and women
- Use social protection tools to enhance productivity and income
- Improve nutrition and promote balanced diets

Enhance the resilience of people, communities and ecosystems

- Prevent and protect against shocks: enhance resilience
- Prepare for and respond to shocks
- Address and adapt to climate change
- Strengthen ecosystem resilience

Adapt Governance to New Challenges

- Enhance policy dialogue and coordination
- Strengthen innovation systems
- Adapt and improve investment and finance
- Strengthen the enabling environment and reform the institutional framework

SDG2- Centrally Sponsored Schemes/Central Sector Schemes (CSS)

- Rashtriya Krishi Vikas Yojana (RKVY); and Krishi Unnati Schemes
  - Mission for Integrated Development of Horticulture (MIDH)
  - Integrated Scheme on Agriculture Census & Statistics
  - Integrated Scheme on Agriculture Cooperation
  - Integrated Scheme on Agricultural Marketing
  - National Food Security Mission
  - National Mission on Oilseeds & Oil Palm (NMOOP)
  - National Mission for Sustainable Agriculture (NMSA)
  - and National Mission on Agriculture Extension & Technology (NMAET)
- Pradhan Mantri Fasal Bima Yojana (PMFBY)

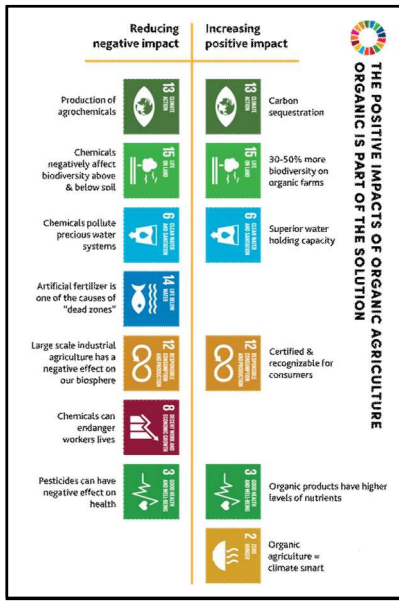
SDG2- Centrally Sponsored Schemes/Central Sector Schemes (CSS)

- Rasthriya Pashudhan Vikas Yojana (White Revolution),
  - National Livestock Mission (NLM)
  - National Programme for Bovine
  - Breeding and Dairy Development, and Livestock Health and Disease Control Programme.
- Interest subsidy for short term credit of farmers
- National Programme of Mid Day Meal in Schools
- Price Stabilisation Fund
- Targeted Public Distribution System (TPDS)
- National Food Security Act (NFSA), passed in 2013
- Antyodaya Anna Yojana

National Mission For Sustainable Agriculture (NMSA)

One of the eight Missions outlined under National Action Plan on Climate Change (NAPCC).

Integrated farming	Water use efficiency	Soil health managementand synergizing resource conservation	
Improved crop seeds, livestock and fish cultures	'Pest management'	'Improvedfarm practices'	'Nutrient management'
'Agricultural insurance'	'Credit support'	'Markets' 'access to information'	'livelihood diversification'.



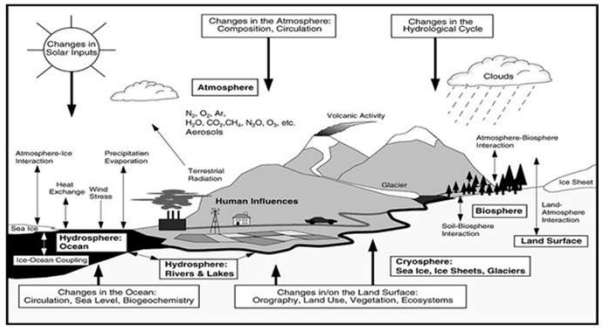
Agricultural Productivity -Interventions

- Investments to increase soil health (e.g., fertilizers, agroforestry)
- Provision of improved seeds and planting material
- Investments in small scale on-farm water management for agriculture (e.g. water harvesting, conservation, irrigation technology)
- Agriculture and irrigation extension services with a special focus on reaching women farmers
- Research in agriculture
- Develop agriculture support systems (early warning systems)

CENTRE FOR ENVIRONMENTAL STUDIES
ANNA UNIVERSITY, CHENNAI – 600 025

Climate Change Impact on Agriculture & Food Supply

Dr. A. MERLINE SHEELA
ASSOCIATE PROFESSOR

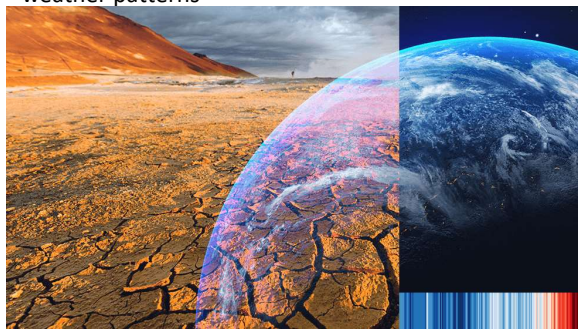


Schematic view of the components of the global climate system (bold), their processes and interactions (thin arrows) and some aspects that may change (bold arrows).

Climate Change 2001: The Scientific Basis; IPCC 2001

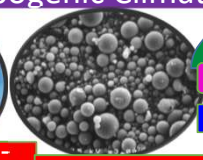
What is climate change?

- Climate change refers to long-term shifts in temperatures and weather patterns



Anthropogenic Climate Change

Fossil, fuel burning – coal, oil, natural gas



Aerosol – soot, coal ash, smoke

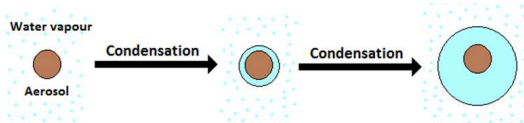
Radiative forcing

Scattering effect cooling effect

Absorbing light Warming effect

Black carbon can absorb 1 million times more energy than the same mass of carbon dioxide.

Cloud interactions



Cloud nucleation, in which aerosols act as surfaces where water may collect in the atmosphere

Calculating Radiative forcing

Stefan-Boltzmann Law

Heat rate through radiation mode can be calculated by Stefan Boltzmann Law which is

$$q = \varepsilon \sigma T^4 A$$

Where

q = heat transfer per unit time (W)

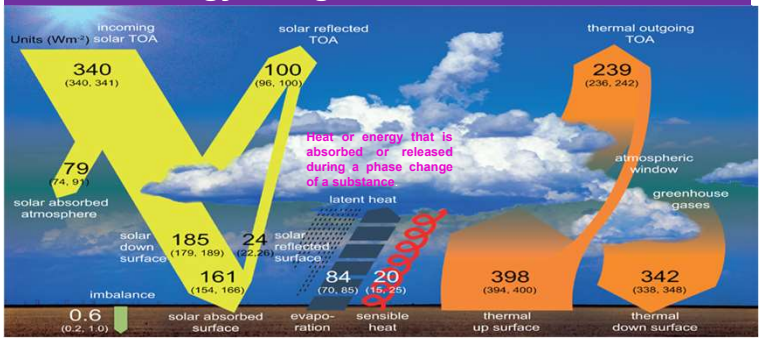
ε = emissivity power

σ = 5.6703 10^{-8} (W/m^2K^4) - ***The Stefan-Boltzmann Constant***

T = Surface temperature in Kelvin (K)

A = area of the emitting body (m^2)

Earth's Energy Budget

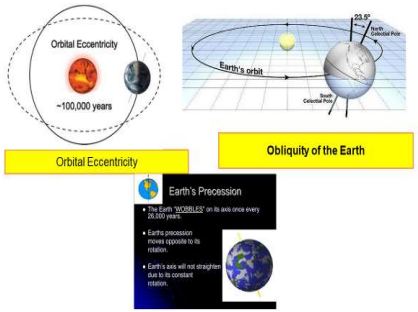


sensible heat is heat exchanged by a body which changes the temperature of the body

Milankovitch cycles: Role in Earth's climate

The Milankovitch cycles include:

- The shape of the Earth's orbit known as eccentricity
- The angle at Earth's axis is tilted with respect to Earth's orbital plane, known as obliquity
- The direction in Earth's axis of rotation is pointed, known as precession.



Atmosphere

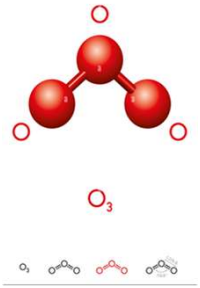
- Most unstable and rapidly changing
- Composition has changed with evolution of the Earth
- The Earths dry atmosphere is composed of
  - nitrogen (N_2, 78.1% volume mixing ratio),
  - oxygen (O_2, 20.9% volume mixing ratio, and argon (Ar, 0.93% volume mixing ratio).

These gases have only limited interaction with the incoming solar radiation and they do not interact with the infrared radiation emitted by the Earth	Trace gases, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3), which do absorb and emit infrared radiation. These so called greenhouse gases, with a total volume mixing ratio in dry air of less than 0.1% by volume, play an essential role in the Earth's energy budget

Ozone

Ozone in the lower part of the atmosphere, the troposphere and lower stratosphere, acts as a greenhouse gas.

- Higher up in the stratosphere there is a natural layer of high ozone concentration, which absorbs solar ultra-violet radiation.
- In this way this so-called ozone layer plays an essential role in the stratosphere's radiative balance, at the same time filtering out this potentially damaging form of radiation

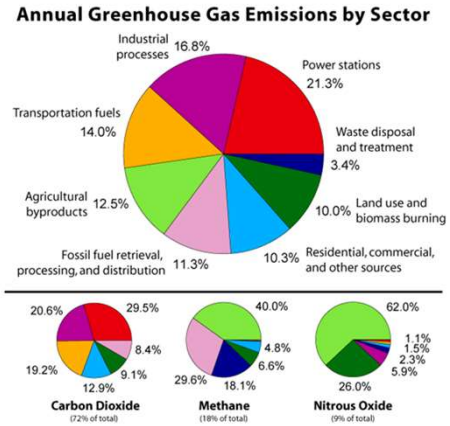


Others

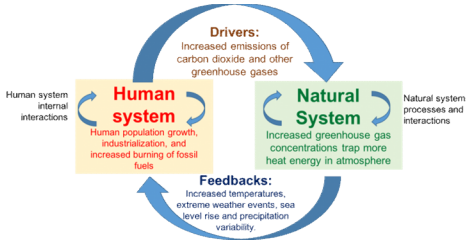
Beside these gases, the atmosphere also contains solid and liquid particles (aerosols) and clouds, which interact with the incoming and outgoing radiation in a complex and spatially very variable manner

- The most variable component of the atmosphere is water its various phases are vapour, cloud droplets, and ice crystals.
- Water vapour is the strongest greenhouse gas.

For these reasons and because the transition between the various phases absorb and release much energy, water vapour is central to the climate and its variability and change



Natural and anthropogenic drivers of climate change



IPCC Sixth Assessment Report

- Human activities are causing climate change, and the planet is irrevocably headed towards warming by 1.5 degrees Celsius over pre-industrial times in the next two decades
- The report predicts that based on existing commitments by countries to curb their emission, **the world is on track for global temperature warming by at least 2.7°C by 2100**, calling it **'Code red for humanity'**.
- The report also mentions that unless extremely deep emission cuts are undertaken by all countries immediately, the 2015 Paris Agreement goals are unlikely to be met.
- The report recommended that countries should strive to achieve net-zero emissions — no additional greenhouse gases are emitted — by 2050.

India

- Increase in frequency and severity of hot extremes
- The increase in rainfall will be more severe over southern parts of India
- Rain could increase by 20% on the southwest coast compared to the 1850 – 1900 level
- Floods, glacial lake outbursts
- Decline in glacier volume
- Regional mean sea level rise in South Asia


Heat waves - Forest fires

Warming in Indian Ocean

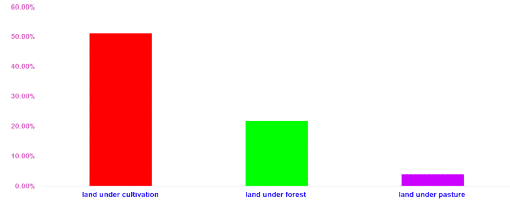
- Changes in monsoon precipitation (More severe rain is expected over southern India in the coming decades. The report says the presence of aerosols and particulate matter due to human activity has influenced rainfall events in the Indian subcontinent)
- Rise in sea level – frequent and severe coastal flooding (Across the six Indian port cities of Chennai, Kochi, Kolkata, Mumbai, Surat, and Visakhapatnam, 28.6 million people would be exposed to coastal flooding if sea levels rise by 50 cm)
- The global mean sea level in the Indian Ocean is rising at 3.7 mm annually.
- Extreme sea-level events, that previously occurred once every 100 years, will now be seen nearly every year

Glacier melting

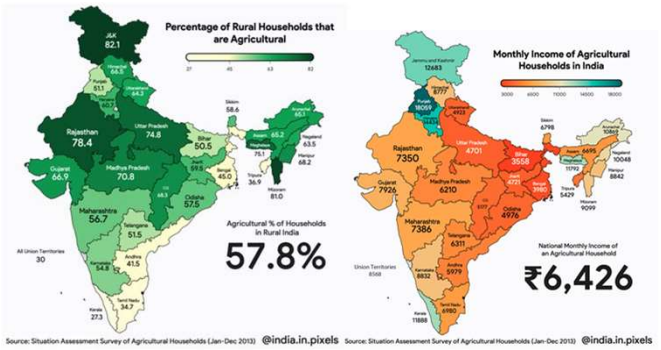
- Glaciers in the Hindu Kush Himalayan (HKH) region will keep shrinking and the snow cover will retreat to higher altitudes.
- Heatwaves and humid heat stress will be more intense and frequent in the 21st century
- Northern India, specifically the Indo-Gangetic Plain, was one among three large agricultural regions along with the US Midwest and Central Valley, where high ammonia concentrations were seen due to large-scale biomass burning
- India's geography makes it extra vulnerable to extreme climate events. The geography of India is such that it is surrounded by the warm tropical waters of the Indian Ocean on all three sides and the melting Himalayas on the north.

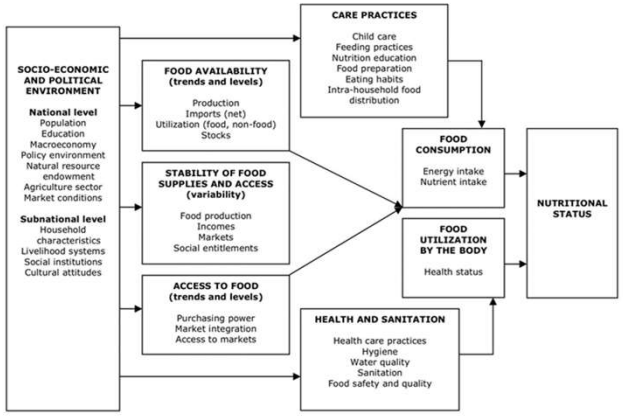
Land under Agriculture in India

- The use of land under agriculture depends on
  - Soil type
  - Irrigation facilities
  - Climate



Percentage of land under agriculture and related sectors





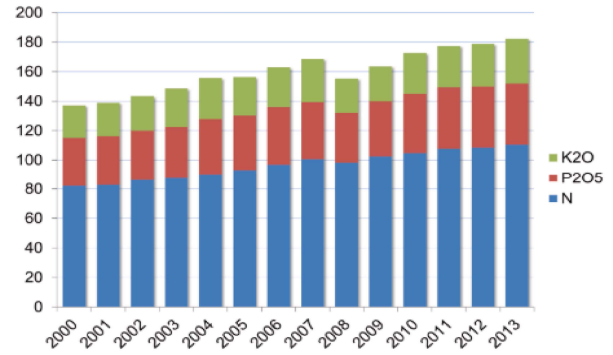
Conceptual Framework of possible causes of low food consumption and poor nutritional status (FAO, 2000)

Role of Agriculture for climate change

- In 2018, global emissions due to agriculture (within the farm gate and including related land use/land use change) were 9.3 billion tonnes of CO_2 equivalent (CO_2eq)
- Methane and nitrous oxide emissions from crop and livestock activities contributed 5.3 billion tonnes of CO_2eq in 2018, a 14 percent growth since 2000
- Livestock production processes such as enteric fermentation and manure deposition on pastures dominated farm-gate emissions, together generating 3 billion tonnes of CO_2eq in 2018
- Land use and land use change emissions were 4 billion tonnes CO_2eq in 2018, caused mainly by deforestation (2.9 billion tonnes CO_2eq) and drainage and burning of organic soils (1 billion tonnes CO_2eq). They decreased globally by 20 percent since 2000
- From drainage and fires of organic soils increased by nearly 35 percent since 2000

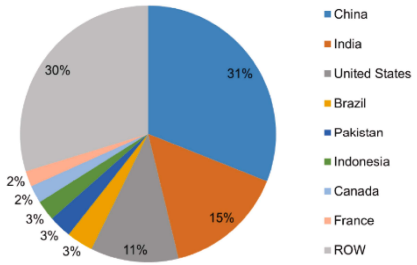
(Source: FAO, 2018)

Evolution of global fertilizer consumption by nutrient.



Heffer and Prud'homme, 2016

Country breakdown of global N fertilizer consumption



Heffer and Prud'homme, 2016

Methane emission from paddy fields

- Wetland rice fields represent globally 15–20% of the annual anthropogenic CH_4 emissions, and about 4% of the global CH_4 emissions

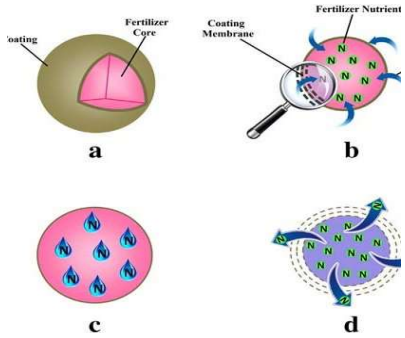
Factors affect methane emission from paddy field

- Water Regime
- Cropping season
- Soil temperature
- Fertilizer application
- Agricultural practices

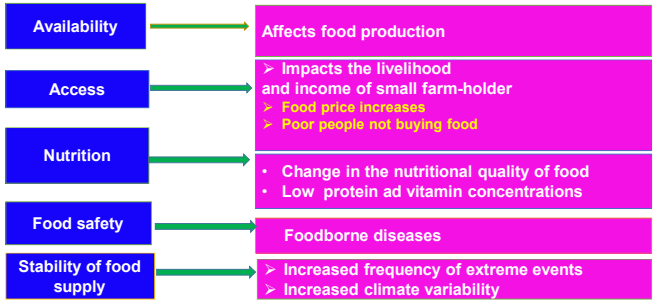
Control of methane emission

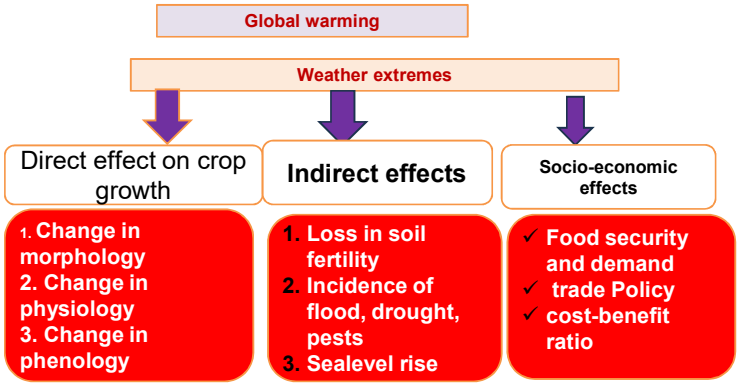
- Alternative flooding-drying
- Cultivars with few unproductive tillers
- Small root system
- High oxidative ability, and harvest index
- Excessive application of organic amendments
- Application of potassium, biochar, nitrate, sulfate, ferric iron, urease, and nitrification inhibitors
- Conservation tillage
- Precision agriculture

Control release urea



Dimensions of climate change risks





Climate and agriculture

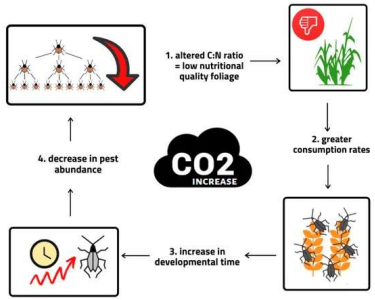
- 'Agriculture' is the main occupation for 50 percent of population in India. Agriculture and allied sectors contribute 15.4 per cent of the Indian GDP (OECD, 2017).
- Farming activities are carried out by the selection of crop which is specific to suit climate, soil type, resource availability, etc.
- Therefore, farming production and productivity is completely dependent on climatic conditions
- Weather disruptions, like changes in temperature, precipitation and solar radiation, affect the agriculture ecosystem including livestock, arable and hydrology sectors.
- As per the global report prediction, a loss of 10- 40 percent in crop productivity is estimated for 2100

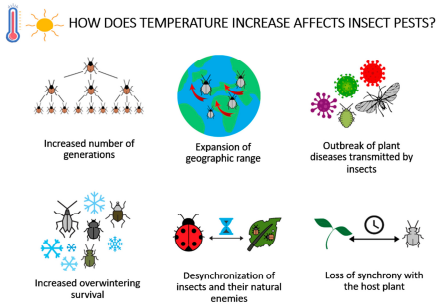
Threat to food security due to Pests (climate related)

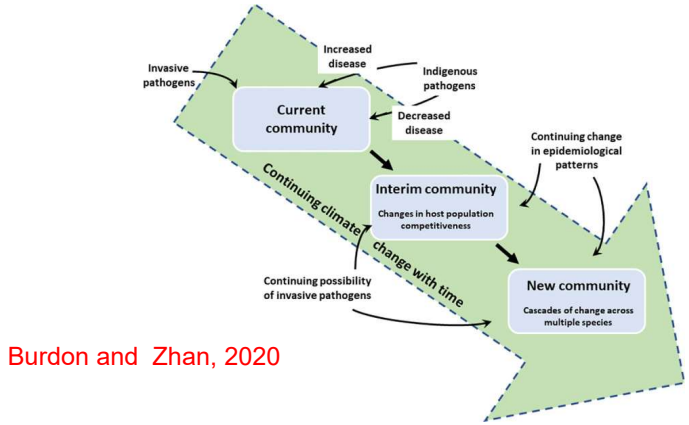
Invasive pests

- Species such as fall armyworm, which feeds on crops that include maize, sorghum and millet, have already spread due to warmer climate.
- Others, such as desert locusts, which are the world's most destructive migratory pests, are expected to change their migratory routes and geographical distribution.

Impact of atmospheric CO_2 increase on agricultural insect pests



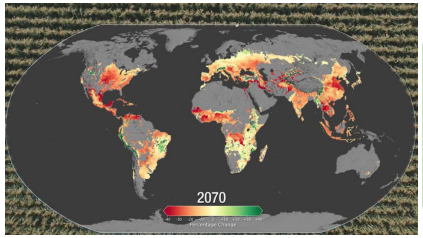




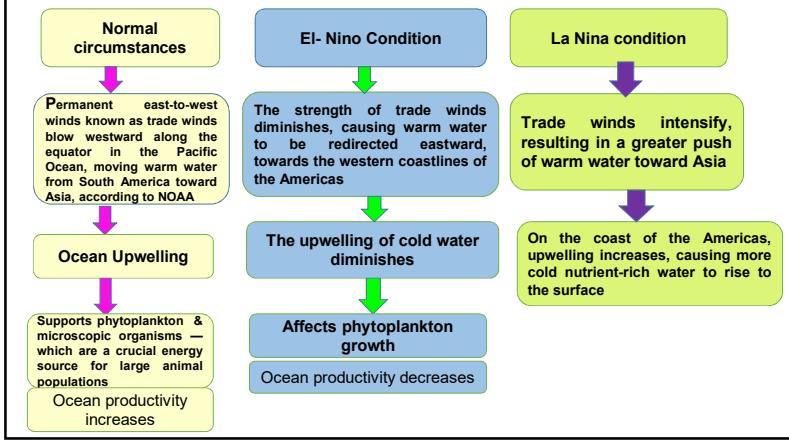
Burdon and Zhan, 2020

Crop yield loss

- Climate change may affect the production of maize (corn) and wheat as early as 2030, according to a new NASA study.



projected increases in temperature, shifts in rainfall patterns, and elevated surface carbon dioxide concentrations from human-caused greenhouse gas emissions. These changes would make it more difficult to grow maize in the tropics, but could expand wheat's growing range.



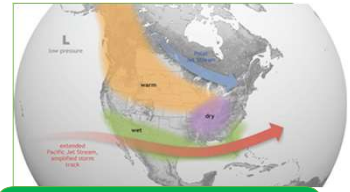
El Nino effect on weather

El Nino is a weather Phenomenon

Ocean temperatures in the Central and Eastern Pacific Oceans rise above normal → Changes in Atmospheric patterns → Weakening of monsoon circulation over the Indian subcontinent → Indian monsoon tends to be weaker

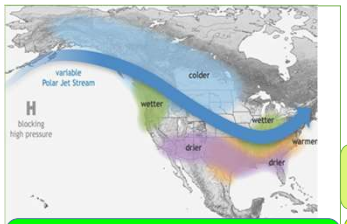
El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe."

El Nino takes place every 2 to 7 years and last for months to two years



El Niño has a substantial impact on our weather patterns as elevated ocean temperatures cause the Pacific jet stream to shift southward from its normal position

India: Below-average rainfall
Drought condition
A decline in summer crop



During La Niña the presence of cold waters in the Pacific Ocean results in a northward shift of the jet stream

Dry conditions in the southern United States while causing increased rainfall and flooding in the Pacific Northwest and Canada.

In India stronger monsoon

Winter temperature increased than normal in the northern regions and cooler in the southern regions

Hurricanes

El Nino effects on Indian Agriculture

Reduced Rainfall

- Crop failure
- Water scarcity
- Increased food cost
- Yield decrease

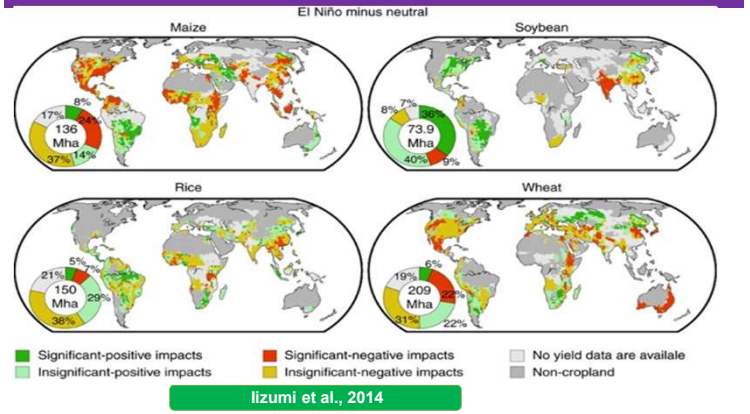
El Nino occurrence in India

Between 2001 and 2020, India saw seven El Nino years

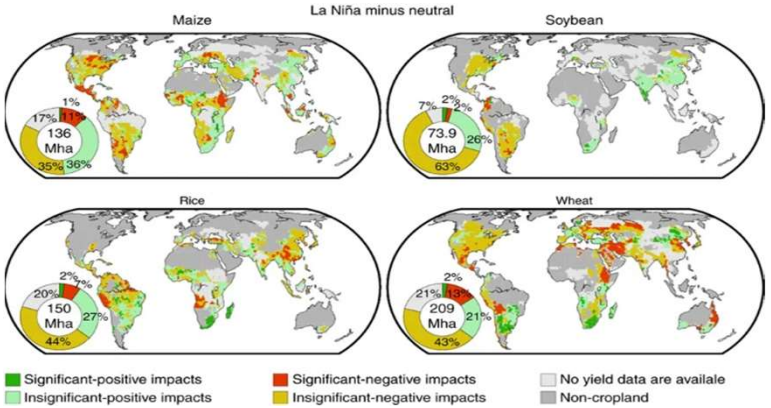
Four El Ninos resulted in drought (2003, 2005, 2009-10, 2015-16)

Kharif or summer-sown farm output decline by 16%, 8%, 10% and 3%, stoking inflation.

Impacts of El Niño Southern Oscillation on the global yields of major crops



Iizumi et al., 2014



Solutions to Climate Change


Transition to clean energy


Energy efficiency


Forest Conservation

International Cooperation


Adapting to climate


Sustainable Agriculture

Precision Agriculture

1) Efficient resources management through variable-rate application of nutrients, agrochemicals, and water
2) Reducing crop yield losses during harvesting
3) Minimizing environmental risks (i.e., reduced greenhouse gas emissions and nutrients leaching), and
4) Optimizing footprints of the farming inputs (e.g., carbon sequestration and soil organic matter)

Catch crop

Any crop that is grown between two main crops

A catch crop aims to catch or take up nutrients that could potentially leach out of the soil, principally nitrogen, and convert inorganic nutrients into organic forms which are more resistant to leaching and also provide nutrition for the soil biome, augment soil organic matter, and improve soil structure.

Relay cropping

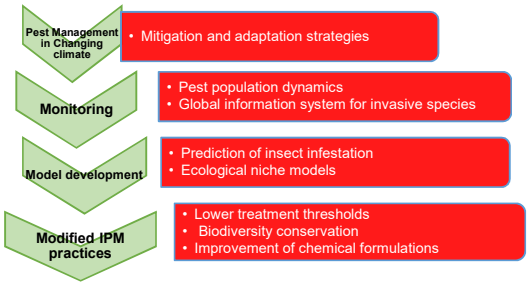
- Relay cropping is a method of multiple cropping in which one crop is seeded into a standing second crop well before the second crop is harvested.
- Relay cropping is a complex set of resource-efficient technologies capable of improving
  - soil quality,
  - increasing net return,
  - increasing land equivalent ratio, and
  - controlling weed and pest infestation.

Rice-cauliflower-onion-summer gourd is one type of relay crop grown in India.

Cover crops

- Any non-cash crop grown in addition to the primary cash crop
- These crops have the potential to increase soil organic matter and fertility, reduce erosion, improve soil structure, promote water infiltration, and limit pest and disease outbreaks.

Potential pest management strategies for mitigation and adaptation to new environmental conditions



Adaptation strategies

- Direct sowing
- Climate-resilient crops (planting drought-tolerant crops)
  - tolerant variety of chickpeas
  - wilt and sterility mosaic-resistant pigeon pea
- Early planting
- Early maturing crop species
  - early maturing variety of soybean
- Crop diversification
  - a shift from the regional dominance of one crop to regional production of a number of crops, to meet the ever-increasing demand for cereals, pulses, vegetables, fruits, oilseeds, fibers, fodder, grasses
- Rainwater harvesting
- Market responses
  - Income diversification and credit schemes
  - Developing meteorological and forecasting capability

Farm Ponds

Case studies - Climate Change Adaptation in Agriculture

CAPACITY BUILDING PROGRAMME
CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION PLAN TAMIL NADU – AGRICULTURE
CCC&DM, Anna University, Chennai
22 September 2023

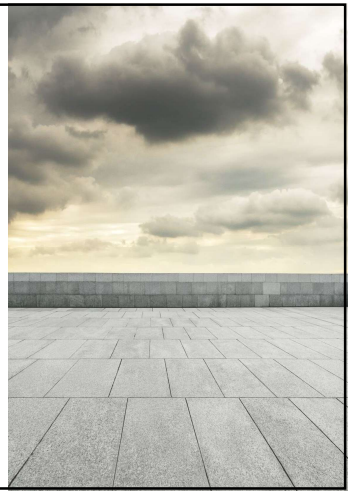
R.Rengalakshmi
M S Swaminathan Research Foundation

MSSRF

Adaptation

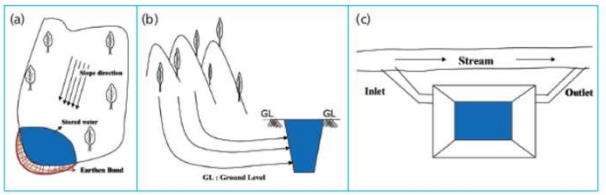
- Process of adjustment to the actual climate and its effects
- Plays a key role in reducing exposure and vulnerability to climate change in natural systems.
- Adaptation is subject to hard and soft limits. A hard adaptation limit is when no adaptive actions are possible to avoid intolerable risks while in a soft adaptation limit options may exist but are currently not available to avoid intolerable risks through adaptive action.

- **Early Warning Systems and Climate Information Systems** -EWS for All by 2027 (CoP 27) – Different time and spatial scales (Medium Range Weather Forecast – bi weekly – at block and District level
- **Farm Level measures**: Cultivar adjustment; planting date adjustment; adjusting planting date; irrigation optimization (AWD/DSR); soil improvement; fertilizer optimization; other management adaptations at system level within farm and across the landscape, Restoration of coastal and hydrological processes, introduction of heat- and drought-adapted genotypes into high-risk populations, increasing the size and connectivity of habitat patches, agroecological farming, agroforestry etc
- **Ecosystem-based Adaptation (EbA)**: *EbA* is defined as the use of ecosystem management activities to increase the resilience and reduce the vulnerability of people and ecosystems to climate change.



Case 1: FARM PONDS+: Suitable to the regions – frequency of dry spells and drought are increasing: Tiruvannamalai district

1900 plus Farm ponds established within a shorter time scale - MGNREGS



Farm Ponds Types – a) surface farm pond; b) spring fed farm pond; c) offstream farm pond

Inlet Channels and Stone works in the spill way

Designing Farm Ponds

- Design parameters – Mean Annual Rainfall and its spread, Soil type, Infiltration rate, Slope of the catchment area, drainage pattern
- Farm pond location is crucial - water from the major part of the catchment area drains to farm ponds – accordingly, land management needs to be done
- Design with a silt trap system helps to reduce the post-construction management

SOIL and Average annual rainfall

- Areas receive an average annual rainfall ranging from 500 to 750 mm – Construction of farm ponds with 500 m3 capacity
- Vertisol/Black soil area where mean annual rainfall is above 750 mm - constructing 500–1000 m3 capacity farm ponds without lining

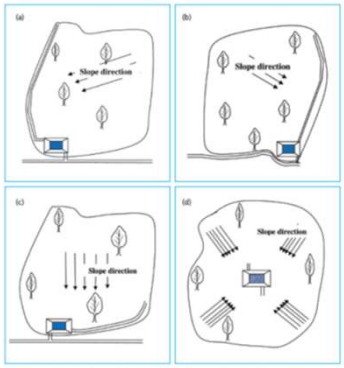


Fig. 2 (a,b,c, & d) : Planning and selection of site for farm pond location in farm catchment areas with different slopes

Category	Crops	CWR* (mm)	Critical stages	DAS	Water requirement(mm) for critical irrigation in kharif	
					30mm	50mm
Cereals	Sorghum	450	Booting, Blooming Milky Dough Stage	40-55 55-65 65-80	90	150
	Maize	450	Tasseling Silking Grain development	40-65 66-95 96-105	90	150
Pulses	Redgram	200	Flowering Pod setting	35-40 55-65	60	100
	Chickpea	200	Late vegetative phage	35-40	30	50
	Black gram	200	Flowering Pod setting	35-40 55-65	60	100
	Green gram	200	Flowering Pod setting	35-40 55-65	60	100
Oil seed crops	Ground nut	400	Flowering, Peg Formation Pod Development	30-45 45-55 60-80	90	150

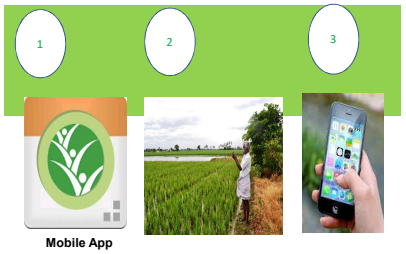
Case 2 - Integerated Agro-forestry

- About 1000 acres of unused and barren land were converted into fertile land & now additional 1000 acres are under development
- Farmers have cultivated multiple crops such as jack, mango, cashew, lime, orange, coffee, pepper, clove and silver oak that ensured long-term income opportunities from their own land
- 215 mini percolation ponds and 17 common wells were established in four panchayats that helped these farmers with irrigation, livestock management and household consumption
- About 138.58 tons of vegetables and 83.62 tons of millets were harvested by farm families and increasing local consumption
- 150 on-farm, off-farm and non-farm small-scale enterprises are established
- Around 8401 training days were organized leading to skill empowerment of the farm families.

This initiative led for the formation of farmers' producer organization "Kolli Hills agri-bioresource Producer Company Limited" covering 583 tribal farm families.

WADI Phase –II Kolli Hills 2019 -2025

- "Multi-story mixed farm to increase income, enhance nutrition supply, and ensure environmental sustainability."
- 500 farm families in the northern and southern panchayats
- Promoted, Jack, Nutmeg, Mango, Acid lime, Sapota, Pomegranate. Amla, Goava, Moringa, Fodder Crops, Vegetables
- Soil conservation and Water Resource Development
- Health and Women Development
- Institutional Development
- Training and Capacity building
- Community based production, precleaning and marketing



Case 3 : Picture Based Advisories Bundled with Picture Based Insurance for Sustainable and Scalable Risk Management Services

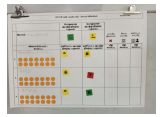
- The picture-based monitoring of crop phenology for advisory and insurance and services is an innovative tool to improve agricultural risk management in crop cultivation in partnership with CABI.

Pilot tested – 1000 farmers with HDFC services

PICTURE BASED ADVISORIES – SEEING IS BELIEVING 2019-2020

- Smallholder farmers in India are increasingly exposed to extreme weather events and biotic stress (pests, diseases, nutrient disorders, weeds etc.).
- In this context, picture-based monitoring of crop phenology to extend necessary advisory support and insurance services to improve agricultural risk management was initiated.
- Target farmers: Pudukottai and Thanjavur Paddy and Groundnut cultivators.
- Methodology: Picture validation, advisory dissemination, loss assessment and insurance pay out.

- **Season 1: Kharif 2019**
- Planning stage-Learnings for the next season and understanding farmer's expectations
  - 25 villages- PBA + Plant clinics
    25 villages- Only Plant clinics
  - A total of 1059 farmers were registered
  - Village sessions were conducted to familiarize the farmers to the concept of PBA and PBI
  - Risk surveys conducted- crop loss due to pest and disease is more at individual level
  - 1180 overview images & 373 close up images received.
  - 64.30% of registered farmers have sent the repeat pictures.



PICTURE BASED INSURANCE 2020-2021

Damage level	No.of insured farmers who received the payout based on the damage category			
	< 20% damage	20-50% damage	50- 75% damage	Total
Damage category	37	136	2	175
Insurance amount received	0	Rs. 14,28,000 @ Rs. 10,500	Rs. 39,000 @ Rs. 19,500	**Rs 14,67,000**


Stem Borer – Paddy Pest (White Ear)


Bacterial Leaf Blight – Paddy Disease (Leaf Tip drying, Yellow Margins)

Major Learnings

- Field agent model was adopted where the local volunteers helped to take the images.
- The synergy of PBA + Plantwise helped the farmers to confirm the problem and follow the subsequent recommendations at closer time interval.
- PBA showed promising experience by farmers and way forward for the remote advisories


Gram Pod Borer- Groundnut Pest (Feeding leaves in circular Patches)


Tikka Leaf Spot – Groundnut Disease (Yellow Leaf spots, Light & dark brown patches)

Seed banks adopt the traditional practice of seed exchange to promote the use of quality seeds, managed by the local community at the village level. It has been demonstrated as a suitable model to promote traditional varieties and landraces of under-utilized crops.

Case 4: Community seed banks:
A platform for Alternative seed systems for small millet landraces

Seed Systems and Seed bank

- Understanding How formal and informal seed systems operate to plan for seed support
- Preparing a database of farmers who are growing traditional varieties
- Variety-sensitive seed support: Providing agro-ecological matching of varieties to physical environments and farmers' preferences
- Establishment of village-based 'Seed Bank' with the necessary training and awareness – use and resupply of seeds with locally developed norms and rules


Kuzhivedichan


Kallurundai

Case 5: Greening of Hillocks, Tiruvannamalai dt, Tamil Nadu - EbA

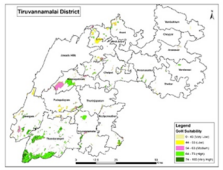
They are in a degraded state causing severe losses in crucial ecosystems services – runoff, soil erosion and flooding which are affecting local biodiversity and farm lands

The good catchment area becomes bad and the surface runoff and soil erosion results in increased siltation of water bodies downstream

Built the capacity of implementing officers and community on the scientific planning and implementation of activities
GIS and Remote sensing tools were used to map and plan for the afforestation and land management measures
Based on slope 4 zones were categorized and appropriate Key activities were implemented – rockfill dams, sunken pits, staggered contour trenches with mounds for planting locally adapted tree species etc in upstream and compartmental bunds, agro forestry, injection wells, farm ponds, percolation ponds etc in the downstream
Decision support systems developed for upscaling in other similar ecosystems

Key results

- 68.5 Ha of hillocks were treated with 4000 continuous contour trenches, planted 29972 trees, six gabion structures, seven rockfill dams, 6 check dams, 8 percolation tanks and 35 farm ponds with more than 100 ha under agro-forestry plantations were carried out.
- Increased vegetation cover reducing the soil erosion and siltation in water bodies and increasing the ground water recharge in the downstream
- The micro climate of the planted upstream area is improving which attracts birds and other insects
- It supports ten village communities in the down hillocks and promotes agriculture in a 2500 ha area covering 2000 farmers and other communities



Decision support system

Degraded hills – Before treatment in 2019

Hills after treatment in 2022

Key learnings

1. Adaptation technologies – bundled with support services for higher level of adoption
2. System oriented – for a transformative changes
3. Building on the traditional practices supports in quicker adoption – CSBs
4. Support mechanisms for the farmers to invest in some of the hard structures as well as community-based infrastructures
5. Digital technologies offer innovative farmer centric solutions

THANK YOU.....

Status of Agriculture in Tamil Nadu

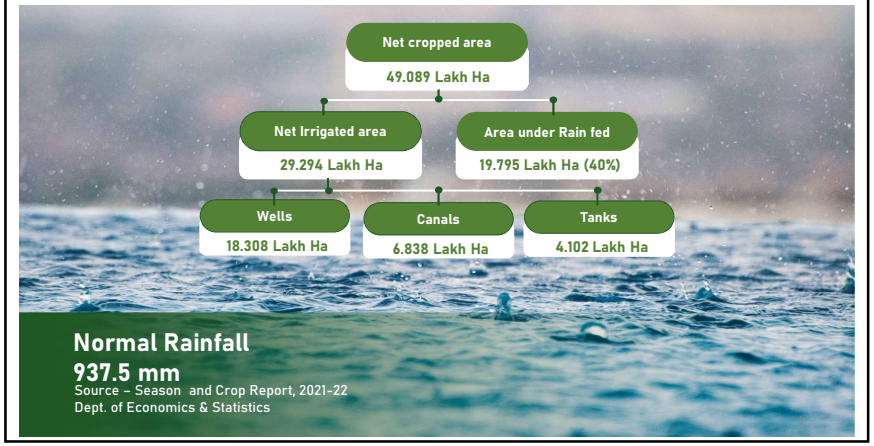
S.SANKARASUBRAMANIAN
Deputy Director of Agriculture (Training)
Commissionerate of Agriculture
Chennai

Tamil Nadu Agriculture at a glance

1. **Total Geographical area - 130.33 Lakh Ha**
2. Net Area sown - 49.089 Lakh Ha (38%)
3. Area sown more than once – 14.392 Lakh Ha (11%)
4. **Total cropped area - 63.481 Lakh Ha**
5. **Cultivable waste land (23%) - 30.105 Lakh Ha**
   - Current fallow - 8.005 Lakh Ha
   - Other fallow -18.636 Lakh Ha
   - Culturable waste - 3.464 Lakh Ha

   Sum of Net area sown & Cultivable Waste land – 79.194 Lakh Ha **(49.089 + 30.105)-(60.8%)**
6. **Area not suitable for cultivation – 51.136** Lakh Ha **(39.2%)**

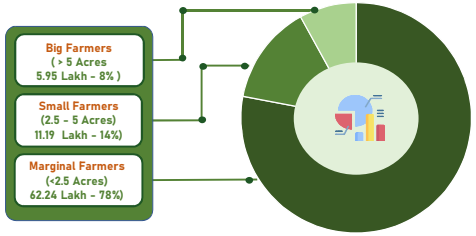
Agriculture & TN at a Glance



AGRO – CLIMATIC ZONES OF TAMIL NADU

Sl. No	Zones	Districts covered	Characters of the zone
1	North Eastern	Kanchipuram, Chengalpattu, Tiruvallur, Cuddalore, Villupuram, Kallakurichi Vellore, Tirupathur, Ranipettai, Tiruvannamalai	Coastal Area or Dry tract. Annual Rainfalll is 1105 mm. Soils found in this zone are Red Sandy loam, Clay loam and Saline coastal Alluvium.
2	North Western	Dharmapuri, Krishnagiri, Salem and Namakkal (Part)	Dry tract. Annual Rainfall is 875 mm. Major soils are Calcareous Soil.
3	Western	Erode, Coimbatore, Tirupur, Theni, Karur (Part), Namakkal (Part), Dindigul, Perambalur and Ariyalur (Part)	Dry tract but fertilize soil. Annual Rainfall is 715 mm. Red loamy and Black Soil are the major soils.
4	Cauvery Delta	Thanjavur, Nagapattinam, Mayiladuthurai, Tiruvarur and parts of Tiruchirapalli, Karur, Ariyalur, Pudukkottai and Cuddalore	Receives more rainfall in North East Monsoon. Annual Rainfall is 985 mm. Soils found in this zone are Red loamy and Alluvium.
5	Southern	Madurai, Sivagangai, Ramanathapuram, Virudhunagar, Tirunelveli,Tenkasi, Thoothukudi	Dry Tract. Annual Rainfall is 857 mm. Black soil, Coastal alluvium and Red Soils are the major soils.
6	High Rainfall	Kanyakumari	Annual rainfall is 1420mm. Saline coastal, Alluvium and red loam are the major soils.
7	Hilly	The Nilgiris and Kodaikanal (Dindigul)	Annual rainfall is 2124 mm. Lateritic is the major soil

Land Holdings in TN



79.38 Lakh

Total Operational Land Holding

92 % - SF & MF operating 62% of land holdings

Average Land Holding in TN – 1.87 Acres (0.75 Ha)

Source- Agricultural Census – 2015-2016 by Dept. of Economics & Statistics

5

Demand & Production of major Food Crops in TN

	Rice	Millets	Pulses	Oilseeds	Vegetables	Fruits
Total Demand (Lakh MT)	90.55	23.59	13.28	11.13	68.98	22.99
Total Production (Lakh MT)	79.06	7.66*	4.99	10.83	64.52 (**)	67.62

*Excluding maize production of 28.27 Lakh MT

** Excluding tapioca production of 30.55 Lakh MT

Source:
1) Total demand has been calculated based on per capita food requirement as per ICMR
2) Supply is production in 2021-22 as per Dept of Economics & Statistics

6

Agricultural Crops Area 5 Year Trend

In Lakh Ha

S. No	Crops	2018-19	2019-20	2020-21	2021-22	2022-23
1	Paddy	17.21	19.07	20.36	22.17	21.59
2	Millets	9.24	9.61	9.8	9.55	9.24
3	Pulses	8.50	8.24	8.02	8.02	7.91
4	Cotton	1.35	1.70	1.12	1.48	1.73
5	Sugarcane	1.66	1.31	1.28	1.48	1.59
6	Oilseeds	3.90	4.09	4.73	4.33	4.17
7	Horticultural Crops	11.43	12.01	12.93	13.23	13.03
Total Area		**53.29**	**56.03**	**58.24**	**60.26**	**59.26**

Agricultural Crops Production 5 Year Trend

In L.MT

Sl. No.	Crops	2018-19	2019-20	2020-21	2021-22	2022-23
1	Paddy	61.31	72.65	68.81	79.06	75.57
2	Millets	37.08	36.31	34.7	35.92	36.31
3	Pulses	5.51	6.06	4.73	4.99	5.03
4	Cotton (L.Bales)	3.20	4.18	2.43	3.02	3.19
5	Sugarcane (Cane)	170.96	141.19	132.84	161.67	176.58
6	Oilseeds	9.40	10.75	10.63	10.83	9.49

5 years trend of Productivity of Agricultural crops

In Kg/ Ha

Sl. No.	Crops	2018-19	2019-20	2020-21	2021-22	2022-23
1	Paddy	3,562	3,809	3,379	3,566	3,500
2	Millets	4,012	3,777	3,541	3,761	3,930
3	Pulses	648	735	590	622	636
1	Cotton (in terms of Lint/Ha)	404	419	369	347	313
2	Sugarcane (cane - MT/Ha)	103	108	104	109	111
3	Oilseeds	2,410	2,628	2,247	2,501	2,276

TN Status in Crop Productivity at National level

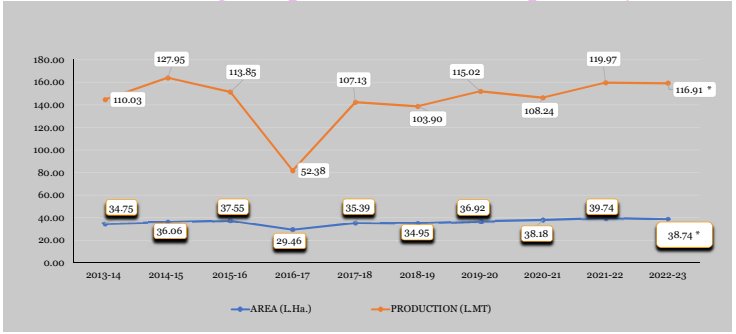
1	2	3	4
First	Second	Third	Fourth
Oilseeds Groundnut Sugarcane Aonla Guava Jack Cabbage Green Chillies Marigold	Maize Paddy Pineapple Radish Tapioca Cloves Chrysanthemum Jasmine Rose	Papaya Pear Plum Sapota Carrot Coconut	Food Grains Nutri-Cereals (Ragi, Bajra, Varagu, Thenai)

9

Source: 1) Agricultural Statistics at a Glance, 2022 2) 3rd Advance Estimate 2021-2022

FOOD GRAIN-AREA, PRODUCTION YEAR WISE TREND

Trend of food grain production for the past 10 years



*2022-23 Final Estimate

10

HONOURABLE CHIEF MINISTER'S VISION

(a) To take steps to bring an additional area of 11.75 lakh hectare under net area sown so as to increase the present cropped area from 60% to 75%

(b) An area of 10 lakh hectare of present double cropped area will be increased into doubled i.e. 20 lakh hectare in the next ten years.

(c) Tamil Nadu will be brought within the first three positions in the country in agricultural productivity in crops like food grains and commercial crops such as coconut, cotton, sunflower and sugarcane.

11

Challenges/Intervention

- Fragmentation and lesser land holdings / Cluster approach
- Labour shortage / Mechanization
- Input cost / New age fertilizers
- Marketability / Collective marketing &value addition
- Technology adoption / Motivation
- Lack of synergy in public extension / Team building

12

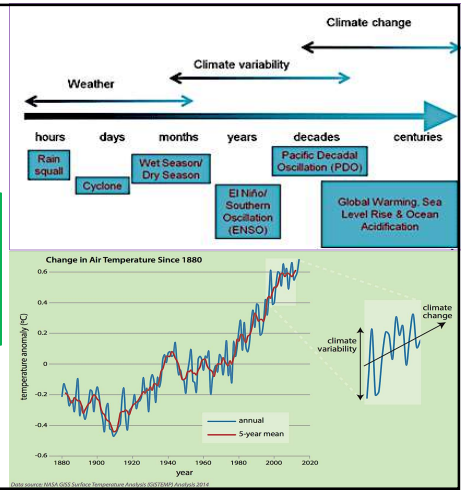
Thrust areas

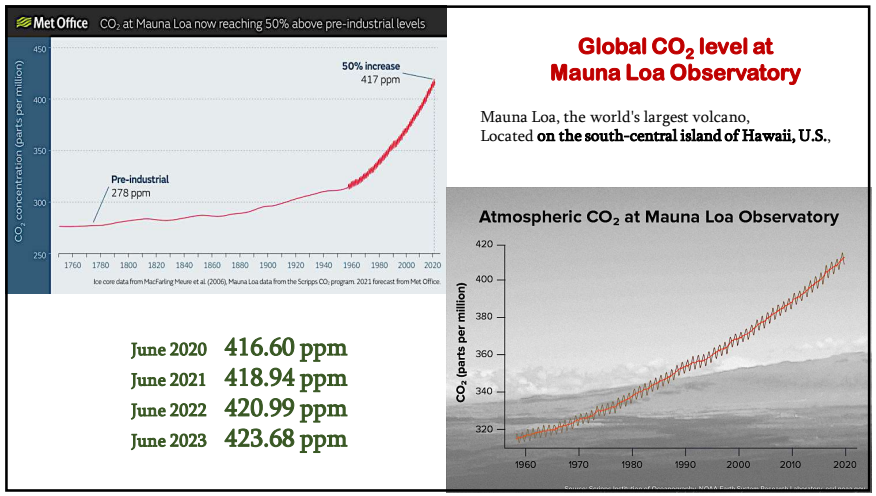
- Bringing back fallow land into cultivation
- Organic farming
- Integrated Farming System
- Micro irrigation
- Agro forestry
- Market linkage
- Collective marketing

THANK YOU

Climate Change and Climate Variability

- Weather: Changes within a short period
- Climate: Ave. weather over a period & large area
- Climate variability: Reversable deviation from the normal
- Climate change: Irreversible changes over a period

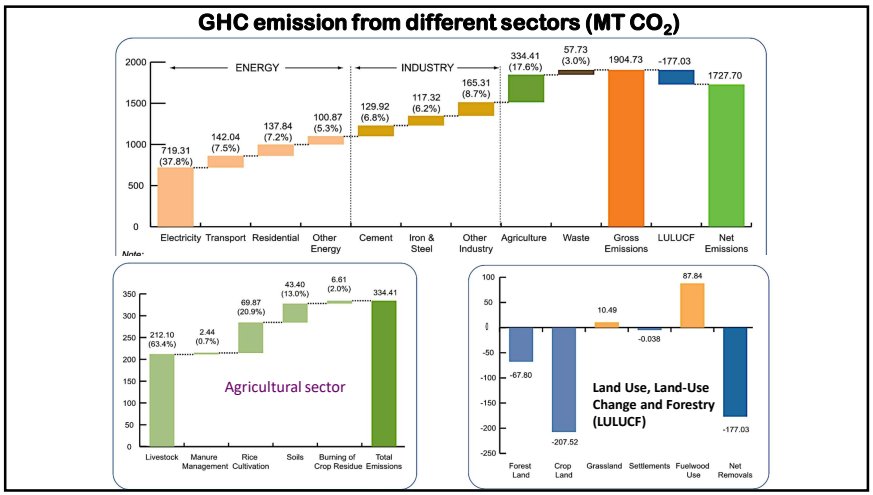




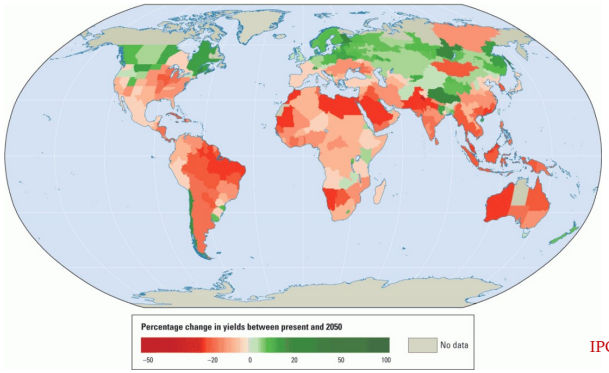
Global CO_2 level at Mauna Loa Observatory

Mauna Loa, the world's largest volcano,
Located **on the south-central island of Hawaii, U.S.**,

June 2020	416.60 ppm
June 2021	418.94 ppm
June 2022	420.99 ppm
June 2023	423.68 ppm



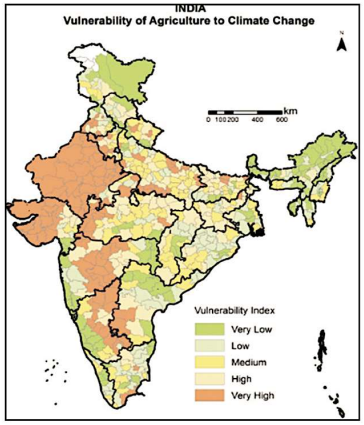
Percentage change in crop yield between present and 2050



15 - 25 yield reduction in India

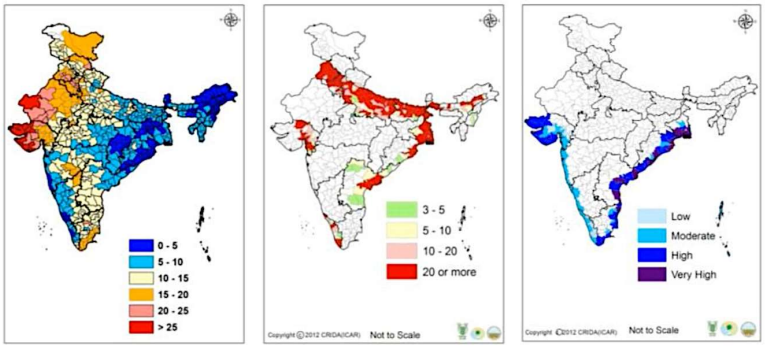
IPCC VI AR 2022

Vulnerability of Indian agriculture to Climate Change (2021-2050)



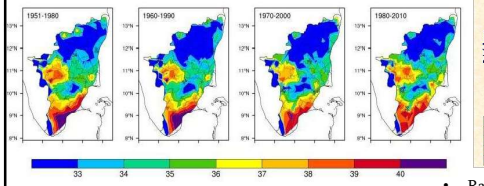
Source: CA Rama Rao et al (2013)[22]

Drought Incidence | Area prone to floods (%GA) | Cyclone-proneness



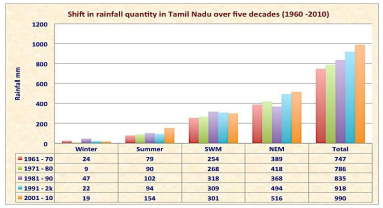
Source: CRIDA (ICAR), 2020

Shift in onset of monsoon over the past 60 years



- Monsoon onset week was shifted from 1950 to 2010
- Shift has both temporal and spatial variation
- Two weeks earlier onset in southern districts of TN
- One week earlier in north western and western TN.
- Delayed a week at Coastal, WZ and North eastern TN.

Increasing intensity of rainfall, shift in rainfall season, hence **more emphasis should be given on soil moisture conservation research.**



	Winter	Summer	SWM	NEM	Total
1961 - 70	24	79	254	389	747
1971 - 80	9	90	268	418	786
1981 - 90	47	102	318	368	835
1991 - 2k	22	94	309	494	918
2001 - 10	19	134	301	516	990

- Rainfall increased from 747 to 990 mm **(Ave. is 914mm)**
- Quantity increased during NEM but decrease in SWM
- Rainy days decreased from 68 to 48 days, drastic in SWM
- Frequency of >50 mm is once in 17 events & >100 mm is once in 155 events.
- Chance of deficit rainfall occurs once in every four years and excess rainfall is once in eight years.

❖ Decrease in rainy days is an alarming one, which will be resulted in poor distribution of rainfall and reduction in LGP.

Long period Seasonal Average 1980 - 2010

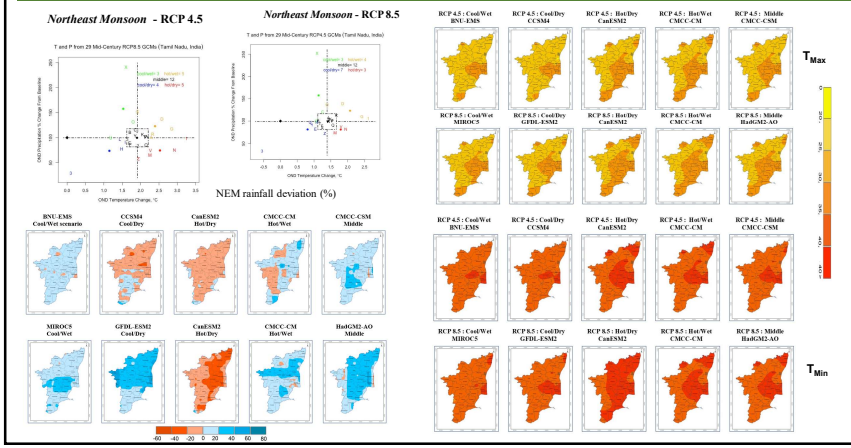
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave. mm	18.9	22.9	59.1	108.5	201.7	753.0	861.4	659.1	365.8	334.8	163.5	44.6	3593.3

Long period Seasonal Average 1980 – 2010

Season	Winter	Summer	South West Monsoon	North East Monsoon	Annual
Ave. mm	41.9	369.3	2639.3	542.9	3593.3

Standard Week	1951 - 80	1961 - 90	1971 – 2K	1981 - 10	1951 - 10	Proposed week
Premonsoon sowing week	14	15	14	14	14	14
Rainy season start week	15	16	15	15	15	15
Rainy season end week	50	49	50	50	50	50
Length of growing period	38	36	38	38	38	38
Wet spell start week	20	22	21	21	21	21
Wet spell end week	47	45	45	47	45	47

Future climate projections under RCP 4.5 and RCP 8.5 scenario over Tamil Nadu (V. Geethalakshmi)



Temperature Effects on Crop Yield

Crop	Topt, °C	T_{max} °C	Yield at T_{opt} t/ha	Yield at 28°C, t/ha	Yield at 32°C t/ha	% decrease (28 to 32°C)
Rice	25	36	7.55	6.31	2.93	54
Soybean	28	39	3.41	3.41	3.06	10
Dry bean	22	32	2.87	1.39	0.00	100
Peanut	25	40	3.38	3.22	2.58	20
Sorghum	26	35	12.24	11.75	6.95	41

Extreme events

Drought: Prolonged periods of low precipitation can lead to drought conditions, causing **soil moisture deficits** and **water shortages** for irrigation.

Floods: Excessive rainfall and flooding can **saturate fields, erode soil, and damage crops** and detrimental.

- Lead to the spread of **diseases and pests**
- Post-flood **soil contamination** can impact the quality and safety of produce.

Heat wave & Cold wave

- High temperatures causes heat stress in plants
- Causing reduced photosynthesis
- Wilting, and decreased fruit set.
- Frost and freeze events can damage sensitive crops
- Lead to significant yield losses, especially during critical growth stages.

Hailstorms

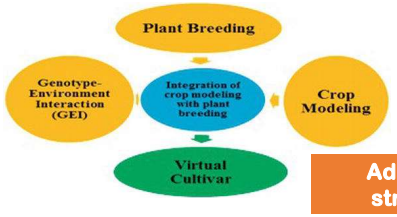
- Physically damage crops, leading to yield losses
- Reduced marketable quality.
- These events are particularly detrimental during flowering and fruiting stages.

NOAA national weather service: heat index

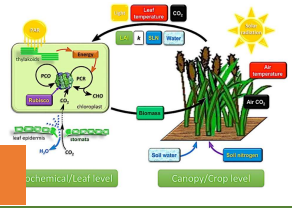
Temperature / Relative humidity	80 °F (27 °C)	82 °F (28 °C)	84 °F (29 °C)	86 °F (30 °C)	88 °F (31 °C)	90 °F (32 °C)	92 °F (33 °C)	94 °F (34 °C)	96 °F (36 °C)	98 °F (37 °C)	100 °F (38 °C)	102 °F (39 °C)	104 °F (40 °C)	106 °F (41 °C)	108 °F (42 °C)	110 °F (43 °C)
40%	80 °F (27 °C)	81 °F (27 °C)	83 °F (28 °C)	85 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	94 °F (34 °C)	97 °F (36 °C)	101 °F (38 °C)	105 °F (41 °C)	109 °F (43 °C)	114 °F (46 °C)	119 °F (48 °C)	124 °F (51 °C)	130 °F (54 °C)	136 °F (58 °C)
45%	80 °F (27 °C)	82 °F (28 °C)	84 °F (29 °C)	87 °F (31 °C)	89 °F (32 °C)	93 °F (34 °C)	96 °F (36 °C)	100 °F (38 °C)	104 °F (40 °C)	109 °F (43 °C)	114 °F (46 °C)	119 °F (48 °C)	124 °F (51 °C)	130 °F (54 °C)	137 °F (58 °C)	
50%	81 °F (27 °C)	83 °F (28 °C)	85 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	95 °F (35 °C)	99 °F (37 °C)	103 °F (39 °C)	108 °F (42 °C)	113 °F (45 °C)	118 °F (48 °C)	124 °F (51 °C)	131 °F (55 °C)	137 °F (58 °C)		
55%	81 °F (27 °C)	84 °F (29 °C)	86 °F (30 °C)	89 °F (32 °C)	93 °F (34 °C)	97 °F (36 °C)	101 °F (38 °C)	106 °F (41 °C)	112 °F (44 °C)	117 °F (47 °C)	124 °F (51 °C)	130 °F (54 °C)	137 °F (58 °C)			
60%	82 °F (28 °C)	84 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	95 °F (35 °C)	100 °F (38 °C)	105 °F (41 °C)	110 °F (43 °C)	116 °F (47 °C)	123 °F (51 °C)	129 °F (54 °C)	137 °F (58 °C)				
65%	82 °F (28 °C)	85 °F (29 °C)	89 °F (32 °C)	93 °F (34 °C)	98 °F (37 °C)	103 °F (39 °C)	108 °F (42 °C)	114 °F (46 °C)	121 °F (49 °C)	128 °F (53 °C)	136 °F (58 °C)					
70%	83 °F (28 °C)	86 °F (30 °C)	90 °F (32 °C)	95 °F (35 °C)	100 °F (38 °C)	105 °F (41 °C)	112 °F (44 °C)	119 °F (48 °C)	126 °F (52 °C)	134 °F (57 °C)						
75%	84 °F (29 °C)	88 °F (31 °C)	92 °F (33 °C)	97 °F (36 °C)	103 °F (39 °C)	109 °F (43 °C)	116 °F (47 °C)	124 °F (51 °C)	132 °F (56 °C)							
80%	84 °F (29 °C)	89 °F (32 °C)	94 °F (34 °C)	100 °F (38 °C)	106 °F (41 °C)	113 °F (45 °C)	121 °F (49 °C)	129 °F (54 °C)								
85%	85 °F (29 °C)	90 °F (32 °C)	96 °F (36 °C)	102 °F (39 °C)	110 °F (43 °C)	117 °F (47 °C)	126 °F (52 °C)	135 °F (57 °C)								
90%	86 °F (30 °C)	91 °F (33 °C)	98 °F (37 °C)	105 °F (41 °C)	113 °F (45 °C)	122 °F (50 °C)	131 °F (55 °C)									
95%	86 °F (30 °C)	93 °F (34 °C)	100 °F (38 °C)	108 °F (42 °C)	117 °F (47 °C)	127 °F (53 °C)										
100%	87 °F (31 °C)	95 °F (35 °C)	103 °F (39 °C)	112 °F (44 °C)	121 °F (49 °C)	132 °F (56 °C)										

Key to colors: Caution; Extreme caution; Danger; Extreme danger

Climate smart crops or genotypes tolerant to drought, flood and and high temperature

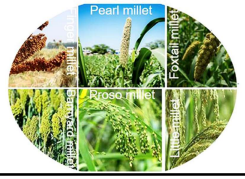


Crop weather models for developing management technologies for climate variability



Adaptation strategies

Include native millets in alternate cropping system



Revalidate crop water requirement worked 1970's

Crop	Water requirement (mm)	Crop	Water requirement (mm)
Rice	1200	Tomato	600 – 800
Wheat	450 – 650	Potato	500 – 700
Sorghum	450 – 650	Pea	350 – 500
Maize	500 – 800	Onion	350 – 550
Sugarcane	1500 – 2500	Chillies	400 – 600
Sugarbeet	550 – 750	Cabbage	380 – 500
Groundnut	500 – 700	Banana	1200 – 2200
Cotton	700 – 1300	Citrus	900 – 1200
Soybean	450 – 700	Grapes	700 – 1200
Tobacco	400 – 600	Mango	1000 – 1200
Beans	300 – 500	Turmeric	1200 – 1400

Climate change, new varieties and new management technologies may have altered the water requirement

Heat stress management

Overall view of crops grown under ambient +

Flower initiation at 45 DAS at ambient + 2°C

a) Foliar spray of Panchagavya b) Soil drenching with Jeevamirtham

Heat stress management

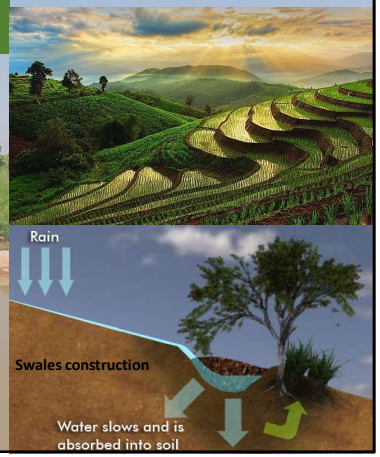
Use of organics : Effect of heat stress on seed yield (g plant^{-1}) in Cowpea

Treatment	AT	AT+2°C	Mean
T1	13.99	11.15	12.57
T2	14.36	12.14	13.25
T3	9.91	8.05	8.98
T4	11.73	8.78	10.25
T5	8.43	6.97	7.70
T6	7.93	6.46	7.20
Mean	11.06	8.92	9.99
	T	t	T*t
SED	0.09	0.16	0.22
	**	0.32**	0.46*

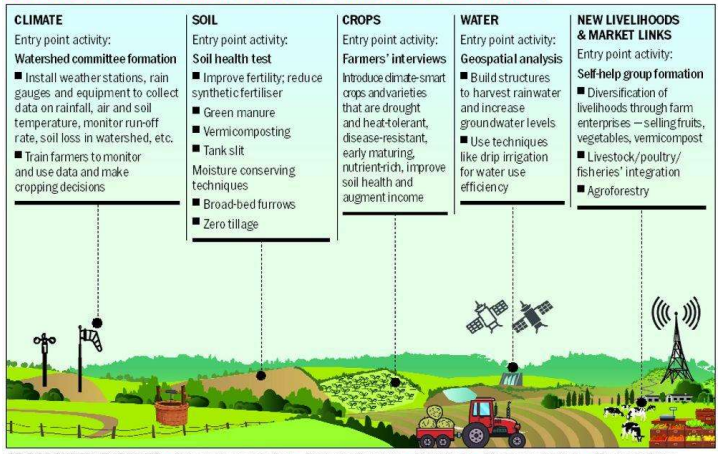
T – Treatment factor t – Temperature factor T*t – Interaction AT – Ambient Temperature
NS – Non significant(P<0.05) *Significant ** Highly significant AT + 2°C – Ambient Temperature + 2°C
T1: Vermicompost + Soil drenching with 2 litres of Jeevamirtham at 30, 45 & 60 DAS
T2: Vermicompost + Foliar application of 3% Panchagavya at 30, 45 & 60 DAS
T3: RDF + Foliar application of 40ppm NAA at flower initiation and 50% flowering stage
T4: RDF + Foliar application of 0.2 ppm Brassinolide at flower initiation and 50% flowering stage
T5: Vermicompost alone
T6: Recommended Dose of Fertilizer (RDF) – Check

Water Management – Exsitu conservation

- Contour farming
- Swales
- Rainwater harvesting.
- These techniques help to capture and manage water during heavy rainfall
- Preventing runoff and soil erosion.



CLIMATE-SMART VILLAGE: WATERSHED MANAGEMENT APPROACH



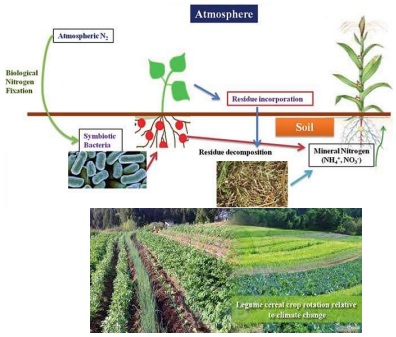
Water Management – Insitu conservation

Cultural/agronomical	Mechanical	Agrostological
Addition of organic matter, Summer ploughing, Contour farming, cover crops, mulching, strip cropping, cropping systems, Tillage practices	Basin listing, Subsoiling, Compartmental Bunding, Ridges and furrows, Broad bed furrow, Contour bunding, graded bunding, Bench terracing	Pasture, Strip cropping with grasses, Ley farming, Vegetative barriers

Terracing

A piece of sloped plane that has been cut into a series of successively receding flat surfaces or platforms, which resemble steps, for the purposes of more effective farming.

Crop rotation with legume and green manure crop



Mishra et al., 2009

Insitu conservation

Minimum tillage or zero-tillage

- Promotes minimum disturbance of soil structure and organic matter found in the soil by increasing the decomposition of plants in-situ.
- **Higher infiltration caused by the vegetation present in the soil.**
- Organic matter increases and enhances the cycling of nutrients.
- Less resistance to root growth due to improve structure, allowing crops to germinate and develop faster with additional soil moisture.

Crop residues in combination with reduced and no tillage

- Increase soil organic matter content and microbial activity present in the soil.
- Reduce soil evaporation as plant residues increase soil moisture.

Drip system/Micro irrigation

- Increase water-use efficiency
- Partial-root zone drying (PRD) maximizes water use efficiency by adding water only on half of the root zone.
- Reduce soil erosion and macronutrient losses from leaching.
- Promote weed control as water is locally applied.
- Reduce the risk of diseases that occur under damp conditions.

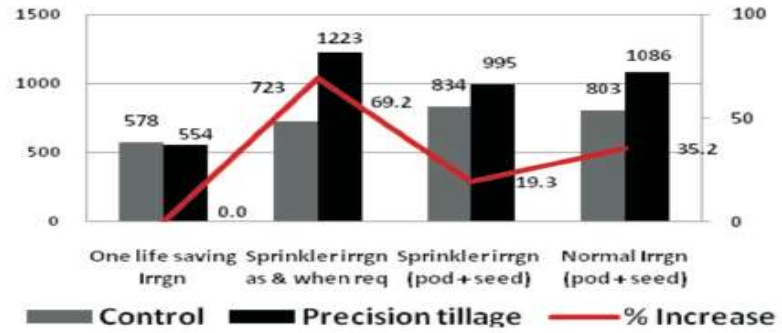
Life saving irrigation/Efficient use of resources

Table 3. Effect of drip-fertigation on yield, economics, water-use efficiency (WUE) and soil organic carbon (SOC) under long-dura pigeonpea

Drip-fertigation (at stages)	Grain yield (kg/ha)	Net returns (₹ '000/ha)	WUE (kg/ha-cm)	Agronomic efficiency (kg grain/ kg NPK)	SOC (%) 0–15 cm	SOC (%) 15–30 cr
Rainfed	2,858	66.4	58.2	10.6	0.27	0.18
$Drip^{Br}$	3,419	74.9	66.9	16.9	0.31	0.23
$Drip^{pod}$	3,092	64.4	60.1	13.2	0.28	0.19
$Drip^{Br+pod}$	3,468	76.1	65.1	17.4	0.32	0.25
$Irrigation^{Br+pod}$	3,262	74.5	60.2	15.0	0.29	0.22
CD (P=0.05)	225	7.01	4.4	2.6	0.21	0.17

Br, Branching; pod, pod formation

Fig. 2. Irrigation scheduling aided with overhead sprinklers and laser leveler (Precision tillage)



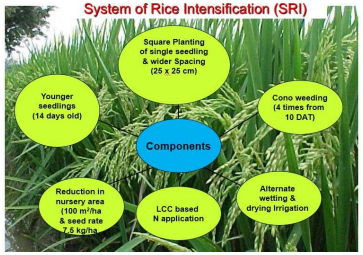
Adaptation strategies for Land degradation and greenhouse gas emissions

- Subsoiling
- Crop rotation, crop association and fallow and Legumes
- Grass strips
- Mulching
- Minimum tillage or zero-tillage
- Crop residues in combination with reduced and no tillage
- Bio-fertilizers
- Split fertilization
- Wetting/Drying rice
- Machine transplanting
- **SRI**

Direct seeded rice

- Direct seeding method can be an alternate for flooded conventional system for mitigating the methane emission.
- Direct seeding can be done in either in wet soil or dry soil (Alam *et al.*, 2020). Absence of anaerobic – Less emission of CH_4

SRI

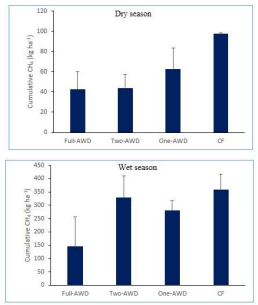


Bio-fertilizers

- Application of living organisms to seeds, plant surfaces and/ or soil.
- Reduce the environmental impacts (from volatilization and leaching) from chemical fertilizers which have a high macronutrient concentration.
- Improve nutrient availability for plants and increase yields.

Wetting/Drying rice

- Reduces rice water requirements by 30 percent.
- Reduces weed development by reducing water inputs necessary for the expansion of weeds.



Mitigation Potential and Yield-Scaled Global Warming Potential of Early-Season Drainage from a Rice Paddy in Tamil Nadu, India

Early Alternate Wetting and Drying treatment (reduced methane emissions by 35.7 to 51.5 %)

Effect of treatments on yield and methane Emission of Rice (mg /m²/day)
SRI rice cultivation under Inorganic farming + Azolla 250 Kg/ha recorded higher yield with lesser methane

	Coimbatore				Madurai				Aduthurai			
	Grain yield (kg/ha)	B:C ratio	Methane Emission		Grain yield (kg/ha)	B:C ratio	Methane Emission		Grain yield (kg/ha)	B:C ratio	Methane Emission	
			I	II			I	II			I	II
T_1	4386	1.6	67.7	110.3	3350	1.5	64.8	97.4	3463	1.4	76.9	116.4
T_2	5167	2.2	62.5	101.6	5285	2.3	58.9	90.7	5053	2.4	73.7	104.6
T_3	4821	1.7	63.6	96.3	3675	1.6	59.6	88.3	3775	1.5	70.8	102.6
T_4	5523	2.2	59.4	91.5	5387	2.4	55.6	85.3	5237	2.4	65.1	99.4
T_5	5034	1.7	52.9	85.3	3900	1.6	51.9	79.6	3993	1.8	60.3	90.6
T_6	5678	2.2	47.4	83.6	5650	2.4	49.8	75.8	5460	2.5	56.6	85.4

T_1 – SRI Organic farming, T_2 – SRI +Inorganic faming, T_3 – SRI Org + BGA, T_4- SRI + Inorg + BGA, T_5 SRI + Organic + Azolla, T_6 – SRI Inorganic + Azolla

I – Vegetative stage, II – Flowering stage

Influence of amendments on nitrous oxide emission in rice (mg $m^{-2} hr^{-1}$)

Treatments	Active Tillering	Panicle Initiation	50 per cent flowering	Maturity
T1	0.2442	0.3941	0.4238	0.5181
T2	0.1598	0.3218	0.4018	0.4231
T3	0.1634	0.3498	0.4237	0.4729
T4	0.1754	0.3338	0.4077	0.4484
T5	0.1864	0.3585	0.3892	0.5143
T6	0.1561	0.3179	0.3788	0.4114
T7	0.1611	0.3375	0.3933	0.4393
T8	0.1575	0.3312	0.3902	0.4188

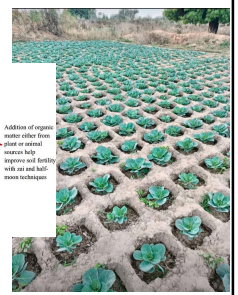
N_2O Emissions

Study revealed that application of **T_2 fly ash amendment alone with recommended dose of fertilizers** showed greater reduction in greenhouse gases throughout the crop stages. Fly ash with Silica Solubilizing Bacteria and Gypsum with Silica Solubilizing Bacteria also reduced GHG.

Management practices on NH_3 Volatilization loss from croplands (Pan *et al.*, 2022)

Category	Factor	Parameter	Factor favors NH_3 volatilization
Agricultural practices	Fertilization	• Crop selection and its dose level. • Types of fertilizer (e.g., granulated fertilizers). • Modification to fertilizer	• Timing of applying urea or animal urine[2]. • Urea and animal urine favor volatilization[2]
	Method of application	• Broadcasting vs subsurface application. • Deep injection. • Spraying or sprinkling	• Recommended depth for injection is 3–5 cm[2]
	Cultivation system	• Clean tillage/No-tillage. • Mulch/Sword. • Fallow rotation. • Type of land-use	• No-tillage farming favors[1]. • Crop residue on the soil surface favors[89]
Soil properties	pH	• Fertilizer hydrolysis. • Nitrification by bacteria	• High soil pH favors (especially calcareous soils)[80]
	Fertility	• Nitrogen content (or total ammoniacal nitrogen). • Organic matter (soil humus layer, buffering and sorption ability). • Cation exchange capacity (CEC)	• Initial mineral nitrogen content in soil should be considered[84]. • Low clay and organic matter favors[89]. • Low CEC favors[90]
	Moisture	• Texture (drainage)	• Initially moist soil followed by drying[89]
	Microbials	• The mobility and availability of nitrogen. • Nitrification/Denitrification processes	• Introducing biofertilizers[87] or mixed microorganisms[88] could reduce volatilization
Meteorological conditions	Precipitation	• Rainfall. • Humidity	• No rain or irrigation after application favors[89]. • Greater relative humidity of the air favors[89]
	Temperature	• Solar radiation. • Seasonal effect • Daily temperature difference	• High temperature (e.g., the peak temperature of the day) favors[2,14]
	Wind speed	• Wind speed/Wind erosion	• High wind speed favors[1]

Zai Pit System

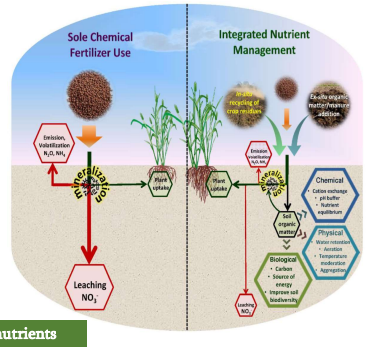


Zai is a conventional soil rehabilitation management practice where organic matter is buried in a small pit to help restore fertility and conserve water in the soil.

Soil management: Site-specific nutrient management

Site-specific nutrient management

- Provides economic benefits for farmers from lower input costs (fertilizers) and yield enhancements.
- Reduces GHG emissions (N_2O) through a more efficient use of nitrogen.



Balanced use of nutrients

Soil Test & Yield Target based Fertiliser Prescriptions (STCR-IPNS)

Rice (SRI)

Soil : River alluvium (Noyyal series)

Season : Rabi

FN = 4.63 T – 0.56 SN – 0.90 ON

FP_2O_5 = 1.98 T – 3.18 SP – 0.99 OP

FK_2O = 2.57 T – 0.42 SK – 0.67 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + Azospirillum @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + Azospirillum @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	SP	SK	FN	FP_2O_5	FK_2O	FN	FP_2O_5	FK_2O
200	18	300	159	58	25*	157	56	25*
220	20	350	148	52	25*	146	50	25*
240	22	400	137	46	25*	135	44	25*
260	24	450	126	39	25*	124	37	25*
280	26	500	114	33	25*	112	31	25*

*maintenance dose

Validation experiments/Field Demonstrations: Response ratio (Fertilizer Use Efficiency) and fertilizer savings

S.No	Crop	Soil / Soil Series	Response ratio (kg kg^{-1})	
			Blanket / Blanket + FYM @12.5 t ha^{-1}	STCR-IPNS (NPK based on STCR + FYM @12.5 t ha^{-1})
1.	Rice	Alluvial (Noyyal)	9.73	15.52
2.	Sorghum	Red sandy loam (Irugur)	10.67	16.24
3.	Pearl millet	Mixed black calcareous (PN palayam)	9.87	11.08
4.	Finger millet	Red sandy loam (Palaviduthi)	6.68	8.32
5.	Foxtail millet	Mixed black calcareous (PN palayam)	10.52	13.33
6.	Little millet	Red sandy loam (Irugur)	5.71	9.60
7.	Barnyard millet	Mixed black calcareous (PN palayam)	11.03	11.92
8.	Maize	Red sandy loam (Palaviduthi)	10.80	12.31
9.	Greengram	Red sandy loam (Irugur)	2.63	4.94
10.	Blackgram	Mixed black calcareous (PN palayam)	3.20	4.13

✓ Fertilizer saving: Fertiliser Nitrogen 19 kg ha^{-1} for rice under Kadambady soil series; in terms of Urea : 276.37 tonnes for an area of 6703 ha, if soil available Nitrogen is 200 kg ha^{-1}

Soil health cards

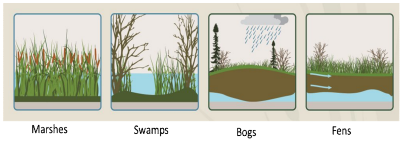
- The soil health card evaluates the health or quality of a soil as a function of its characteristics, water, plant and other biological properties.
- The card is a tool to help the farmer to monitor and improve soil health and give an indication on how much fertilizers need to be applied for the crop that will be grown in the ensuing season.
- Over use of chemical fertilizer could be avoided, at the same time any secondary or micro nutrient deficiency could also be rectified to maintain the soil health.

Utilising Organic manure

Organic manure	Nutrient content (%)		
	N	P	K
FYM	1.76	0.24	1.50
Vermicompost	1.00	0.16	1.45
Neem cake	1.97	0.15	1.05

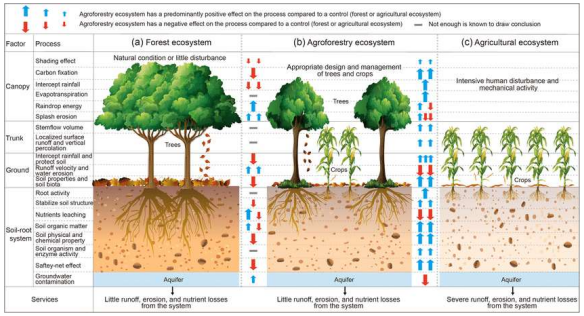
Others

Safeguarding the wetlands which sequester largest stores of carbon on the planet



Crop diversification and alternate cropping system with lesser Energy requirement

Agroforestry



- Carbon sequestration
- Root systems stabilize the ground
- Reduce soil erosion.
- Improves soil health
- Contributing to efficient and self-sufficient use of water.
- Canopy cover reduces evaporation

Agroforestry Models Developed by ICAR Institutes/Universities as per agroclimatic zones

Coconut (*Cocus nucifera*)

Guava (*Psidium guajava*)

Mango (*Mangifera indica*)

for North Eastern agro-climatic zone of Tamil Nadu Zones

Weather Based Crop Insurance for Risk Management In Agriculture

Weather Based Crop Insurance Scheme in Tamil Nadu

- WBCIS is being implemented in Tamil Nadu from Kharif 2008 onwards in selected districts viz., Salem, Dharmapuri, Perambalur, Ariyalur, Virudhunagar, Coimbatore, Villupuram and Dindugul
- 2010-11 Rabi onwards the scheme is extended to Tiruppur, Tirunelveli and Theni districts
- Crops Covered: Onion, Tomato, Chillies, Gherkins. Tapioca, Turmeric, Banana, Jasmine, Rose, Tuberose and Grapes are presently been covered

Sl.No	Implementing Agency	Districts
1	Agricultural Insurance Company of India Ltd.,	Dharmapuri. Perambalur, Ariyalur, Salem, Virudhunagar.
2	ICICI-Lombard General Insurance Company	Villupuram, Dindugul.
3	IFFCO-TOKIO General Insurance Company	Coimbatore, Thiruppur.
4	Cholamandalam MS General Insurance Company	Tirunelveli
5	HDFC-ERGO General Insurance Company	Theni.

WBCIS Implementing Agencies in Tamil Nadu

Performance of WBCIS in selected States of India Nagaraja *et al.*, 2015

S.No.	State	Indicators Used to Measure the Performance			
		Farmers Benefited Ratio (%)	Claims Settlement Ratio (%)	Average Area Insured (Hect. Per Farmer)	Claims Paid(Rs) / Gross Premium Collected (Rs) (%)
1	Rajasthan	49.9	97.2	1.37	57.5
2	Bihar	59.6	65.8	1.02	37.9
3	Andhra Pradesh	70.0	99.9	1.63	74.2
4	Maharashtra	24.7	99.0	0.97	53.1
5	Madhya Pradesh	77.9	92.4	1.66	47.6
6	Karnataka	67.0	99.3	1.23	51.0
7	Uttar Pradesh	49.3	29.2	0.80	12.1
8	Gujarat	34.3	100.0	0.83	38.3
9	Haryana	56.0	233.7	1.68	86.1
10	Orissa	68.3	100.0	1.45	56.8
All 18 States		52.1	89.2	1.30	51.3

Source: Calculated from Table. 14.12 (b)- Agricultural Statistics at a Glance-2014, p.351.

Working of WBCIS

An illustration of Ganganagar Tehsil of Ganganagar District in Rajasthan for Wheat crop is given below

District: Ganganagar	**Block: Ganganagar**
Crop: Wheat	**Sowing: Standard Sowing Period**

Sum Insured per Hectare (Rs.)	**22,500**
Sum Insured per Acre (Rs.)	**9,000**

Reference Weather Station: IMD/ Automatic Weather Stations (AWS) at Ganganagar

COVER 1: Heat or Rise in Mean Temperature Ganganagar District in Rajasthan for Wheat crop

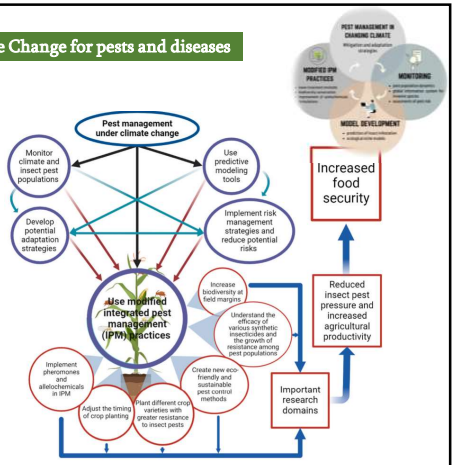
	STANDARD SOWING PERIOD					
Period (Fortnight)	**Jan-1st FN**	**Jan-2nd FN**	**Feb-1st FN**	**Feb-2nd FN**	**Mar-1st FN**	**Mar-2nd FN**
Fortnightly Trigger Temp. (°C) →	**12.86**	**13.59**	**14.95**	**16.31**	**19.72**	**22.91**
Rise in Fortnightly Mean temp (°C)	**Payout (Percentage of Sum Insured)**					
1.0	0.00	0.00	0.00	0.00	0.00	0.00
2.0	0.00	0.00	0.00	3.82	4.31	4.31
3.0	0.00	0.00	0.00	6.76	6.57	6.57
4.0	0.00	3.99	3.53	9.92	8.39	8.39
5.0	4.66	5.70	4.92	12.68	9.52	9.52
6.0	6.60	7.04	9.20	15.17	10.78	10.78

AICIL, website

- ***Cover Objective***: To cover anticipated yield loss due to rise in atmospheric temperature
- ***Cover period***: 1st January to 31st March

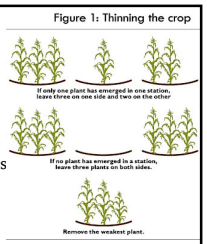
Adaptation Measure for Climate Change for pests and diseases

- Integrated pest management.
- Using available early warning system for insect pest.
- Biological control measures.
- Utilization of indigenous traditional knowledge base for Pest control.
- Soil solarization technique.
- Breeding for pest, disease and drought resistance varieties.
- Careful tracking of geographical distribution of pest.
- Phytosanitary regulations to prevent or limit the introduction to risky insect pest.



Agro advisories & Early warning systems

Agro advisories

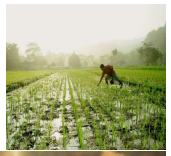


Drought:

- **Reduce plant population** (up to 15%) to minimize the transpiration .
- Need based **intercultural operations** - dust mulching to check the evaporation losses and for efficient soil moisture utilization.
- Adoption of **mechanical weed control**.
- Control/minimize the insect and pest incidence with **Panchagavya** and Jeevamirtham
- Traditional and drought **tolerant crops /varieties**
- **Mulching** with dry leaves, grasses and other organic farm waste to lower the sub surface temperature and evaporation losses.
- ***Insitu*** practices like field leveling, bunding, trenching, terracing and fallow ploughing to arrest runoff losses of water and top soil.
- ***Exsitu*** water harvesting practices like farm ponds, community tanks, watersheds and pools can prove a life saver.

Agro advisories for heat wave

- Increase the frequency of irrigation
- Irrigate only during the evening or early morning
- Use sprinkler irrigation
- Provide crop residue mulch
- If your area is prone to heat wave - wind/shelters breaks/Alley crops



Agro advisories for Cold wave

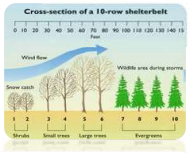
- Increase the frequency of irrigation with very minimum water
- Sprinkler irrigation to release latent heat of fusion by releasing heat into the surrounding air through condensation of water droplets.
- Irrigate only during the evening, dry soil more prone to frost
- Mulches helps during cold wave but detrimental long duration frost
- Do not disturb the soil, loosen surface reduce the conduction of heat from lower surface
- Burning of semi dry biomass to create smoke
- Area prone to cold wave - wind/shelters breaks/Alley crops
- Do not apply nutrient to soil during cold weather, plant could not uptake

Agro Advisories for torrential rain and flood

- **Advise raised bed cropping in flood prone areas**
- **Provide adequate drainage and water harvesting to farm ponds / common tanks**
- **Provide bunds/drench against slopes / along the contour to reduce erosion capacity of water**
- **Crisscross ploughing at regular interval to drain water safely & reduce erosion capacity of water**
- **Inward ring basin around the trees to harvest water in the root zone**
- **Keep 5 cm water in recently sown nursery to avoid seed displacement.**
- **Harvest the crops that at physiological maturity.**

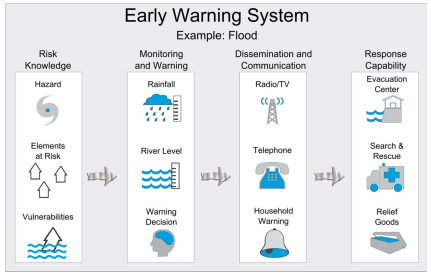
Agro Advisories for Heavy wind and Cyclone

- Provide **adequate support** to tall growing crops if WS increases
- If temperature increases >42°C, chances of **local squally** wind is more.
- **Proper pruning, thinning, training, propping, dethrashing and support should be given**
- Wind break and shelterbelts in wind prone areas
- Provide mulches to reduce wind erosion
- **Avoid irrigation in tall growing crops if heavy** wind is anticipated.
- Provide adequate drainage facilities if cyclonic storms expected
- Protect animal shed to withstand the heavy wind.
- **Keep gunny bags all around poultry sheds**



Early Warning Systems

- Information about weather forecasts and trends
- Helps preparing in advance for extreme weather events, such as heavy rainfall, storms, or heatwaves.



Crop Efficient zone

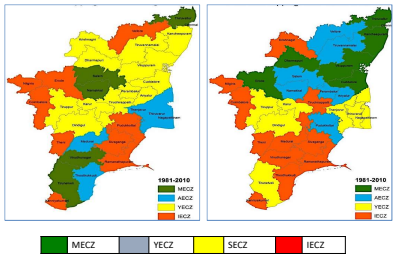
- Over the years, because of change in rainfall pattern, depletion of groundwater, reduced LGP there is spatial shift in crop potential.
- Uneconomic crops are grown by the farmers need to be replaced by the economically beneficial crops to achieve and sustainability.
- Reassess efficient crops for the present soil and climatic condition.

Crop Efficient Zone

Relative Spread Index (RSI) Relative Yield Index (RYI)

$$RYI = \frac{\text{\% of the total cultivable area in the district}}{\text{Area of selected crop expressed as \% to the total cultivable area in the State}} \times 100$$

$$RSI = \frac{\text{Mean yield of selected crop in a district (t/ha)}}{\text{Mean yield of selected crop in the state (t/ha)}} \times 100$$

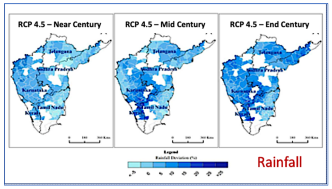


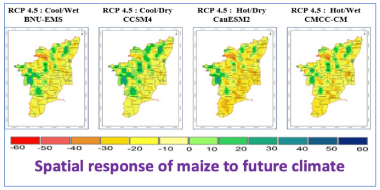
Web based "TNAU Moisture Adequacy Index" Software

- MAI is one of the important indices for agricultural drought assessment.
- TNAU MAI calculator is capable of calculating MAI for district and block level.
- Weekly rainfall value alone needed. Database is having normal PET values
- Any period, Yearly / Seasonal / monthly / weekly MAI could be calculated
- Useful for scientist, students, DoA officials & State Disaster management dept.

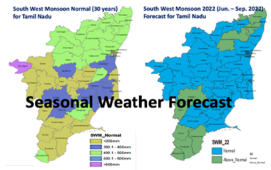
website
aas.tnau.ac.in/mai

Region specific climate change impact, mitigation and adaptation research instead of country / state as a whole





Downscaling the seasonal and medium range (block o village) weather forecast with higher accuracy

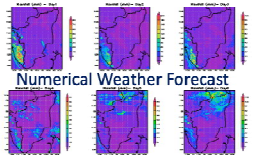


District (100km)

Block (27 km)

Block (27 km)

Village (3km)



TNAU - Weather Forecasting Services

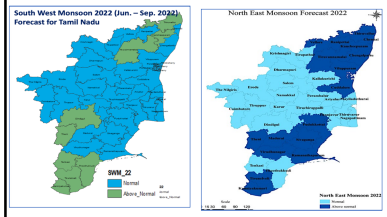
TNAU – Village Level Medium range Forecast

- At 3 km resolution, 35640 points in TN
- Next 6 days - Daily and Hourly scale
- Forecast in both Map & Table View
- Forecast Accuracy 70 – 80%
- Seven weather parameters
  - Rainfall & Wind Speed (2m & 10m)
  - RH, Max. & Min. Temperature
- Forecast for all revenue villages
- Public domain @ free of cost
- List of rainfall expected villages
- Easily locate extreme rainfall
- Can be linked to Uzhavan App

http://aas.tnau.ac.in/vlf/

Weather Forecast / Early warning of extreme events

TNAU's District Level Seasonal Forecast



- Since 2014, the only SAU issuing seasonal forecast
- District wise, twice during last week of May and Sep. for SWM and NEM, respectively
- Accuracy is 60 – 70%

TNAU's Village Level Medium Range Forecast

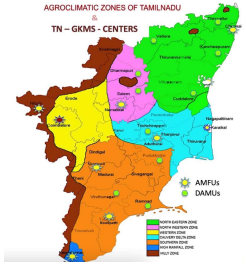
- Since, 2011, the only SAU issuing medium range forecast
- All revenue villages of TN @ 3km resolution for next 6 days
- Updated daily in open domain "http://tnau.ac.in/vlf
- Accuracy is 70 – 80%, list the intensity of rainfall

Map view of location specific forecast – Next hour

- Click any point at the map or Type latitude & longitude in the boxes will give next hour forecast

Farmers Connection Technologies

IMD's GKMS – AMFU & DAMU Centers



- Nine GKMS &. 11 DAMU centers
- Weather based block level agromet advisories
- Twice in a week as SMS thro' mKisan
- About 12.61 lakh farmer in TN receiving SMS

TNAU – Automated Agro Advisory Services

- Weather based, farm specific, crop and stage specific advisories
- 108 crops, 6 stages, 54 weather perils
- 48000 farmers registered and receiving SMS through mobile App

Heavy wind speed warning advisory from ACRC, TNAU

ஈரோடு மாவட்ட வானிலை சார்ந்த வேளாண் அறிக்கை

கடந்தவாரவானிலை (14.09.2021 முதல் 16.09.2021)				அடுத்தநாள்களுக்கானவானிலை முன்னறிவிப்பு - 22. 09.2021- 08.30 வரை				
14,09	15,09	16,09	தேதி	நாள்-1 18,09	நாள்-2 19,09	நாள்-3 20,09	நாள்-4 21,09	நாள்-5 22,09
0.0	0.0	1.9	மழை (மி.மீ)	4	4	12	10	3
30	34	33	அதிக பட்ச வெப்பநிலை (°செ)	33	33	33	33	33
23	23	23	குறைந்த பட்ச வெப்பநிலை (°செ)	23	23	23	23	23
5	6	6	மேக மூட்டம் (ஆக்டா)	8	8	8	8	7
77	76	78	அதிகபட்ச காற்றின் ஈரப்பதம் (%)	90	90	90	90	90
59	68	70	குறைந்தபட்சகாற்றின்ஈரப்பதம் (%)	50	50	50	50	50
22	17	19	காற்றின் வேகம் (கி.மீ/மணி)	20	20	20	20	20
230	230	230	காற்றுவீசும் திசை	230	230	230	230	230

எதிர்பார்க்கப்படும் வானிலை ஈரோடு (18. 09. 2021 முதல் 22. 09.2021)

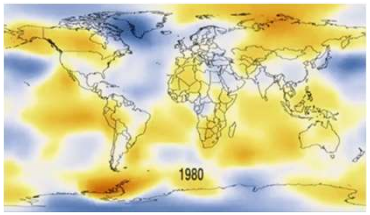
வரும் நாட்களில் வானம் பெரும்பாலும் மேக மூட்டத்துடன் காணப்படும். மேகமூட்டமான வானிலையுடன் இலேசான தூறல் மழை பொழிய வாய்ப்புள்ளது. அதிகபட்ச வெப்பநிலை 33°செ ஆகவும், குறைந்தபட்ச வெப்பநிலை 23°செ ஆகவும், காலைநேர காற்றின் ஈரப்பதம் 90 சதவிகிதமாகவும், மாலைநேர காற்றின் ஈரப்பதம் 50 சதவிகிதமாகவும் பதிவாக வாய்ப்புள்ளது. சராசரியாக காற்றின் வேகம் மணிக்கு 20 கி.மீ வேகத்தில், பெரும்பாலும் தென் மேற்குதிசையில் வீசக்கூடும்.

Advisory

பருத்தி		மழை எதிர்பார்க்கப்படுவதால் இறவையில் சாகுடி செய்யப்பட்டுள்ள பருத்திக்கு தழுத்த வடிகால் வசதி ஏற்படுத்தவும்.
வாழை		மழையுடன் காற்றின் வேகம் 15 கி.மீ க்கு மேல் அதிகிக்க வாய்ப்புள்ளதால் ரஸ்தாளி மாறுகைகளுக்கு வேலுள்ள வாழை மரங்களுக்கு முட்டு கொடுக்க வேண்டும்.
தென்னை		எதிர் பார்க்கப்படும் தூறல் மழையினைப் பயன்படுத்தி தென்னை மரத்தினை சுற்றியுள்ள பாத்திகளை ஆழப்படுத்துவதன் மூலம் பருவமழை மழை நீரினை வீணாகாமல் சேகரிக்கவாம்.

Date – 21.09.2021 – Anthiyur, Local circulation lodged 50000 banana trees

CLIMATE MODELING AND PROJECTIONS



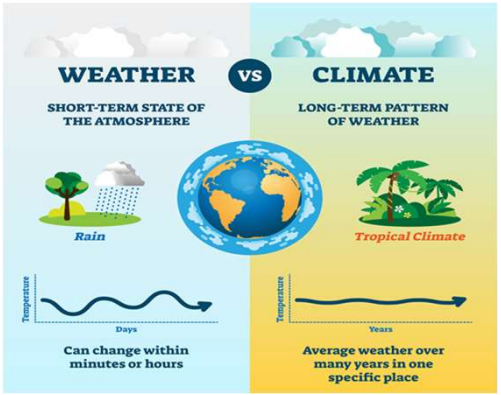
Presented by

Dr. R. Geetha, Project Scientist

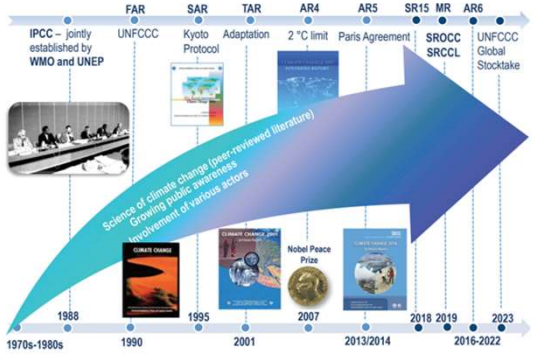
Ms. K. Sathyapriya , Project Associate

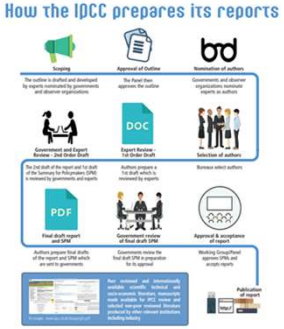
Climate Modeling Team, Centre for Climate Change and Disaster Management, Anna University

CLIMATE



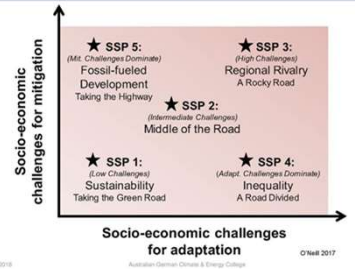
Intergovernmental Panel on Climate Change (IPCC)



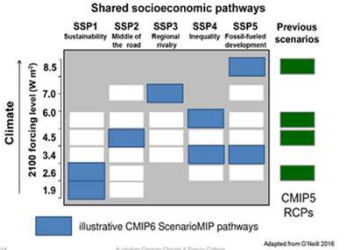


SHARED SOCIO ECONOMIC PATHWAYS (SSP)

SSP overview



SSP matrix

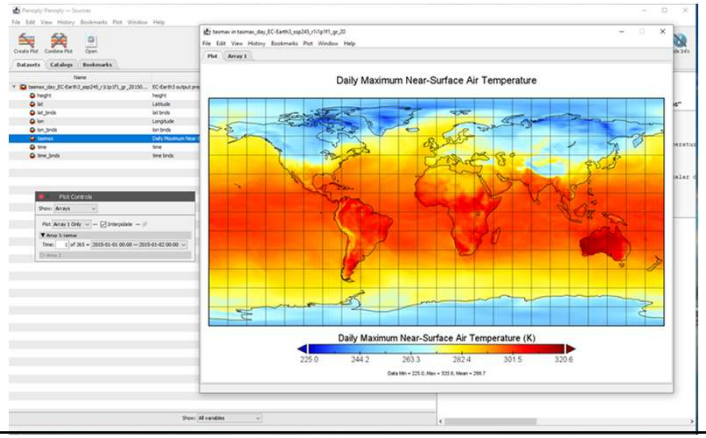


GLOBAL CLIMATE MODEL

- Global Climate Models(GCM) provide projections of future climate
- Climate change impacts occur at regional and national scales requires high resolution projections
- Downscaling provides finer details of climate projections

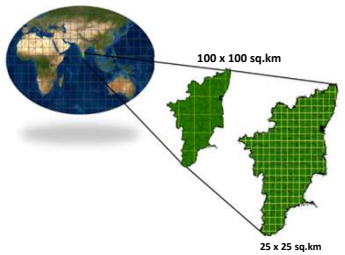
Climate Model Intercomparison Project 6 (CMIP6)

GLOBAL CLIMATE MODEL -VISUALIZATION



Downscaling of Global Climate Models

Two main approaches for downscaling climate model outputs are



Statistical Downscaling

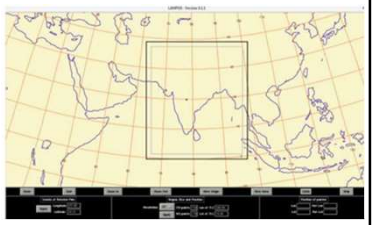
Dynamical Downscaling

STATISTICAL DOWNSCALING

- Statistical downscaling methods use the empirical relationship between large-scale circulation based predictor variables and regional climate variables
- It is based on the assumption that the statistical relationship between large-scale GCM outputs and observational data established for the present-day climate remain unchanged in future climate

DYNAMICAL DOWNSCALING

- A Regional Climate Model (RCM) is used with GCM outputs to create higher spatial resolution data via dynamical downscaling.
- RCMs can simulate the past or predict/project the future regional climate
- They require spatially detailed topography and land-use datasets as input data, as well as initial and boundary conditions(which are generally created from GCM outputs)



High Performance Computing System

Outline

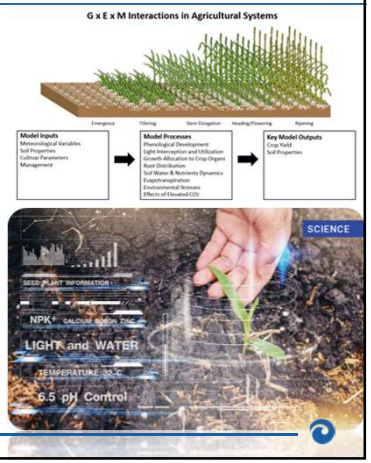
- ❑ Crop simulation model (CSM)
- ❑ Crop simulation model concepts
- ❑ CSM Applications
- ❑ DSSAT – Overview
- ❑ DSSAT Components

Issues for Agriculture in the 21st Century

- **Food security**
- **Climate related risks**
- Increased demands for agricultural products
- Increased water scarcity
- Rapid changes in land use and cropping patterns
- Information needed for **decision making** (crop choosing, sowing and management)
- Gap between information needed and that created by traditional agronomic research
- High and increasing **costs of field experimentation**
- Need for **integration of knowledge**

Crop simulation model

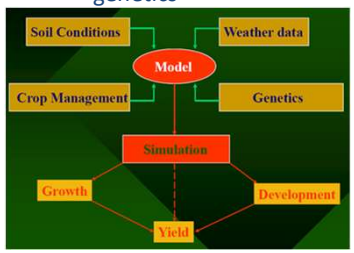
- ✓ A crop simulation model is a computational tool or software program designed to mimic and simulate the growth, development, and yield of crops within an agricultural system.
- ✓ These models integrate various factors such as weather conditions, soil properties, crop genetics, and management practices to simulate how a crop would respond and evolve over time under different scenarios.
- ✓ By utilizing mathematical algorithms and equations, crop simulation models provide insights into how crops interact with their environment and respond to changes, enabling researchers, agronomists, and farmers to make informed decisions about crop management, resource allocation, and risk assessment.



Crop simulation models

Calculate or predict ***crop growth and yield*** as a function of:

- soil conditions
- weather conditions
- crop management
- genetics



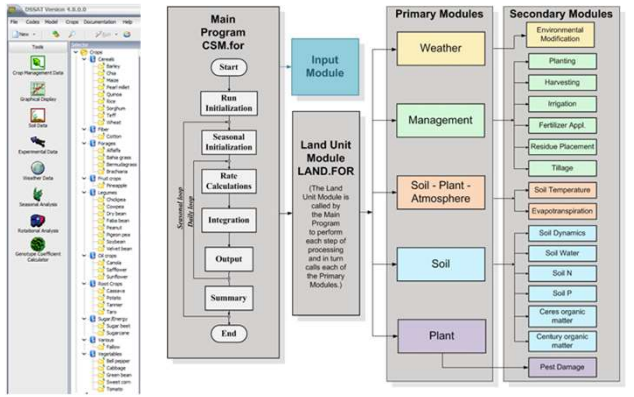
Model available

- DSSAT - The Decision Support System for Agrotechnology Transfer (DSSAT)
- INFOCROP
- WOFOST - FORTRAN version of the WOrld FOod STudies (WOFOST) crop simulation model
- PCSE - Python Crop Simulation Environment (PCSE/WOFOST)
- ApsimX - ApsimX is the next generation of APSIM

DSSAT

- **Decision Support System** for Agrotechnology Transfer (DSSAT) is a software application program that comprises **crop simulation models for over 42 crops** (as of v4.6).
- DSSAT is supported by **data base management programs** for **soil, weather, and crop management and experimental data**, and by utilities and application programs.
- The crop simulation models in DSSAT **simulate growth**, **development** and **yield** as a function of the soil-plant-atmosphere dynamics

DSSAT-CSM-Components



(Jones et al., 2003; Hoogenboom et al., 2010)

DSSAT - Tools

Crop management

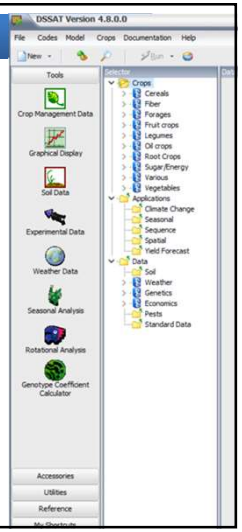
Graphical display

Soil data- S build

Weather Man

Experimental - X Build

G Build



MINIMUM DATA

The Minimum Data Set (MDS) refers to a minimum set of data required to run the crop weather models & crop model simulation & outputs.

Evaluation requires:

❑Site weather data for the duration of the growing season

❑Site soil profile & soil surface data

❑Crop management data from the experiment

❑Observed experimental data from the experiment

Weather data

The minimum required weather data includes:

❑Latitude & longitude of the weather station

❑Daily values of incoming solar radiation (MJ/m-day)

❑Maximum & minimum daily air temperature(◦C)

❑Daily total rainfall (mm)

Weather Man

- Weather Man is a tool for importing, analyzing, and exporting daily weather data for use in crop simulation modelling and other activities.
- This includes quality control and filling gaps in data through generated values that match the statistical properties of the rest of the data set.

Soil Data

Soil profile data by soil horizons include:

upper and lower horizon depths (cm),
percentage sand, silt, and clay content,
1/3 bar bulk density,
organic carbon,
pH in water,
saturation, androot abundance information.

S Build

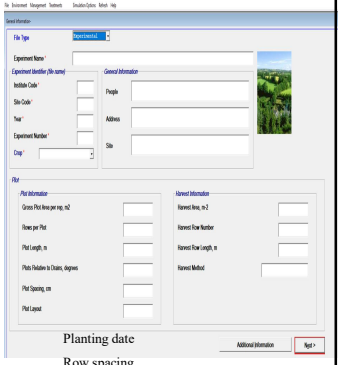
- S Build provides a simple tool for creating and modifying soil profile properties required to simulate crops in DSSAT.
- S Build can be used to edit or add profiles via a user-selected soil file (Soil.sol or *.sol), which contains data on the soil profile properties.
- These data are used in the soil water, nitrogen, phosphorus and root sections of the crop models.
- S Build is a Windows program that allows the user to enter data into tables, freeing the user from possible formatting errors associated with entering data directly into an ASCII file. Given basic data on soil texture by depth, the program can estimate missing data via pedo transfer functions.

Genetic Coefficients

- **Species parameters and functions**
Defines the response of a crop to environmental conditions, including temperature, solar radiation, CO_2 and photoperiod, as well as plant composition and other functions and parameters
- **Ecotype coefficients**
Defines coefficients for groups of cultivars that show similar behavior and response to environmental conditions.
- **Cultivar coefficients**
Cultivar and variety specific coefficients, such as photothermal days to flowering & maturity, sensitivity to photoperiod, seed size, etc.
- GenCALC and GLUE

Management and Experimental Data

Management data includes information on planting date, dates when soil conditions were measured prior to planting, planting density, row spacing, planting depth, crop variety, irrigation, and fertilizer practices. These data are needed for both model evaluation and strategy analysis.

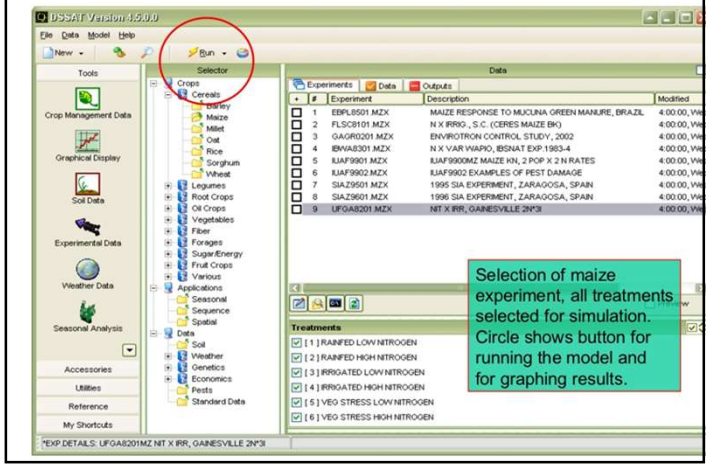


In addition to site, soil, and weather data, experimental data include crop growth data, soil water and fertility measurements. These are the observed data that are needed for model evaluation.

Planting date
Row spacing
Crop variety
Irrigation
Soil condition prior to planting
Planting depth

X Build

- X Build program provides a menu-driven interface for describing experiments in terms of treatments, environments (soil and weather), crop manage more and simulation options.
- It allows users to specify any combination of management options for simulation of several crops for purpose of validation (comparison with observed data), seasonal analysis, crop rotations, and spatial analysis that are available in DSSAT.
- The software outputs DSSAT File X data files.



AT Create

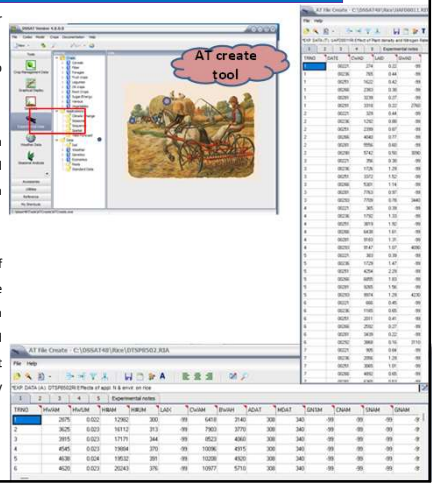
AT Create is the Experimental Data Utility for conveniently entering crop measurement data The tool can create two types of crop measurement files:

1. **A file**

   Summary, primarily end of season average performance (A) data, and critical phenological observations, such as flowering data and maturity date.

2. **T file**

   Time series (T) observations, such as leaf area index measured multiple time during the growing season, growth analysis data, including leaf, stem, and reproductive biomass, soil moisture at different depths over time, and many others.



DSSAT Sens

- DSSAT Sens is a sensitivity analysis tool that allows a user to check the sensitivity of the model to changes in input parameters.
- In a standard sensitivity analysis all inputs are kept the same except for one or two inputs that are changed at a fixed interval from a starting to an ending value.
- In the DSSAT Sens tool the user selects the input parameter that he/she wants to change, its initial value, the interval, and the number of iterations.
- DSSAT Sens then creates a new crop model input file.
- Inputs that can be changed include cultivar selection, cultivar coefficients, crop management including planting date, spacing and plant density, soil profile and weather data.

Easy Grapher

Easy Grapher is a graphing and analysis program .It allows users to manipulate time series and cross-validation graphs for all simulation runs and calculates validation statistics. Easy Grapher can:

- Create time-series graphs;
- Display measured data in simulation graphs;
- Create evaluation graphs, e.g. graph simulated data (x) against measured data (y) for overall runs; and
- Calculate evaluation statistics such as RMSE, E, EF and d (degree of agreement), and display them on a validation graph.

GBuild

- GBuild is a plotting tool for data visualization that provides users with the capability to easily plot graphs that are routinely used during the development and validation of crop models. Different graphic options give different views of the research results.
- GBuild lets one compare data from experimental measurements with results from simulation models.
- Additionally, GBuild calculates statistics based on experimental and simulated data. The output can be seen on the screen, printed, and can be saved in a file.
- It also provides the possibility of exporting the data into an Excel spread sheet, or to a text file. The program is leads the user through a series of steps to graph the desired results.

Gen Select

- Gen Select is the user interface to define the inputs for the Genetic Coefficient Calculator GENCALC.
- After a user selects a crop and cultivar, GENCALC will show all experiments and treatments associated with this cultivar.
- The user then select the appropriate treatments, preferably the non-stressed treatments, for model calibration using GENCALC

GLUE Select

- GLUE Select is the user interface to define the inputs for the Genetic Coefficient Estimator GLUE.
- GLUE stands for Generalized Likelihood Estimator and uses a pseudo-Baysian method for estimating the values and associated uncertainty for each cultivar or genetic coefficient.
- A very large number of simulations are required to be able to obtain an accurate estimate for the cultivar coefficients.
- One of the requirements is that the crop model input data are complete and that the treatments that are being used for model calibration were not exposed to any water or nutrient stress and pests, weeds, and diseases.

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

VISION

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

MISSION

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

CONTACT

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