



Training Report on **Climate Modelling and Risk** **Assessment Framework for** **Risk-Informed Adaptation** **Planning**

Training Report on

Climate Modelling and Risk Assessment Framework for Risk-Informed Adaptation Planning

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This training programme stands as a testament to our shared commitment to climate-resilient development and collaborative knowledge building. Together, we are advancing Odisha's journey towards sustainable, climate-informed agricultural planning and strengthening the resilience of its farming communities.

Executive Summary

This report summarises the outcomes of a training programme, 'Climate Modelling and Risk Assessment Framework for Risk-Informed Adaptation Planning,' which was held in Bengaluru on 12–13 September 2025. The training programme—organised by the Department of Agriculture and Farmers' Empowerment (DA&FE), Government of Odisha (GoO), and Centre for Study of Science, Technology and Policy (CSTEP)—is the second in a series of capacity-building programmes aimed at improving climate resilience in Odisha's agriculture sector.

Building on the learnings from the first training programme, this programme trained fifteen officials from three directorates of DA&FE: Agriculture and Food Production, Horticulture, and Soil Conservation and Watershed Development. The officials were chosen from the first training programme group on the basis of their interest and abilities. The curriculum aimed to help participants better understand climate modelling concepts, analytical methods, and risk assessment frameworks to support risk-informed adaptation planning. It included lectures from experts, interactive discussions, and hands-on exercises that taught participants how to analyse historical climate data, perform projections, assess hazards and exposures, and quantify vulnerability and risk.

Participants explored diverse subjects over two days, encompassing the necessity and development of climate models, data sources for climate forecasts, visualisation and interpretation of model outputs, and techniques for performing hazard, exposure, and vulnerability studies. Facilitators from CSTEP and experts in climate change led the sessions, making sure that both theoretical and practical skills were developed. The programme also included interactive games and case-based activities to help participants remember what they learnt and work together to solve problems. Participants liked how relevant, structured, and technically deep the programme was. They also liked how it gave them hands-on experience in analysing climate data and assessing risks.

Participants were particularly keen on climate data analysis and visualisation, sectoral risk assessment methods, and the use of climate risk information in agricultural planning and decision-making. The talks made it clear how important it is to connect scientific information with policy and programme execution to improve climate adaptation at the state and district levels.

This training programme is an important step towards creating a group within DA&FE that is technically equipped to use climate and risk analytics to inform evidence-based agricultural plans that account for risk. The programme demonstrated once again that Odisha needs to continue expanding its capacity, work together across sectors, and use scientific data to make decisions that will help the state's agriculture become more resilient to climate change.

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Abbreviations

AI	Artificial intelligence
APHRODITE	Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation
AR5	Assessment Report 5 (of the Intergovernmental Panel on Climate Change)
CDO	Climate Data Operators
CFSR	Climate Forecast System Reanalysis
CMIP6	Coupled Model Intercomparison Project Phase 6
CORDEX	Coordinated Regional Climate Downscaling Experiment
CRU	Climatic Research Unit
CSA	Climate-smart agriculture
CSTEP	Center for Study of Science, Technology and Policy
CSV	Comma-separated values
DA&FE	Department of Agriculture & Farmers' Empowerment
ERA5	European Centre for Medium-Range Weather Forecasts Reanalysis Fifth Generation
GHCN	The Global Historical Climatology Network
GRIB	GRIdded Binary
GIS	Geographic Information System
GCM	Global climate model
GoO	Government of Odisha
IMD	India Meteorological Department
ICAR	Indian Council of Agricultural Research
IPCC	Intergovernmental Panel on Climate Change
ML	Machine learning
MODIS	Moderate Resolution Imaging Spectroradiometer
MERRA2	Modern-Era Retrospective analysis for Research and Applications
NetCDF	Network Common Data Form
OUAT	Odisha University of Agriculture and Technology
QGIS	Quantum Geographic Information System
RCM	Regional climate model
SAU	State agricultural university
SSP	Shared Socio-economic Pathway
TRMM	Tropical Rainfall Measuring Mission





1. Introduction

Odisha's agriculture sector is increasingly exposed to the impacts of climate change. Recurrent climate hazards such as heatwaves, droughts, floods, and cyclones adversely affect crop productivity, water availability, soil health, and rural livelihoods.

These challenges are compounded by knowledge gaps, limited access to adaptive technologies, and constrained decision-making capacity at the state and district levels. To help address this gap, the Center for Study of Science, Technology and Policy (CSTEP), in collaboration with the Department of Agriculture & Farmers' Empowerment (DA&FE), Government of Odisha (GoO), is supporting the state's transition to climate-smart agriculture (CSA). This partnership aims to enhance institutional capacity, improve climate literacy, inform policy, and promote sustainable practices in the state's agriculture sector.

As part of this effort, CSTEP and DA&FE have launched a series of capacity-building programmes. This training programme, the second in the series, focused on building technical skills to quantify vulnerability and risk in the agriculture sector. It aimed to deepen participants' understanding of how climate data, sectoral indicators, and analytical tools can inform prioritisation and adaptation strategies. The concept note and agenda are included as Appendix A and Appendix B, respectively.



1.1. Objectives

The training programme was designed as a progressive learning pathway—moving from foundational concepts in climate data to applied risk assessment and informed decision-making for CSA (Figure 1).

Figure 1: Progressive learning pathway of the training programme



2. Participant Overview

The training programme was conducted for fifteen district- and state-level officials from the three directorates of DA&FE: Agriculture and Food Production, Horticulture, and Soil Conservation and Watershed Development. Officials who participated in the first training programme were screened for their interest and aptitude. Subsequently, selected officials were nominated by DA&FE for this training programme. The participant list is provided in Appendix C.

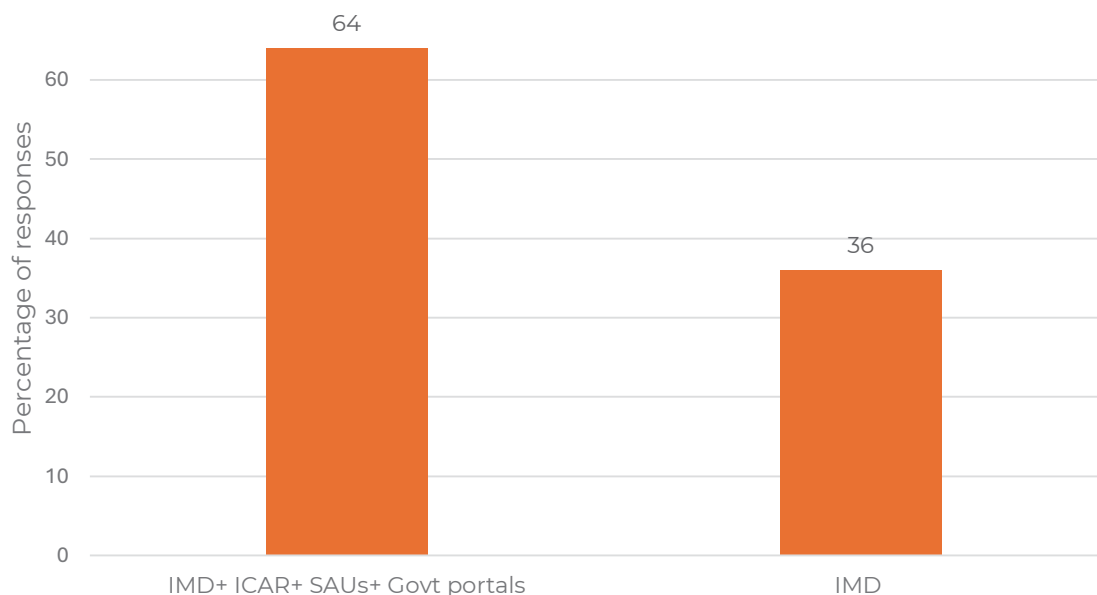
2.1. Participants' pre-training knowledge and expectations

To understand baseline knowledge and training expectations, the participants were asked to complete a short pre-training survey before the sessions began. The survey assessed their familiarity with core climate risk concepts, including the distinction between weather and climate, key data sources, and the role of climate models in risk assessment. It also included a question about whether the participants had benefited from the previous capacity-building training programme by applying climate change knowledge in their district-level work. The responses provided a snapshot of existing understanding and helped tailor subsequent sessions to strengthen capacities in interpreting model data and integrating risk information into agricultural planning.

Overall, the responses indicated that the participants had a fair conceptual understanding of climate-risk fundamentals but were limited in their familiarity with the technical aspects of modelling and risk analysis. All the participants could correctly distinguish between weather and climate and identified that a climate change model provides future climate trends and scenarios. However, comprehension of climate data sources and risk-assessment frameworks was relatively low.

When asked, 'Which of the following sources provides climate and weather data in India?', only about 36% of the participants correctly identified the India Meteorological Department (IMD) as the primary source. The remaining respondents selected Indian Council of Agricultural Research (ICAR) / state agricultural universities (SAUs), state government portals, or all of the above, indicating some overlap and confusion regarding the roles of different institutions in climate data generation and dissemination (Figure 2). This highlights the need to familiarise officers with the roles of institutions involved in climate data generation and how such data sets can be accessed and applied in risk assessment.

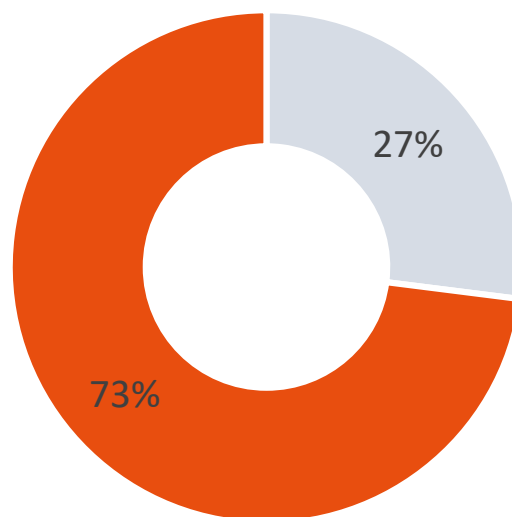
Figure 2: Participants' understanding of institutional sources of climate and weather data in India



Understanding of the key components of the climate-risk assessment framework varied among the participants. Around 73% of them correctly recognised that effective agricultural risk assessment relies on combining multiple data sets, such as historical climate records, soil and crop-yield data, and market information, indicating awareness of the importance of integrated data use. However, only about 36% of the participants accurately identified ‘the ability of farmers to cope and adapt’ as the correct definition of vulnerability within the framework. The remaining responses reflected confusion among exposure, hazard frequency, and vulnerability, pointing to the need for continued emphasis on how data and vulnerability indicators interact to shape overall climate risk.

All the participants demonstrated a strong understanding of fundamental aspects of climate risk and adaptation planning. They correctly identified that climate hazards encompass a range of extreme events, including floods, droughts, and heatwaves, indicating a sound understanding of the different types of risks affecting agricultural systems in their districts (Figure 3). Likewise, all of them recognised that developing an effective district-level climate risk-informed adaptation plan requires the participation of farmers, local communities, and multiple government departments. This reflects a shared appreciation of the need for inclusive, multi-stakeholder approaches in planning and implementing adaptation measures.

Figure 3: Participants' understanding of key data inputs for climate-risk analysis



- Historical rainfall and temperature records
- Historical rainfall and temperature records + Soil and crop-yield data + Market price data



3. Training Content & Delivery Methods

To enrich the learning experience, the training programme combined expert-led lectures, interactive discussions, and hands-on technical activities. The sessions were intended to help participants understand climate data and risk assessment methodologies, both in theory and practice (Figure 4). Hence, each theoretical session was followed by a hands-on exercise, which enabled the participants to directly implement the knowledge they had acquired in the Geographic Information System (GIS), command-line tools for processing Network Common Data Form (NetCDF) files, and data analysis environments. This participatory approach facilitated collaborative learning and enhanced conceptual clarity among the participants. The subsequent subsection outlines the flow of the two-day training programme.

Figure 4: Overview of training methodologies



3.1. Training outline

The training programme commenced with a welcome address by Dr Indu K Murthy (Head, Climate, Environment and Sustainability, CSTEP), followed by Dr Sangram Keshari Pattanaik (Joint Director of Agriculture, DA&FE), who highlighted the significance of climate preparedness in agriculture to establish the context. A keynote lecture by Dr K J Ramesh, the former Director General of IMD, established the scientific foundation by elucidating the necessity, evolution, and applications of climate modelling. This was followed by the launch of a training report that summarised the findings of the first capacity-building programme, signifying the ongoing partnership between CSTEP and DA&FE (Figure 5).

Figure 5: Photos capturing the inception of the training programme



The participants were introduced to observed climate data sources, climate change projections, and downscaling methods during subsequent sessions conducted by Dr Indu K Murthy and Ms Vidya S. These sessions were supplemented by practical exercises that directed the participants in data retrieval, visualisation, and interpretation. An interactive lab session on climate data analysis techniques concluded the first day; the session utilised real data sets to discern trends and variability across time scales.

Ms Tashina Madappa provided an introduction on the second day, which emphasised the relationship between hazard, exposure, and vulnerability as conceptualised in the Intergovernmental Panel on Climate Change (IPCC) risk assessment framework. The focus of the day stayed on the risk assessment framework. The subsequent sessions, which were conducted by Ms Vidya S, Mr Pradeep M S, and Ms Vidhatri Thakkar, explored the practical aspects of mapping hazard zones, identifying exposure indicators and quantifying vulnerability using GIS and climatic data. Mr Achintya Gupta also facilitated an interactive game that helped the participants internalise the process of indicator weighting and prioritisation in vulnerability and risk assessment. Lastly, the day concluded with a session on identifying key drivers and quantifying overall risk, which was led by Ms Tashina Madappa.

3.2. Session-wise descriptions

Session 1: Climate modelling – Need and evolution for supporting decision-making and policies | Dr K J Ramesh



Methodology

Presentation and interactive discussion



Topics Discussed

- How global warming and ocean warming interact with Earth system processes, causing climate change.
- Climate services and their importance in agriculture, disaster risk reduction, energy, health, and water security.
- Observed and expected variations in rainfall, monsoon, and extreme weather in India.
- The socio-economic risks of climate change for India (droughts, floods, cyclones, and sea level rise).
- How artificial intelligence (AI), machine learning (ML), and new technologies can be integrated into risk management and sustainability frameworks.
- Adaptation and mitigation goals for India, including those pertaining to agriculture, water management, early warning systems, and coastal risk mapping.



Key Learning Outcomes

- Climate risks in India are intensifying, with more frequent droughts, floods, cyclones, and extreme heat events.
- Agriculture and water resources are extremely susceptible, as alternating monsoon patterns jeopardise food security and livelihoods.
- Strengthening climate services and early warning systems is critical, as they deliver high returns in reducing disaster losses.
- Urgent adaptation measures are needed, including efficient irrigation, sustainable farming, and coastal protection.
- Emerging technologies such as AI, ML, Internet of Things, and 3D GIS can play a major role in climate-risk assessment and disaster management.
- Strong collaboration among policymakers, scientists, businesses, and communities is essential to scale resilient solutions.



Session 2: Historical and climate change projections – Data sources and analysis | Vidya S and Dr Indu K Murthy



Methodology

Presentation and interactive discussion



Topics Discussed

- This session was conducted in two parts. The first part focused on the significance of historical climate data. The participants were introduced to long-term patterns in temperature, precipitation, droughts, and extreme events that can be observed using historical data. Ground stations (IMD), satellites, gridded data sets (Climatic Research Unit [CRU] and Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation [APHRODITE]), and reanalysis products (European Centre for Medium-Range Weather Forecasts Reanalysis Fifth Generation [ERA5] and Climate Forecast System Reanalysis [CFSR]) were among the data sources shared with them.
- The second part covered the definition of climate models and their necessity—climate models simulate interactions within the Earth system (which includes the atmosphere, oceans, land, and ice) to project future climatic conditions.
- The discussion covered the role of Shared Socio-economic Pathways (SSPs) in shaping future climate scenarios, the distinction between global climate models (GCMs) and regional climate models (RCMs), and the relevance of spatial resolution in climate data.
- The facilitators also highlighted the need for downscaling and bias correction to ensure data applicability at local scales, with India's Coordinated Regional Climate Downscaling Experiment (CORDEX) South Asia cited as a key initiative providing high-resolution climate projections for India.



Key Learning Outcomes

- Better comprehension of the changes in temperature, precipitation, droughts, and extreme occurrences by analysing historical climate data.
- Historical data supports in risk management and strengthens agricultural planning, water resource management, and disaster preparedness for farmers, planners, and policymakers.
- Climate predictions analyse potential future climate change scenarios using sophisticated models.
- Although these forecasts are not precise, they offer believable futures that inform adaptation and preparation.
- Models that have been downscaled and bias-corrected provide more dependable, localised insights for decision-making.
- Climate-risk assessment relies on projections and historical data to help society prepare for current and future issues.

Session 3: Visualising climate data from climate model outputs | Pradeep M S



Methodology

Presentation and interactive discussion



Topics Discussed

- This session focused on enhancing participants' understanding of how to decode, process, and visualise climate models' output data sets.
- It began with an introduction to the structure and formats of climate data sets, particularly focusing on NetCDF and Gridded Binary (GRIB) files.
- Participants were guided on how to decode parameters from metadata. This sparked a curious and interesting set of questions on data structures, types, and scope, followed by a short discussion on various topics such as data variables, units, data resolution, and temporal and spatial dimensions.
- Further, an engaging discussion took place on how these parameters help in selecting visualisation methods. The session also covered the selection of tools or software for visualisation, including GIS, Quantum GIS (QGIS), programming languages (Python, R), and web platforms (Google Earth Engine).
- Considerable time was also spent in pre-processing raw climate data before selecting visualisation methods, which includes data cleaning and data aggregation to make sure the data sets are error-free. In a few case-study examples, visualisation types (gradient maps, choropleth maps, and time slots) were introduced, and guidance was provided on selecting the most appropriate method based on the research or decision-making context.



Key Learning Outcomes

- Improved understanding of climate data formats.
- Ability to read and interpret metadata for variables and dimensions.
- Awareness of data pre-processing techniques to ensure data quality.
- Knowledge of tool selection for climate data visualisation.
- Enhanced capacity to select effective visualisation types for different purposes.

Overall, the participants gained confidence in handling climate data sets and recognised the importance of standard workflows, from decoding to visualisation.





Concept refresher quiz

To ensure the post-lunch session was engaging and to evaluate the extent to which participants understood the concepts discussed in the morning sessions, an interactive multiple-choice assessment on climate data and hazard analysis was administered. The quiz was designed to review fundamental concepts, including the components of climate models, hazard characteristics (intensity, frequency, and duration), and basic risk concepts, as well as the categories of climate data sets (observed, reanalysis, and model-based). The participants engaged in a lively discussion, elucidating their questions and reaffirming their comprehension. This not only re-energised them for the upcoming technical sessions but also reinforced their comprehension. The facilitators were able to assess the participants' understanding of the morning discussions and establish an engaging learning environment through this activity.



Question
[next >](#)

Session 4: Hands-on activity: Climate data processing (historical and projected) | CSTEP team



Methodology

Presentation, hands-on practice with Climate Data Operators (CDO) commands, and interactive discussion



Topics Discussed

- Where to access the projected and observed climate data. How to read and download the data.
- CDO, a potent open-source tool for processing and analysing climate data, was shown. Sources of climate data included satellites (Tropical Rainfall Measuring Mission [TRMM] and Moderate Resolution Imaging Spectroradiometer [MODIS]), reanalysis (ERA5 and Modern-Era Retrospective analysis for Research and Applications, Version 2 [MERRA2]), observations (IMD and The Global Historical Climatology Network [GHCN]), and projections (Coupled Model Intercomparison Project Phase 6 [CMIP6] and CORDEX).
- The structure, benefits, and file format of NetCDF for storing climatic data. CDO commands for temperature and rainfall analysis, including those for exporting to comma-separated values (CSV) and aggregation (monthly/seasonal). Temperature and precipitation patterns over time and space.



Key Learning Outcomes

- The ideal format for climate data sets is NetCDF, which effectively handles large-scale multidimensional data.
- For processing and evaluating climate data (aggregation and climatic indices), CDO is an effective open-source program.
- Skills in extracting region-specific data sets and translating them to usable formats (CSV/Excel) were enhanced through practical exercises.
- Risk mapping, adaptation planning, and hazard identification are all directly impacted by spatial and temporal climate analysis.
- Aligning vulnerability and climate-risk assessments with district- and state-level climate action planning is crucial.
- Ability to retrieve, handle, and analyse climate data for climate-risk evaluations.



Session 5: Introduction to risk assessment | Tashina Madappa C



Methodology

Presentation and interactive discussion



Topics Discussed

- Fundamentals of climate-risk assessment using the IPCC Fifth Assessment Report (AR5) framework and practical illustrations from the agriculture sector.



Key Learning Outcomes

- Conceptual clarity on how climate risk emerges from the interaction of hazard, exposure, and vulnerability.
- Sequential steps in conducting a risk assessment and how indicator selection influences results.
- Global databases and tools that can be adapted for regional risk profiling, such as INFORM, the World Bank's Climate Change Knowledge Portal, and the World Resources Institute's Aqueduct.
- Conceptual foundation for subsequent quantitative modules on hazard, exposure, and vulnerability.
- Bridging of theoretical understanding with practical applicability by linking global frameworks to Odisha's context.



Session 6: Hazard analysis – Calculating the probability of occurrence and spatial extent of hazards | Vidya S and Pradeep M S



Methodology

Presentation and interactive discussion



Topics Discussed

- Definition of a hazard and its components—intensity, frequency, duration, and spatial extent.
- A hands-on exercise on heatwave hazard analysis for Odisha using ERA5 data.
- Spatial representation of the heatwave hazard, along with the probability of occurrence of the hazard for the risk assessment.



Key Learning Outcomes

- A risk is not yet a disaster; it only becomes harmful when it comes into exposure to people, property, or environments that are open and at risk.
- Hazard analysis is done in two steps: mapping the hazards and computing the probability of occurrence.
- By mapping out where hazards happen and how intense they are and predicting how often they come back, hazard analysis helps us plan better and lower the risk of future disasters.



Session 7: A quick guide to exposure analysis | Pradeep M S



Methodology

Presentation, interactive discussion, and hands-on session using QGIS



Topics Discussed

- In-depth discussion on the relevance of climate exposure.
- Step-by-step workflow for exposure mapping and assessment. Identification and selection of exposure indicators, followed by collection of spatial data sets (from primary and secondary sources), data pre-processing, analysis, and visualisation method in a GIS environment.
- Exposure assessment and mapping of crop land as an indicator of heatwave events by using QGIS and Excel.
- Linking data visualisation techniques for selecting the visualisation type.
- Exposure assessment outcomes using a choropleth map.



Key Learning Outcomes

- Understanding of how exposure shows that people, property, and ecosystems are in danger zones.
- Using QGIS for overlay and intersection methods to measure spatial exposure.
- Calculating exposure percentages and showing on thematic and composite maps.

Overall, this session helped participants connect conceptual knowledge with practical GIS-based applications, enhancing both their analytical and interpretive skills in exposure assessment.



Session 8: Interactive game - Understanding weighting and prioritisation in vulnerability assessment | Achintya Gupta

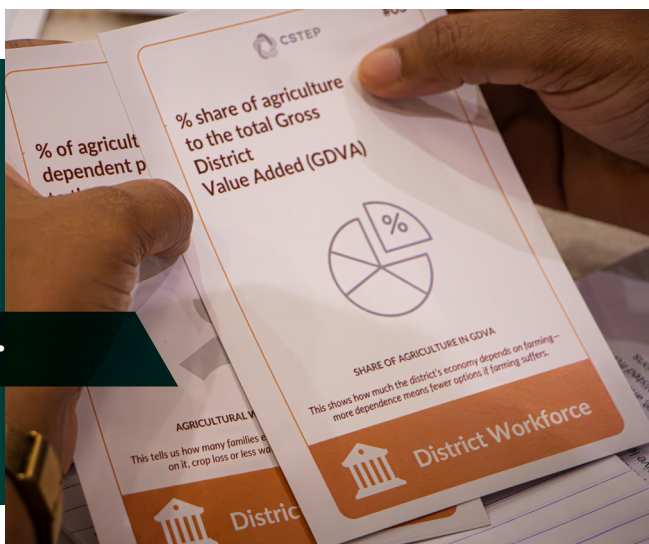
To strengthen the participants' understanding of indicator weighting and prioritisation in vulnerability assessments, two interactive games were conducted: weight distribution (Game 1) and ownership and trade (Game 2). The detailed rules for the game are provided in Appendix E.

01.



In Game 1, the participants were given 20 indicator cards representing different agricultural vulnerability indicators. Each participant received a limited number of beans symbolising 'weight', with the instruction to distribute them across the indicators they considered most important. The activity demonstrated how assigning weights reflects relative importance and shapes composite vulnerability outcomes.

02.



In Game 2, the participants 'purchased' or co-owned indicators, justifying their choices and negotiating with peers. This exercise encouraged reflection on ownership, accountability, and trade-offs in prioritisation processes, mirroring real-world decision-making in climate adaptation planning.

The games prompted highly engaged discussion within groups, as seen in the session photos. The participants debated the relative importance of indicators such as irrigation coverage, crop diversity, and the proportion of smallholders, leading to clear differences in group prioritisation patterns. Many recognised how weighting decisions directly influence vulnerability rankings. The negotiation component fostered collaboration, critical reasoning, and articulation of context-specific justifications.

Session 9: Quantifying vulnerability | Vidhatri Thakkar



Methodology

Presentation, interactive discussion, and Excel-based hands-on activity



Topics Discussed

- Building on the participants' understanding of the IPCC AR5 framework for vulnerability assessment, a guided activity followed through each step, from scoping and indicator selection to quantification and index development for Odisha's agriculture sector.



Key Learning Outcomes

- Understanding of how vulnerability assessments can be systematically conducted to identify high-risk regions or systems.
- Learnings on applying a structured framework to quantify vulnerability using indicators, normalisation technique, and weighting approaches (the equal weightage approach).
- Strengthening comprehension of how rankings and spatial maps inform prioritisation and adaptation planning.

Session 10: Quantifying risk and identifying drivers of risk | Tashina Madappa C



Methodology

Presentation, interactive discussion, and Excel-based guided activity



Topics Discussed

- Quantification of composite risk index, weighting approaches, and drivers of agricultural risk in Odisha's context.



Key Learning Outcomes

- Quantifying and aggregating hazard, exposure, and vulnerability components to derive a composite risk index using an unequal weightage approach.
- The session effectively built upon the previous module on vulnerability by extending the logic to risk quantification.
- Interpreting numerical outputs to identify districts most at risk, and how such assessments support prioritisation and adaptation planning.
- Discussions on drivers of risk encouraged collaborative analysis and critical thinking.

Dr Indu K Murthy concluded the training programme by expressing her gratitude to the participants for their engagement and enthusiasm throughout. The importance of integrating climate risk considerations into agricultural planning and policy was underscored by her, as she emphasised the role of scientific understanding and data-driven tools in guiding effective adaptation actions. The participants' effective completion of the training was recognised by a certificate distribution ceremony. This was followed by a group photograph that encapsulated the spirit of collaboration and learning. The training programme established a technically empowered and motivated cohort within DA&FE. The cohort is now equipped with the knowledge and skills to analyse climate data, assess risks, and implement evidence-based, risk-informed strategies for establishing a climate-resilient agricultural sector in Odisha.

Figure 6: Photos capturing the closing ceremony of the workshop



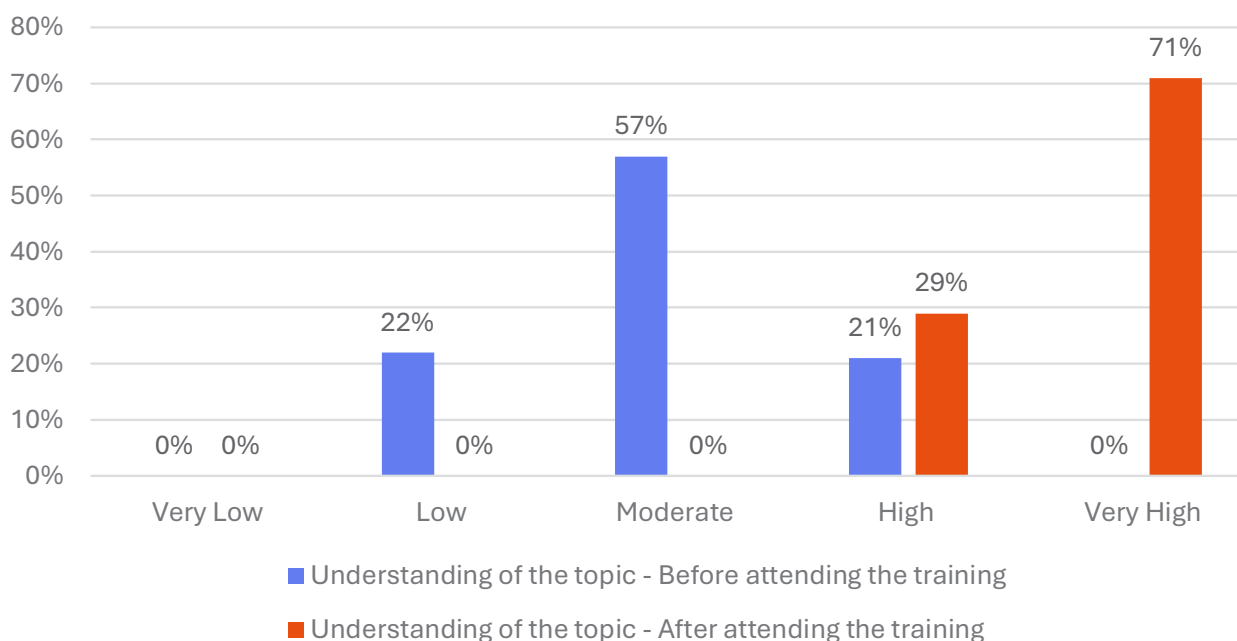
4. Key Outcomes and Learnings

Following the completion of the training programme, the participants were invited to share feedback through a structured post-training survey. The survey aimed to capture their reflections on knowledge gained, content relevance, delivery quality, practical application, logistics, and overall experience. The key findings from their responses are summarised below.

4.1. Understanding and knowledge

The training programme resulted in a notable improvement in the participants' understanding of the topics covered. As reflected in the post-training feedback, most participants (71%) rated their understanding as very high, while the remaining 29% rated it as high (Figure 7). This indicates that the sessions effectively enhanced conceptual clarity and comprehension of key themes introduced during the training.

Figure 7: Percentage of participants by self-rated understanding levels of training topics

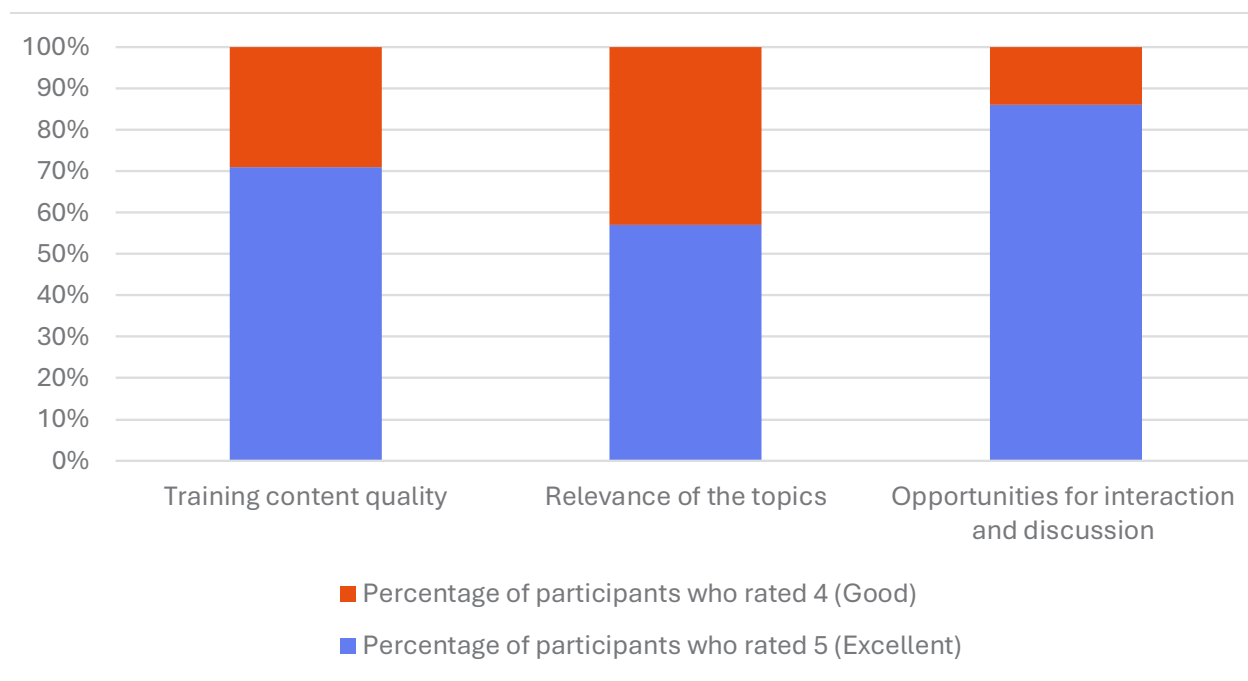


4.2. Training content and delivery

The participants expressed a high level of satisfaction with both training quality and structure. The sessions were perceived as well-designed and effectively facilitated, with the trainers demonstrating a strong command of the subject matter and maintaining active engagement throughout. Most respondents rated the facilitation as excellent, reflecting appreciation for the trainers' clarity, responsiveness, and ability to link theoretical concepts to real-world examples.

The topics covered were also highly relevant to the participants' work contexts, suggesting that the content aligned well with their professional learning needs. Importantly, the interactive nature of the sessions through discussions, group activities, and reflections was highlighted as one of the most valuable aspects of the training. This emphasis on participation and peer exchange contributed significantly to overall satisfaction and learning retention (Figure 8).

Figure 8: Participant feedback on training content and delivery



4.3. Participant views on practical application and logistics

The participants reported strong confidence in applying the knowledge and skills gained from the training in their professional contexts. Nearly two-thirds (64%) described themselves as very confident, while another 29% felt extremely confident in translating learnings into practice. This indicates that the training effectively strengthened the participants' ability to integrate new concepts and approaches into their day-to-day work.

Feedback on logistical aspects, including the duration and coordination of the sessions, was also positive. Most of the participants rated the training duration as good to excellent, suggesting that the schedule was well-balanced between technical sessions and interactive discussions. Further, they appreciated the overall organisation and coordination of the event, which contributed to a smooth and engaging learning experience.



5. Key Takeaways and the Way Forward

The training programme provided the participants with a thorough understanding of the frameworks for climate modelling, data analysis, and risk assessment relevant to the development of climate-resilient agricultural planning. The participants gained confidence in utilising data sets such as IMD observations, ERA5 reanalysis, and CMIP6 projections for adaptation planning through expert lectures and hands-on exercises that taught them how to access, process, and interpret these data sets. The sessions on hazard, exposure, and vulnerability analysis facilitated comprehension of the interconnections that determine the overall climate risk. Moreover, the participants acquired the capacity to recognise the primary risk and vulnerability drivers in the agricultural sector and incorporate them into evidence-based decision-making. Overall, the training programme effectively strengthened the technical capacity of DA&FE officials to apply climate data and analytical tools in planning and decision-making processes.

Building on this foundation, there is potential for further strengthening of institutional capacities through subsequent engagements focused on practical application. Future follow-up engagements may focus on utilising the participants' understanding of climate risk in planning and implementation of CSA practices. The learnings from this module will also help participants to engage more effectively with advanced climate-related topics and incorporate them into long-term decision-making.



6. Appendices

Appendix A: Concept Note

The Centre for Study of Science, Technology and Policy (CSTEP), in partnership with the Department of Agriculture and Farmers' Empowerment (DA&FE), Government of Odisha, is leading a collaborative effort to enhance climate resilience in the state's agriculture and allied sector. This effort includes a series of capacity-building programmes on key climate themes such as adaptation and mitigation, climate modelling, hazard and vulnerability assessments, climate-smart agriculture (CSA), and risk-informed planning.

This concept note outlines the second training module in the series, titled 'Climate Modelling and Risk Assessment Frameworks for Risk-Informed Adaptation Planning.' Building on the foundation laid in Module 1, this programme is designed to strengthen officers' capacities to understand and apply climate analysis, as well as exposure and vulnerability information, for identifying and prioritising adaptation strategies at state and district levels. The training will be held in Bengaluru, enabling direct interaction with experts and hands-on technical sessions in a supportive learning environment.

This module will engage fifteen officers (district- and state-level) drawn from the three key Directorates of DA&FE — Agriculture and Food Production, Horticulture, and Soil Conservation and Watershed Development. Participants have been shortlisted from the Module 1 cohort on the basis of interest, aptitude, and departmental nominations.

The objectives of the training are to:

- introduce participants to climate models, data sources, and analytical methods for historical climate and climate projections,
- provide hands-on training on climate analysis to build skills in accessing, processing, and interpreting climate data sets,
- build understanding and capacity to conduct risk assessment,
- demonstrate how climate data and risk assessment outputs can guide integration of adaptation strategies in departmental planning, and
- create a technically informed cohort capable of supporting risk-based CSA decision-making within DA&FE.

The training will span two days, featuring a mix of expert lectures, interactive sessions, case-based discussions, and hands-on data exercises. Sessions will be led by technical experts from institutions, including CSTEP.

The expected outcomes are:

- familiarity with climate modelling concepts and risk framework,
- practical ability to access, analyse, and visualise climate data relevant to Odisha,
- improved understanding of risk to the agriculture sector and ability to address drivers of risk and vulnerability, enabling evidence-backed adaptation planning, and
- formation of a technically trained cohort within DA&FE capable of applying risk-based approaches in planning.

Appendix B: Agenda

Climate Modelling and Risk Assessment Framework for Risk-Informed Adaptation Planning

Date: 12–13 September 2025

Venue: Attide Biz, Sahakar Nagar, Bengaluru

Day 1: Concepts and foundation			
Activity	Time	Session content	Resource
Registration	9:30 am–10:00 am	Participant arrival and registration	CSTEP team
Inaugural Session	10:00 am–10:05 am	Welcome and opening remarks	Dr Indu K Murthy
	10:05 am–10:15 am	Context setting	Dr Sangram Keshari Pattanaik Joint Director of Agriculture, DA&FE
Session 1	10:15 am–10:45 am	Climate modelling: Need and evolution for supporting decision-making and policies	Dr K J Ramesh Former Director General, India Meteorological Department (IMD)
Tea / bio break & travel forms			
Session 2	11:30 am–12:15 pm	Historical and climate change projections Data sources & analysis	Ms Vidya S & Dr Indu K Murthy
Session 3	12:15 pm–1:00 pm	Visualising climate data from climate model outputs	Mr Pradeep M S
Lunch break			
Session 4	2.00 pm–4:30 pm <i>(tea break at 3:15)</i>	Hands-on activity: Climate data processing (historical and projected)	CSTEP
Q&A	4:30 pm–5:00 pm	Questions and clarifications	
Wrap up			



Day 2: Risk assessment			
Activity	Time	Session content	Resource
Session 5	9:30 am–10:00 am	Introduction to risk assessment	Ms Tashina Madappa C
Session 6	10:00 am–11:15 am	Hazard analysis: Calculating the probability of occurrence and spatial extent of hazards	Ms Vidya S & Mr Pradeep M S
Tea / bio break			
Session 7	11.30 pm–1.00 pm	A quick guide to exposure analysis	Mr Pradeep M S
Lunch break			
Session 8	2.00 pm–2.45 pm	Interactive game	Mr Achintha Gupta
Session 9	2:45 pm–3:15 pm	Quantifying vulnerability	Ms Vidhatri Thakkar
Tea / bio break			
Session 10	3:45 pm–4.30 pm	Quantifying risk and identifying drivers of risk	Ms Tashina Madappa C
Closing ceremony	4:30 pm–5:00 pm	Certificate distribution	
	5:00 pm–5:15 pm	Closing remarks	Dr Indu K Murthy



Appendix C: Participant list

No.	Name	Directorate	Designation	District/Location
1	Mr Narayan Chandra Shahoo	Directorate of Agriculture and Food Production	Block Agriculture Officer (BAO)	Angul
2	Mr Barun Kumar Meher	Directorate of Horticulture	Assistant Agriculture Engineer (AAE)	Khordha
3	Mr Ashutosh Sahoo	Directorate of Agriculture and Food Production	Assistant Agriculture Officer (AAO)	Kandhamal
4	Mr Prashant Kumar Bag	Directorate of Agriculture and Food Production	AAO	Nuapada
5	Mr Ashish Kumar Meher	Directorate of Agriculture and Food Production	AAO	Nuapada
6	Mr Rohan Kumar Panda	Directorate of Agriculture and Food Production	AAO	Khordha
7	Ms Chandra Prava Parida	Institute on Management of Agricultural Extension (IMAGE)	Assistant Director of Agriculture (ADA)	Khordha
8	Ms Soubhagini Behera	Directorate of Soil Conservation and Watershed	Assistant Director, Soil Conservation (ADSC)	Bargarh
9	Mr Siba Prasad Nayak	Directorate of Soil Conservation and Watershed	ADSC	Bhubaneswar
10	Ms Swayam Prava Singh	Directorate of Soil Conservation and Watershed	ADSC	Nuapada
11	Ms Jaffna Ray	Directorate of Agriculture and Food Production	BAO	Cuttack
12	Ms Adyasha Mallick	Directorate of Agriculture and Food Production	AAE	Cuttack
13	Ms Sriya Saswati	Directorate of Horticulture	Assistant Director of Horticulture (ADH)	Balangir
14	Mr Anurag Das Mohapatra	Directorate of Horticulture	Assistant Horticulture Officer (AHO)	Nayagarh
15	Ms Laxmipriya Dehury	Directorate of Horticulture	ADH	Khordha

Dr K J Ramesh



Dr K J Ramesh is a leading expert in weather, climate, and disaster risk management with over four decades of experience. He served as Director General, IMD, and as India's Permanent Representative to the World Meteorological Organisation (WMO) from 2016 to 2019. Currently working as Advisor, South Asia Hydromet Forum, the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), he has led national programmes on climate research, early warning systems, and multi-hazard mitigation. Dr Ramesh has represented India at the United Nations Framework Convention on Climate Change (UNFCCC) negotiations and has contributed to National Disaster Management Authority (NDMA) guidelines on cyclones and floods. He has authored over 50 scientific papers on weather and climate resilience.

Dr Indu K Murthy



Dr Indu K Murthy is Principal Research Scientist and Sector Head for Climate, Environment and Sustainability at CSTEP. With over two decades as a Consultant Scientist at the Indian Institute of Science (IISc), Bengaluru, she brings extensive experience in climate change research and policy advocacy. Her work spans greenhouse gas inventories for the land-use sector, land-based mitigation, and climate risk, resilience, and adaptation.

Dr Murthy serves as an expert reviewer for the UNFCCC and is a member of the International Union for Conservation of Nature (IUCN) Commission on Ecosystem Management and the International Platform on Adaptation Metrics. She is a contributing author to IPCC reports and a coordinating lead author and lead author for the United Nations Environment Programme's (UNEP's) sixth and seventh Global Environment Outlook reports for the Asia-Pacific region. She also holds editorial positions with PLOS Climate, Frontiers in Forests and Global Change, and the International Journal of Climate Change Strategies and Management. She has been published widely in journals, leading national newspapers, and other media platforms.

Tashina Madappa Cheranda



Tashina Madappa Cheranda holds degrees in Biotechnology (St Joseph's University, Bengaluru), Climate Science and Policy (TERI School of Advanced Studies, New Delhi), and Climate Change Law and Policy (University of Strathclyde, Glasgow). With over 14 years of experience, she has worked across India on climate resilience, natural resource management, and sustainable agriculture through roles at IISc, Indian Institute of Technology (IIT) Mandi, the World Bank, Environmental Defense Fund (EDF), and International Institute for Environment and Development (IIED). Currently a Policy Specialist in the Adaptation and Risk Analysis team at CSTEP, her work focuses on CSA, low-carbon farming, and agricultural resilience. She has also led numerous capacity-building programmes for state agencies, civil society, and local governments to integrate climate adaptation into planning and policy.



Vidya S

Vidya S is a Senior Associate at CSTEP with 15 years of experience in climate modelling, impact assessment, and adaptation planning. She has worked on climate-risk assessments for Kerala and Puducherry, climate variability assessments for districts across India, and capacity-building initiatives for state climate change cells. Her technical skill set includes downscaled climate modelling, risk mapping, and spatial analysis of heat and health indicators.

Vidya's work consistently integrates scientific projections with vulnerability indicators, enabling tailored risk responses in both urban and rural contexts. She has been instrumental in developing and applying frameworks that identify and address health stressors such as extreme heat, while also communicating these findings to stakeholders and policymakers through training sessions and technical materials



Pradeep M S

Pradeep M S is a Senior Associate at CSTEP, specialising in geospatial applications for climate adaptation and policy research. With over seven years of experience in geography and geoinformatics, he has worked on projects involving climate hazard mapping, urban land loss due to sea level rise, and renewable energy risk assessments under United Nations Environment Programme (UNEP)-funded initiatives. His recent work applies ML and deep learning for high-resolution spatial analysis supporting nature-based planning. Previously, he worked with the Indian Space Research Organisation's (ISRO's) National Remote Sensing Centre on Geo-MGNREGA. Skilled in GIS, Python, and Google Earth Engine, he holds certifications from the National Aeronautics and Space Administration (NASA), UNEP, and ISRO and writes on climate-risk assessments.



Vidhatri Thakkar

Vidhatri Thakkar is an Analyst with CSTEP's Adaptation and Risk Analysis team and has a master's degree in Environmental Studies from Ashoka Trust for Research in Ecology and the Environment – The University of Trans-Disciplinary Health Sciences and Technology (ATREE-TDU). She has focused on climate-risk assessments, with a specific interest in the intersection of heat, health, and vulnerability.

Vidhatri played a key role in developing a heat-health risk index for Karnataka, using climate data and socio-economic indicators to identify high-risk districts in the state. Her expertise lies in translating complex climate data into actionable insights for public health resilience. She supports projects that strengthen the adaptive capacity of vulnerable populations to various climate stressors



Achintya Gupta

Achintya Gupta is a Consultant in the AI & Digital Platforms domain at CSTEP, bringing a background in software engineering and data systems.

He holds a bachelor's degree in Computer Science from Rose-Hulman Institute of Technology.

Prior to joining CSTEP, he worked as a Software Development Engineer at Amazon, where he gained experience in scalable systems and cloud-based solutions. At CSTEP, Achintya contributes to digital and AI-enabled tools, platforms, and applications that support climate and development work. He also brings interest and skills in game development, applying interactive tools and technology-enabled methods in training and knowledge transfer.



Appendix E: Interactive game rules

Game 1: Weight distribution



Purpose

To help participants understand how assigning weights reflects the relative importance of different indicators in a vulnerability or risk assessment.



Rules

1. There are 3 identical sets of 20 cards (each card represents 1 indicator).
2. Each group gets 1 full set of 20 cards.
3. Every group has five participants, and each person receives seven beans (representing weight/ importance points).
4. Each participant distributes their beans across the cards they consider most important.
5. They may put all beans on one card (if they think it is the most critical) or spread them across several cards.
6. The more beans on a card, the higher its weight/priority.
7. After everyone places their beans, the group discusses the results: which indicators received more beans, which were ignored, and what this means for prioritisation.



Learning

Just like in real assessments, not all indicators are equally important. Assigning weights helps reflect priorities and highlight where the greatest risks or sensitivities lie.



Game 2: Ownership and trade



Purpose

To introduce the idea of ownership, responsibility, and negotiation in prioritisation exercises.



Rules

1. There are 3 identical sets of 20 cards.
2. Each group gets 1 full set of 20 cards.
3. Each group has five participants, and each person receives five beans.
4. Each card costs two beans to own.
5. If two participants want the same card, they can co-own it by paying one bean each.
6. Ownership comes with responsibility.
7. Each participant who owns a card must briefly explain why they chose it and why it matters in a vulnerability or risk context.
8. Co-owners must either agree on a joint rationale or give complementary reasons for their choice.
9. Ownership also implies defending and standing by the card during group discussions—just as decision-makers justify priorities in real-world assessments.
10. Participants may trade cards with others if they feel another indicator is more relevant to them (trading is optional).



Learning

Prioritisation is not only about assigning importance but also about taking on responsibility, providing justification, and negotiating—much like how real-world decisions are made in policy or community planning.



Appendix F: Glimpses from the training programme





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