

<b>Course title:</b> Climate Change and Development				
<b>Course code:</b> 156		<b>No. of credits:</b> 3	<b>L-T-P:</b> 28-17-0	<b>Learning hours:</b> 45
<b>Pre-requisite course code and title (if any):</b>				
<b>Department:</b> Department of Policy and Management Studies				
<b>Course coordinator(s):</b> Dr. Pritha Datta			<b>Course instructor(s):</b> Dr. Pritha Datta	
<b>Contact details:</b> pritha.datta@terisas.ac.in				
<b>Course type:</b> Elective			<b>Course offered in:</b> 3 <sup>rd</sup> Semester	
<b>Course description:</b> This course provides an in-depth exploration of climate change, focusing on key aspects such as data analysis, vulnerability assessments, adaptation strategies, maladaptation, and mitigation measures. Students will gain a comprehensive understanding of the science, socio-economic impacts, and responses associated with climate change in the context of development. The course is structured to foster critical thinking, research skills, and practical applications for addressing climate change challenges				
<b>Course objectives:</b>				
<ul style="list-style-type: none"> <li>✓ To acquire an understanding of the science behind climate change and develop proficiency in climate data analysis.</li> <li>✓ To evaluate the vulnerability of regions, ecosystems, and socio-economic systems to climate change.</li> <li>✓ To investigate adaptation strategies aimed at enhancing resilience and promoting sustainable development.</li> <li>✓ To critically assess instances of maladaptation and unintended consequences.</li> <li>✓ To explore measures for mitigation, such as renewable energy and carbon capture.</li> <li>✓ To analyze real-world case studies and propose climate solutions for development.</li> </ul>				
<b>Course content</b>				
<b>Module</b>	<b>Topic</b>	<b>L</b>	<b>T</b>	<b>P</b>
1	<b>Introduction to Climate Change in the Context of Development</b> This foundational module starts by exploring the earth's climate system, providing a comprehensive overview of atmospheric components. By delving into historical perspectives, students gain insight into how climate change has evolved alongside global development agendas and international agreements. The module also addresses key drivers like greenhouse gas emissions, deforestation, and industrial activities, laying the groundwork for understanding the complex forces shaping our climate and developmental landscapes. <ul style="list-style-type: none"> <li>a) Overview of the Earth's climate system</li> <li>b) Key drivers of climate change and their developmental implications</li> <li>c) Historical perspectives on climate change in global development agendas and other international agreements</li> </ul>	4	0	0
2	<b>Climate Change, Vulnerability, and Development</b> This module deepens the understanding of vulnerability within	4	2	0

	<p>the context of development, employing both conceptual and practical approaches. It introduces frameworks for vulnerability assessment, enabling students to identify vulnerable regions, populations, and ecosystems. Additionally, it covers tools and methodologies for assessing socio-economic vulnerability, with case studies providing insight into real-world adaptation challenges.</p> <ul style="list-style-type: none"> <li>a) Concepts and frameworks for vulnerability assessment within the developmental context.</li> <li>b) Identifying vulnerable regions, populations, and ecosystems, with a focus on understanding the intersectionality of socio-economic factors and environmental risks</li> <li>c) Tools and methodologies for assessing socio-economic vulnerability and its implications for development.</li> <li>d) Case studies: Exploring the livelihood vulnerability of mountainous and coastal communities in India, elucidating the intertwined nature of vulnerability and development in the face of climate change.</li> </ul>			
3	<p><b>Climate Change, Adaptation, and Resilience</b>  This module explores adaptation strategies to enhance resilience and mitigate the impacts of climate change. It covers various types of adaptation, with a focus on nature-based solutions that promote biodiversity and ecosystem services. Emphasis is placed on integrating adaptation strategies into policy and planning processes to mainstream resilience-building measures across sectors and governance levels.</p> <ul style="list-style-type: none"> <li>a) Types of adaptation: incremental, systemic, and transformational, with a focus on resilience-building</li> <li>b) Nature-based solutions for climate adaptation and their role in fostering resilience</li> <li>c) Mainstreaming adaptation into policy and planning frameworks to enhance overall resilience</li> <li>d) Case studies: Examining adaptation strategies implemented by coastal and mountainous communities in the agriculture and water sectors of India, highlighting resilience-building practices amidst climate challenges.</li> </ul>	4	2	0
4	<p><b>Climate Change, Maladaptation, and Development</b>  In this module, dedicated to the critical evaluation of adaptation efforts within the context of development, special attention is given to maladaptation. It defines maladaptation and provides examples, scrutinizing the factors contributing to unintended negative consequences.</p> <ul style="list-style-type: none"> <li>a) Definition and examples of maladaptation, contextualized within the developmental landscape</li> <li>b) Factors contributing to maladaptation, with a focus on the intersection with development challenges</li> <li>c) Assessing the unintended consequences of adaptation measures</li> <li>d) Case studies: Maladaptive outcomes in the agricultural sector and water management of developing and</li> </ul>	6	2	0

	developed countries			
5	<p><b>Integrating Development Perspectives into Mitigation Measures</b></p> <p>In this module, students are introduced to climate change mitigation within the broader context of development, offering a comprehensive overview of strategies aimed at reducing or preventing the emission of greenhouse gases. This module not only explores the technical aspects of mitigation but also underscores the socio-economic dimensions inherent in sustainable development.</p> <ul style="list-style-type: none"> <li>a) Overview of climate change mitigation with a focus on sustainable development</li> <li>b) Renewable energy technologies</li> <li>c) Sustainable land use and forestry practices</li> <li>d) Carbon capture and storage</li> <li>e) Case studies: Factors determining household use of clean energy and sustainable land use practices in developing countries</li> </ul>	6	2	0
6	<p><b>Climate Data Analysis in the Context of Development</b></p> <p>This module starts by introducing various sources of climate data, emphasizing their significance in climate research. The module then delves into data preprocessing techniques essential for cleaning and organizing datasets. Statistical analysis methods are covered, and students will engage in hands-on exercises, gaining proficiency in working with real-world climate data.</p> <ul style="list-style-type: none"> <li>a) Introduction to climate data sources and databases</li> <li>b) Data preprocessing techniques</li> <li>c) Statistical analysis of climate data</li> <li>d) Hands-on exercises using climate datasets</li> </ul>	4	9	0
		28	17	0
<p><b>Evaluation criteria:</b></p> <ul style="list-style-type: none"> <li>✓ Minor-1: Assignment: Presentation (20%) and Report submission (30%)</li> <li>✓ Major Test: written test (50%)</li> </ul>				
<p><b>Learning outcomes:</b></p> <ul style="list-style-type: none"> <li>✓ By the end of the Major Test, students will be able to demonstrate a comprehensive understanding of key concepts, theories, and analytical techniques related to climate change and its impact on development.</li> <li>✓ Upon completion of the Assignment Submission, students will showcase their ability to critically analyze and synthesize climate data within the context of development projects. Their assignments will reflect a deep understanding of the interconnectedness between climate change, development, and the utilization of climate data for evidence-based decision-making.</li> </ul>				
<p><b>Pedagogical approach:</b></p> <p>This course adopts an integrated pedagogical approach, combining theoretical knowledge with practical applications to facilitate deep learning and skill acquisition. It emphasizes active learning methodologies such as hands-on exercises, case studies, and collaborative projects to engage students in real-world problem-solving. Assessment methods are designed to assess both conceptual understanding and practical proficiency, encouraging students to apply their knowledge to analyze and propose solutions to complex climate change challenges.</p>				

## Essential Reading:

### Module 1: Introduction to Climate Change

- Harris, J.M., Roach, B. and Environmental, J.M.H., 2007. The economics of global climate change.
- Pachauri, R.K., Allen, M.R., Barros, V.R., Broome, J., Cramer, W., Christ, R., Church, J.A., Clarke, L., Dahe, Q., Dasgupta, P. and Dubash, N.K., 2014. Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change (p. 151). Ipcc.
- Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barrett, K. and Blanco, G., 2023. Climate change 2023: synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change.

### Module 2: Climate Change and Vulnerability Assessment

- Thomas, K., Hardy, R.D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J.T., Rockman, M., Warner, B.P. and Winthrop, R., 2019. Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10(2), p.e565.
- Pandey, R., Jha, S.K., Alatalo, J.M., Archie, K.M. and Gupta, A.K., 2017. Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities. *Ecological indicators*, 79, pp.338-346.
- Sahana, M., Rehman, S., Paul, A.K. and Sajjad, H., 2021. Assessing socio-economic vulnerability to climate change-induced disasters: evidence from Sundarban Biosphere Reserve, India. *Geology, Ecology, and Landscapes*, 5(1), pp.40-52.

### Module 3: Climate Change and Adaptation Strategies

- Mendelsohn, R., Dinar, A. and Williams, L., 2006. The distributional impact of climate change on rich and poor countries. *Environment and development economics*, 11(2), pp.159-178.
- Mendelsohn, R. and Dinar, A., 1999. Climate change, agriculture, and developing countries: does adaptation matter?. *The World Bank Research Observer*, 14(2), pp.277-293.
- Vermeulen, S.J., Dinesh, D., Howden, S.M., Cramer, L. and Thornton, P.K., 2018. Transformation in practice: a review of empirical cases of transformational adaptation in agriculture under climate change. *Frontiers in Sustainable Food Systems*, 2, p.65.
- Panda, A., 2018. Transformational adaptation of agricultural systems to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, 9(4), p.e520.
- Datta, P., Behera, B. and Rahut, D.B., 2023. Climate change and water-related threats in the Indian Sundarbans: food security and management implications. *International Journal of Water Resources Development*, pp.1-22.
- Shukla, R., Agarwal, A., Gornott, C., Sachdeva, K. and Joshi, P.K., 2019. Farmer typology to understand differentiated climate change adaptation in Himalaya. *Scientific reports*, 9(1), p.20375.
- Datta, P., Behera, B. and Rahut, D.B., 2022. Climate Change and Indian Agriculture: A Systematic Review of Farmers' Perception, Adaptation, and Transformation. *Environmental Challenges*, 8.
- Aryal, J.P. and Marenya, P., 2021. Understanding climate-risk coping strategies among farm households: Evidence from five countries in Eastern and Southern Africa. *Science of the Total Environment*, 769, p.145236.
- Aryal, J.P., Sapkota, T.B., Rahut, D.B., Krupnik, T.J., Shahrin, S., Jat, M.L. and Stirling, C.M., 2020. Major climate risks and adaptation strategies of smallholder farmers in coastal Bangladesh. *Environmental Management*, 66(1), pp.105-120.
- 10. Aryal, J.P., Sapkota, T.B., Khurana, R., Khatri-Chhetri, A., Rahut, D.B. and Jat, M.L., 2020.

Climate change and agriculture in South Asia: Adaptation options in smallholder production systems. *Environment, Development and Sustainability*, 22(6), pp.5045-5075.

#### **Module 4: Climate Change and Maladaptation**

- Barnett, J. and O’neill, S., 2010. maladaptation. *Global environmental change*, 20(2), pp.211-213.
- Juhola, S., Glaas, E., Linnér, B.O. and Neset, T.S., 2016. Redefining maladaptation. *Environmental Science & Policy*, 55, pp.135-140.
- Datta, P. and Behera, B., 2023. Assessing farmers’ maladaptation to climate change in a sub-Himalayan region of India. *Environment, Development and Sustainability*, pp.1-18.

#### **Module 5: Climate Change and Mitigation Measures**

- Harris, J.M., Roach, B. and Environmental, J.M.H., 2007. The economics of global climate change.
- Rahut, D., Behera, B. and Ali, A., 2017. Factors determining household use of clean and renewable energy sources for lighting in Sub-Saharan Africa. *Renewable and Sustainable Energy Reviews*, 72, pp.661-672.
- Dhakal, A., Cockfield, G. and Maraseni, T.N., 2015. Deriving an index of adoption rate and assessing factors affecting adoption of an agroforestry-based farming system in Dhanusha District, Nepal. *Agroforestry systems*, 89, pp.645-661.
- Azhgaliyeva, D. and Rahut, D.B., 2022. Climate Change Mitigation: Policies and Lessons for Asia.
- Aryal, J.P., Rahut, D.B., Sapkota, T.B., Khurana, R. and Khatri-Chhetri, A., 2020. Climate change mitigation options among farmers in South Asia. *Environment, Development and Sustainability*, 22(4), pp.3267-3289.

#### **Module 6: Climate Data Analysis**

- Gilbert, R. O. (1987). *Statistical methods for environmental pollution monitoring*. New York: Wiley.
- Datta, P. and Das, S., 2022. Assessing the consistency of trends in Indian summer monsoon rainfall. *Hydrological Sciences Journal*, 67(9), pp.1384-1396.
- Datta, P. and Das, S., 2019. Analysis of long-term seasonal and annual temperature trends in North Bengal, India. *Spatial Information Research*, 27(4), pp.475-496.
- Ali, A., 2017. Coping with climate change and its impact on productivity, income, and poverty: evidence from the Himalayan region of Pakistan. *International journal of disaster risk reduction*, 24, pp.515-525.

#### **Student responsibilities:**

Maintaining a minimum attendance of 75% is mandatory. Additionally, students are expected to submit assignments and projects promptly and actively engage in class discussions.

#### **Course Reviewers:**

The course is reviewed by the following experts.

1. Prof. Bhagirath Behera, Professor of Economics, Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur, India.
2. Dr. Dil Bahadur Rahut, Vice-Chair of Research and Senior Research Fellow, Asian Development Bank Institute (ADBI), Japan.

*This Course outline was prepared by Dr Pritha Datta and approved by the..... Academic Council Meeting on ..... at TERI School of Advanced Studies, New Delhi.*

