Climate Course Catalogue:

A GUIDE FOR PAKISTANI HIGHER EDUCATION PROFESSIONALS

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PART 1: Introduction to climate change courses

Background

Climate change has become one of the greatest challenges of the 21st century, with a plethora of consequences for ecosystems, economies and societies worldwide. Rising temperatures, changes in precipitation and more frequent extreme weather events all demonstrate that climate change threatens not only our generation but also future generations. The pervasive nature of climate impacts transcends sectoral boundaries, negatively affecting actors across diverse domains, such as the private sector, governments at all scales and communities.

Similarly, Higher Education Institutions (HEIs) face growing risks from climate impacts. However, they are also uniquely positioned to catalyze transformative action in dealing with the multifaceted needs for climate mitigation and adaptation. Through education, research and leadership, HEIs have the potential to shape a more sustainable and resilient future for all. HEIs are also seen as playing a vital role in educating future environmental auditors, economists, community organizers, corporate managers, engineers, practitioners, technical professionals, policymakers and, most significantly, local communities about actions to be taken to mitigate and adapt to climate change.

Although considerable progress has been made by HEIs around the globe in incorporating climate change in their curricula, such efforts are critically lacking in lower-income countries like Pakistan, which are already resource-deficient and have limited capacity to mitigate and adapt to climate change. Hence, there is a great need for HEIs in Pakistan to transform and lead society into a new era of climate action.

Against this backdrop, UK and PIK have embarked on a collaborative endeavour to support Pakistan in mainstreaming climate change into its higher education and research through developing and integrating new climate-specific courses into different bachelor's and master's degree programs in Pakistan as well as bringing new methodologies and approaches to local universities and research institutions through organizing capacity building activities and joint networking activities. Recognizing the pressing need to address climate change, this partnership aims to facilitate the exchange of knowledge between Pakistani and German research institutes and universities. This endeavour highlights the potential of HEIs in becoming a catalyst for climate action and acting as a conduit for knowledge generation and capacity building.

Climate change courses

This collaboration has resulted in the development of six interdisciplinary courses dedicated to the pivotal subject of climate change. The topics of these courses were identified through intensive discussions involving over 80 university teachers, researchers and climate change experts from diverse backgrounds from Punjab, Khyber Pakhtunkhwa and Islamabad.
The following courses have been developed:

(1) Climate data, models and observation

(2) Climate-resilient agriculture and food systems

(3) Climate change governance: Theory, practice and emerging frontiers

(4) Sustainable development in a changing climate

(5) Gender, climate change and disasters

(6) Climate change impacts on ecosystems

These courses draw upon diverse perspectives from different natural and social science disciplines and offer holistic insights into the multifaceted dimensions of climate change and its implications for society, the economy and the environment. Each course is designed to encapsulate the latest advancements in climate science, policy and practice, ensuring a comprehensive and nuanced exploration of key thematic areas. From climate mitigation and adaptation strategies to the socio-economic impacts of climate change, these courses are meant to equip students with a robust foundation to navigate the complexities of climate change.

The extensive coverage of topics in these courses makes these courses valuable not only for educational institutions but also as a self-learning and training resource for professionals, including climate experts, policymakers and journalists, who wish to acquaint themselves with these topics and specialize in these areas.

Purpose of the catalogue

This catalogue provides a comprehensive overview of the climate change courses that have been developed for various bachelor's and master's degree programs in Pakistan. This catalogue will help university teachers and other users in finding detailed information about the structure and topics covered in each course. Specifically, it will serve to provide:

- A basic orientation to the courses, including a comprehensive outline highlighting the topics covered in each lecture,
- Course learning outcomes, which are aligned with the guidelines set forth by the Higher Education Commission of Pakistan, and
- The relevance of the course to Pakistan's existing education landscape on climate change.

Accessing the Power Point lecture presentations

The complete course contents will soon be available on the Climate Information Resource (CIR) platform, a collaborative initiative between GIZ and the Global Change Impact Study Centre. The primary objective of the CIR is to serve as a comprehensive repository, gathering diverse materials and insights pertaining to climate initiatives across Pakistan. The platform can be accessed at: https://www.gcisc.org.pk/climatechangecourses

Using the PowerPoint lecture presentations

Each course consists of a series of 28 lectures in English which last 60 to 90 minutes. For each lecture, a comprehensive PowerPoint presentation has been developed. Each lecture is built with flexibility in mind, allowing instructors to tailor the material to the specific requirements and preferences of their students and universities. The PowerPoints presentations can be used in three ways:

(1) Instructors can choose to deliver an entire lecture without any modification to ensure comprehensive coverage of the subject matter.

(2) Instructors can follow a more selective approach, handpicking specific slides and/or topics that align with the needs of their students and teaching objectives.

(3) Instructors can treat these slides as a foundation for building another course, incorporating additional resources and infusing their own expertise and teaching style.

These PowerPoint presentations serve as teaching aids, offering educators an opportunity to integrate the course materials into their teaching practice. It is also pertinent to highlight that all the course material is readily available for access by university teachers across Pakistan free of cost. This means that any university teacher, regardless of their geographic location, can obtain these educational resources online and utilize them.

Note that some lectures may include components which require specific software or digital equipment, such as loudspeakers to show a film with sound. Here, instructors are free to omit such components if the requisite software or equipment is not accessible in their classrooms. However, the flexible adoption of course materials assures accessibility and inclusion across diverse educational contexts.

Figure 1, 2 and 3 showcase samples of the lecture slides developed for different courses. These slides include a diverse range of instructional information, including lecture material, classroom discussion questions, homework assignments and other digital resources, such as short documentaries. This holistic approach offers a thorough and interesting learning experience, catering to a variety of learning styles and encouraging a better grasp of the topics.

Figure 1: Example of a course title page.

Paris Agreement

1. The Paris Agreement or PA changed the course of global climate action. It united nations behind the common cause of undertaking ambitious actions to tackle climate change
2. The Agreement is a key instrument for meeting the targets of the 2030 Agenda for Sustainable Development and the SDGs.
3. Adopted in 2015 and entry into force in 2016 (195 signatories)
4. International (formally binding) treaty building on Copenhagen Accord
5. Framework agreement
6. PA work program to develop rules for implementation

UNICEF, 2020

Figure 2: Example of a lecture slide.

Home task: Adaptation vs Mitigation

Consider yourself as the Finance Minister of Pakistan. You're responsible for allocating a limited fund of $5 billion USD towards adaptation and/or mitigation efforts. Choose one scenario from the following options and provide a 300-500 words justification for your decision:

1. All $5 billion will go towards adaptation because…
2. All $5 billion will go towards mitigation because…
3. $5 billion will be divided between adaptation and mitigation because… (also mention the percentage of division).

*Bonus points for highlighting specific adaptation/mitigation actions.

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Figure 3: Example of a home task slide.

Some discussion questions (Based on Anjum & Fraser, 2021)

1. The authors state that 'vulnerability is more than the outcome of a biophysical threat'. How do you perceive this statement?
2. The author proposes to have an integrated approach for mapping multi-level vulnerabilities, that combines household and community level vulnerabilities. Do you think this approach would be helpful? Why or why not? (where do you think gender fits in this approach)
3. The authors highlight some studies which say that migration could help offset some of the adverse effects of slow onset events. Keeping in view differential gendered vulnerabilities, which problems do you see with implementation of this approach?

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Figure 4: Example of a classroom discussion slide.

PART 2: Outlines of the climate change courses

COURSE 1: CLIMATE DATA, MODELS AND OBSERVATION

Credit hours: 3 (28 sessions; 1.5 hours each)
Mode of assessment: Assignments, quizzes, presentations, projects, mid-term examinations, final examinations.
Relevant degree programmes: A range of undergraduate and postgraduate degree programmes are relevant to this course, including but not limited to agriculture, agricultural engineering, civil engineering, climate science, data science/engineering, earth system sciences, environmental sciences/engineering, geographical information system, hydrology, geography, remote sensing, water management, and other related fields.
Prerequisites for students: Basic to intermediate knowledge of climate science, geography, computer programming, modelling, mathematics and handling large datasets.
Prerequisites for teachers: Intermediate to advanced level of knowledge/background in climate data, science and modelling, computer programming, earth system sciences and remote sensing.

Course objectives and description

Due to the emission of greenhouse gases and subsequent warming, the threat of climate change is steadily escalating, with significant changes in temperature, precipitation and other climatic variables projected for the 21st century. These changes may cause more frequent droughts, floods and other extreme events in the future, affecting agricultural productivity, water availability, power generation and ecosystems.

Pakistan's population currently exceeds 220 million and is expected to reach approximately 242 million by 2025. Per capita surface water availability in Pakistan has been gradually declining from 5,650 cubic meters (m^3) (1951) to 1,200 m^3 (2002); currently, it is less than 1,000 m^3. Declining water availability can be felt in different sectors, including manufacturing, commerce and public health, and is expected to intensify in the future. According to the Global Climate Risk Index, Pakistan is the fifth most climate-vulnerable country worldwide. Over the past two decades (1999-2018), Pakistan has incurred significant human and economic costs due to climate change, with approximately ten thousand lives lost and economic losses totalling around 3.8 billion USD.

Therefore, university teachers, researchers, decision-makers and other stakeholders should have specific knowledge and skills to analyse the likely impacts of climate change. The availability and development of open-source global gridded climatic and remote sensing datasets, along with tools such as the Coupled Model Intercomparison Project Phase 6 (CMIP6) for future projections and the Climate Data Operator (CDO), present opportunities for developing courses like "Climate models, data and observations".

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will be able to apply technical data analysis skills*	*C3 (Apply)*
CLO – 2	*Students will be able to analyse key issues related to the subject*	*C4 (Analyse)*
CLO – 3	*Students will be able to follow instructions and perform the embedded systems with applications and programming*	*C5 (Evaluate)*
CLO – 4	*Students will be able to demonstrate the use of acquired knowledge to solve problems of practical nature*	*C6 (Create)*

Teaching methods

A range of teaching methods will be employed for this course, including but not limited to lectures (via the presentations, lecture videos, recent scientific papers and reports, case studies from Pakistan), collaborative learning (discussions and group work), practical exercises (hands-on sessions on proposed tools/GCM projections/remote-sensing datasets), projects (implementing the learning outcomes to derive the climate change projections for case studies from Pakistan), assignments and quizzes.

Relevance to Pakistan

This course holds significant relevance for the Pakistani context, by addressing different climate-related challenges like floods, heatwaves and drought. Through hands-on experience of different tools and models, the course equips students and researchers with the skills needed to analyse and interpret climate data. Furthermore, the course empowers future scientists, policymakers and environmental professionals to develop effective climate adaptation strategies by analysing various case studies for Pakistan's diverse geographical and socio-economic conditions, supporting Pakistan's commitments to international climate agreements, such as the Paris Agreement. Finally, the course contributes to Pakistan's sustainable development efforts, supporting initiatives like the National Climate Change Policy and the Green Pakistan Program.

COURSE CONTENTS

LECTURE 1:
CLIMATE SYSTEM
- Weather and climate
- Atmosphere
- Cryosphere
- Hydrosphere
- Biosphere
- Interaction among climate components

LECTURE 2:
HYDROLOGICAL CYCLE AND PROCESSES
- Hydrological cycle: Processes, variables and storage
- Climate change and precipitation
- Climate change and runoff/river discharge
- Climate change and cryosphere
- Climate change and surface water
- Climate change and groundwater

LECTURE 3:
CLIMATE VARIABILITY AND CLIMATE CHANGE
- Climate variations
- Climate change causes
- Climate data: Observed vs. proxy data
- Physical evidence of climate change

LECTURE 4:
CLIMATE CHANGE PROJECTIONS: A GLOBAL PERSPECTIVE
- Climate change projections
- Global projections: Temperature
- Global projections: Precipitation
- Global projections: Droughts
- Carbon cycle

LECTURE 5:
TOOLS AND METHODS FOR CLIMATE CHANGE IMPACT ASSESSMENT
- Climate change impact assessment and its importance
- IPCC and emissions scenarios
- Assumptions of emissions scenarios
- SRES, RCPs and SSPs

LECTURE 6:
CLIMATE CHANGE SCENARIOS AND GENERAL CIRCULATION MODELS
- Climate change impact modelling chain
- Climate change scenarios
- Types of climate change scenarios
- General Circulation Models
- Evolution of General Circulation Models
- Selection criteria of General Circulation Models

LECTURE 7:
UNCERTAINTY IN GENERAL CIRCULATION MODELS AND DOWNSCALING
- Uncertainty and climate change
- Obtaining finer resolution data: Downscaling
- Spatial downscaling techniques
- Regional Climate Models
- Statistical vs. dynamic downscaling

LECTURE 8:
BIAS IN CLIMATE CHANGE PROJECTIONS
- Biases in climate data
- Need for bias correction
- Bias correction
- Types of bias correction

LECTURE 9:
CLIMATE CHANGE IMPACTS
- Biases in climate data
- Background
- Impact on agriculture
- Impact on hydropower
- Impact on water supply and sanitation

LECTURE 10:
CLIMATE ADAPTATION
- Climate adaptation
- Structural measures of adaptation to climate change
- Non-structural measures of adaptation to climate change

LECTURE 11:
BASICS OF MAPPING, GPS, GIS AND REMOTE SENSING
- Basics of GPS
- Basics of a geographic information system
- Projections and coordinate reference systems

LECTURE 12:
INTRODUCTION TO REMOTE SENSING
- Basics of remote sensing
- Data assimilation in remote sensing
- Remote sensing system
- Digital elevation models
- Multispectral satellites

LECTURE 13
CLIMATE DATA OPERATORS
- Climate Data Operators (CDO)
- Basic setup and software installation
- Basic usage of CDOs
- Tips and tricks for high-resolution data

LECTURE 14:
CLIMATE DATA DOWNLOAD AND PANOPLY
- Data download
- Visualizing climatic data using Panoply
- Climate data store

LECTURE 15:
ANALYSING CLIMATE PROJECTIONS USING CLIMATE DATA OPERATORS
- Initial data processing
- Extracting data and field mean
- Exporting data and creating time series

LECTURE 16:
BASIC STRUCTURE OF CLIMATE DATA OPERATORS
- Options and operator parameters
- Environment variables and operator chaining
- Parallelized operators and operator parameters
- Horizontal grids

LECTURE 17:
INFORMATION AND SIMPLE STATISTICS IN CLIMATE DATA OPERATORS
- INFO and SINFO
- DIFF: Comparison of two datasets
- NINFO and SHOWINFO
- SHOWATTRIBUTE and FILEDES

LECTURE 18:
FILE OPERATIONS IN CLIMATE DATA OPERATORS
- COPY TEE and REPLACE
- MERGE and SPLIT
- DISTGRID: Distribute horizontal grid
- COLLGRID: Collect horizontal grid

LECTURE 19:
SELECTION OPERATIONS IN CLIMATE DATA OPERATORS
- SELECT: Select fields
- SELVAR: Select fields
- SELTIME: Select timesteps
- SELBOX: Select a box of a field
- SELGRIDCELL: Select grid cells

LECTURE 20:
CONDITIONAL SELECTION AND COMPARISON IN CLIMATE DATA OPERATORS
- COND: Conditional select one field
- MAPREDUCE: Reduce fields to user-defined mask
- COMP: Comparison of two fields
- SETMISS: Set missing value

LECTURE 21:
ARITHMETIC AND IMPORT/EXPORT IN CLIMATE DATA OPERATORS
- EXPR: Evaluate expressions
- MATH: Mathematical functions
- ARTH, ARTHC and MONARITH
- OUTPUTGMT: GMT output

LECTURE 22:
INTERPOLATION IN CLIMATE DATA OPERATORS
- REMAPBIL: Bilinear interpolation
- REMAPBIC: Bicubic interpolation
- REMAPNN: Nearest neighbour remapping
- REMAPDIS: Distance-weighted average remapping

LECTURE 23:
CASE STUDY: GLOBAL GRIDDED DATASETS FOR THE GILGIT RIVER BASIN
- Background
- Research objectives and case study
- Data and methodology
- Result and discussions
- Conclusions and research limitations

LECTURE 24:
CASE STUDY: CLIMATE PROJECTIONS OF KHYBER PAKHTUNKHWA USING CMIP6 DATA
- Background
- Impacts of climate change on various sectors in Khyber Pakhtunkhwa
- Methodology and data
- Results
- Adaptation and mitigation methodologies

LECTURE 25:
CASE STUDY: CLIMATE PROJECTIONS OF THE SHIGAR RIVER BASIN USING CMIP6 DATA
- Background
- Study area
- Data and methods
- Major findings
- Conclusions

LECTURE 26:
CASE STUDY: CLIMATE PROJECTIONS OF THE HUNZA BASIN USING CMIP6 DATA
- Background
- Research objectives and case study
- Data and methodology
- Main findings and conclusions
- Research limitations

LECTURE 27:

CASE STUDY: CLIMATE PROJECTIONS OF THE INDUS BASIN USING CMIP6 DATA

- Background
- Research objectives and approach
- Main results
- Discussions

LECTURE 28:

STRENGTHS, UNCERTAINTIES AND WEAKNESSES OF CLIMATIC DATASETS

- Strengths of remote sensing climatic datasets
- Strengths of GCM climatic datasets
- Uncertainties in remote sensing and GCM climatic datasets
- Limitations, challenges and weaknesses

COMPULSORY READINGS

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COURSE 2: CLIMATE-RESILIENT AGRICULTURE AND FOOD SYSTEMS

Credit hours: 3 (28 sessions; 1.5 hours each)
Mode of assessment: In-class discussions, written and oral presentation of assignments (30%), written exam (70%).
Relevant degree programmes: Agricultural science, agronomy, climate science, development economics, environmental science, food science, life sciences and other related fields.
Prerequisites for students: A basic understanding of agricultural production, climate change and its impacts on agricultural production, food systems and human health.
Prerequisites for teachers: PhD in a relevant field.

Course objectives and description

The goal of this course is to develop a teaching module, within the framework of the Higher Education Commission of Pakistan. This module will cover the fundamentals of cutting-edge research to address development issues in Pakistan and combat climate change emergencies. By doing so, the course aims to increase awareness of agricultural resilience and health.

This broad objective stems from the need to harmonize and improve educational resources available to students across Pakistan. This is especially important in areas without graduate programs that establish connections between public health/nutrition, climate change, and agricultural resilience. This collaborative work facilitates cross-disciplinary thinking and a challenge-led research-based curriculum. A curriculum at the frontiers of traditional climate change disciplines is likely to lead to real environmental, economic, and social impacts. This nexus is particularly fitting in the drive to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture across the globe and to explore the missing opportunities to align and synergize actions across the three domains of climate, agriculture and nutrition.

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will be able to recognize the critical link between climate change, agriculture, nutrition and health.*	*C2 (Understand)*
CLO – 2	*Students will be able to apply their knowledge to develop strategies for building successful agricultural, food and nutrition programs in Pakistan under current and future climate change.*	*C3 (Apply)*
CLO – 3	*Students will be able to analyse the discourse surrounding climate change, agriculture, nutrition and health, including the impact of environmental factors on hunger, nutrient availability and malnutrition.*	*C4 (Analyse)*

Teaching methods

The course will foster interactive discussions on climate change, drawing upon real-world examples and scientific literature to deepen understanding. Visual aids will help elucidate complex data, while case studies of successful agricultural-nutrition programs from diverse regions will be analyzed through student reports. These reports will compare the programmes to Pakistan's climate challenges and solutions. Online resources will ensure students remain updated on the latest developments. Additionally, students will present their case study findings via YouTube uploads, facilitating class discussions. Active participation will be encouraged, with students randomly assigned to lead discussions based on prepared questions derived from primary scientific literature.

Relevance to Pakistan

Climate-resilient agriculture and food systems are critical for Pakistan, a country which heavily relies on the agricultural sector, while being particularly vulnerable to climate change. Climate change can lead to a decrease in crop yields, reduce food security and increase the risk of malnutrition, stunting and wasting. Educating future professionals in climate-resilient agriculture and food systems is therefore crucial to tackle

these challenges and improve national health and development, in line with Sustainable Development Goals 2 (Zero Hunger) and 13 (Climate Action). This will be achieved by focusing on three key areas. First, the course will explore different climate-resilient agricultural practices, including conservation agriculture, agroforestry, crop diversification and different water management techniques, to enhance agricultural resilience and sustainability, while also promoting health and nutrition outcomes. Second, the course will analyze different strategies for building sustainable food systems, e.g. reducing emissions from food industries, advancing sustainable fishing and aquaculture or pursuing alternative protein sources. Third, the course will conclude with a focus on aspects of health and nutrition, addressing nutritional considerations in crop selection and production, as well as integrating nutrition into disaster preparedness and response.

COURSE CONTENTS

LECTURE 1:
GLOBAL CLIMATE CHANGE
- Introduction to global climate change
- Drivers of climate change
- Global impacts of climate change on water supply, water-borne diseases and food systems
- Pakistan's vulnerability to climate change
- Climate change and food security

LECTURE 2:
GLOBAL TREATIES ON CLIMATE CHANGE
- Introduction to global treaties
- UNFCCC (1992)
- Kyoto Protocol (1997)
- Paris Agreement (2015)

LECTURE 3:
ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE
- Introduction to environmental pollution
- Impact of environmental pollution on agricultural production
- Environmental pollution affecting public health

LECTURE 4:
CLIMATE CHANGE, AGRICULTURE AND FOOD SECURITY CHALLENGES IN PAKISTAN
- Overview of Pakistan's climate and geographical diversity
- Agriculture in Pakistan
- Climate change links between agriculture and food security
- Climate change and food security in Pakistan

LECTURE 5:
CONTRIBUTION OF AGRICULTURE TO CLIMATE CHANGE
- Introduction: Contribution of agriculture to climate change
- Carbon sequestration and net-zero carbon
- Climate policy in Pakistan

LECTURE 6:
ALIGNING AGRICULTURE WITH SDGS
- Introduction to SDGs
- Relevance of particular SDGs to agriculture and food security
- SDGs and agriculture/food security in Pakistan

LECTURE 7:
CONSERVATION STRATEGIES IN AGRICULTURAL PRACTICES
- Introduction to conservation strategies in agricultural practices
- Human actions leading to soil degradation
- Soil conservation strategies
- Climate change impact on soils: Adaptation and mitigation
- Soil degradation in Pakistan

LECTURE 8:
INTRODUCTION TO CLIMATE-RESILIENT AGRICULTURE
- Introduction to climate-resilient agriculture
- Impact of climate variability on agro-system dynamics
- The soil health, fertility and water conservation nexus
- Mitigating GHGs from agriculture and its practices
- Climate-resilient agriculture for human health in Pakistan

LECTURE 9:
STRATEGIES FOR CLIMATE-RESILIENT AGRICULTURE
- Overview of strategies for climate-resilient agriculture
- Importance of optimizing fertilizer application and techniques for reducing nitrogen-based emissions as a CRA strategy
- Adaptation strategies with hybrid crop varieties
- Benefits of hybrid crop varieties in adapting to climate change

LECTURE 10:
THE ROLE OF BIODIVERSITY IN AGRICULTURAL RESILIENCE
- Introduction to biodiversity
- Crop diversification
- Biodiversity loss
- Strategies for preserving and enhancing crop diversity
- Pathway forward
- Biodiverse diet and public health

LECTURE 11:
REDUCE GROWTH DEMAND FOR FOOD AND AGRI-PRODUCTS (PART 1)
- Understanding food from a food-security perspective
- Universal declaration on human rights for food
- Sustainable food future & unveiling the four critical food gaps
- Food and agriculture-related SDG indicators

LECTURE 12:
REDUCE GROWTH DEMAND FOR FOOD AND AGRI-PRODUCTS (PART 2)
- Food system and climate variability
- Food loss and waste
- Zero waste
- Food waste, diet quality, nutrient losses and environmental health
- Nutrients in food

LECTURE 13:
REDUCE GROWTH DEMAND FOR FOOD AND AGRI-PRODUCTS (PART 3)
- Behaviour shift and behavioural-science tactics
- Dietary shift
- Protein dilemma, protein sources and emerging alternative protein sources
- Solution via smart policies and financing for alternative proteins
- Feeding the future; sustainable fish protein for a growing world
- Approaches for sustainable fishing practices
- Aquaculture
- Improving wild fisheries management

LECTURE 14:
UNLOCKING THE POWER OF MICRONUTRIENTS/FORTIFICATION/BIOFORTIFICATION
- Power of micronutrients
- The potential impact of climate change on micronutrients
- Fortification and biofortifications
- Fortifying the future for addressing the SDGs
- Integration and implementation policy of Pakistan

LECTURE 15:
GREENHOUSE GAS EMISSIONS FROM FOOD SYSTEMS
- Greenhouse gas emissions
- Food systems and greenhouse gas emissions
- Food mile, carbon foot printing and freight mile
- Enteric fermentation
- Manure management
- Food system, food chain and NUE
- Improving rice management
- Strategies for improving rice management

LECTURE 16:
WORKING TOWARDS SUSTAINABLE APPROACHES OF FOOD SYSTEMS TRANSFORMATION IN PAKISTAN
- Food system & its transformation
- Strategies for sustainable food system transformation in Pakistan
- Nutrition-rich staples
- Climate-resilient programmes
- Domestic and international trade supply
- Pakistan's food trade

LECTURE 17:
AGRICULTURAL, FOOD AND NUTRITION SECURITY (PART 1)
- Food security: Understanding the basic concepts
- Nutrition security: Understanding the basic concepts
- Importance of nutrition security in the socioeconomic status of households and their food security
- The impact of climate change on nutrition security
- Current actions linking nutrition and climate change
- Agriculture: Central to food and nutrition security

LECTURE 18:
AGRICULTURAL, FOOD AND NUTRITION SECURITY (PART 2)
- Food system and nutrition outcomes
- Underlying factors of food security
- Underlying factors of nutrition security
- Biofortification: Leveraging agriculture to reduce hidden hunger
- Policies and programmes for reducing food insecurity and vulnerability in Pakistan

LECTURE 19:
AGRICULTURE, HEALTH AND NUTRITION
- Understanding the impacts of agriculture and food system policies on nutrition and health
- Trade and social determinants of health
- Linking agriculture and health in lower-income and middle-income countries

LECTURE 20:
CLIMATE CHANGE, AGRICULTURE, HEALTH AND NUTRITION: TOWARD CONCEPTUALIZING THE LINKAGES
- Agriculture, health and nutrition: Toward conceptualizing the linkages
- Nutrition-agriculture linkages
- Leveraging change in agriculture to affect health and nutrition
- Agriculture policy levers to promote health and nutrition
- Interaction of food systems with human health and nutrition

LECTURE 21:
FOOD AND NUTRITION IN NATURAL AND MAN-MADE DISASTERS
- Introduction to nutrition in emergencies
- Food insecurity and malnutrition: Identification and measurement
- Livelihood interventions for addressing food and nutrition in disasters (waterborne andlivestock diseases)
- Agriculture-associated diseases: Adapting agriculture to improve human health
- Health investments and improve agricultural productivity

LECTURE 22:
INTEGRATION OF INTERNAL NUTRITION RESIDENCY WITH AGRICULTURAL RESILIENCE AFFECTED BY CLIMATE CHANGE
- Climate change threats to human health
- Resilience and adaptation to climate change
- Climate change, migration and public health
- Efforts of the government to tackle the problems

LECTURE 23:
LINKS BETWEEN HEALTH AND FARM LABOUR
- Impacts of diseases on farm labour productivity
- Nutritional interventions for addressing public health in the context of Pakistan

LECTURE 24:
ADDRESSING THE LINKS AMONG AGRICULTURE AND CLIMATE CHANGE WITH COMMUNICABLE DISEASES

- Climate change and spreading of infectious diseases
- Climate change and waterborne diseases
- Climate change soil health and spreading of diseases
- Climate change and immune system

LECTURE 25
ADDRESSING THE LINKS AMONG AGRICULTURE AND CLIMATE CHANGE WITH NON-COMMUNICABLE DISEASES

- Climate change and non-communicable diseases
- Climate change and HIV/AIDs
- Climate change and cardiovascular diseases
- Climate change and cancer

LECTURE 26:
CROSS-SECTORAL COORDINATION UNDER CHANGING CLIMATE IN THE PUBLIC SECTOR: A CHALLENGE TO LEVERAGING FOR IMPROVING PUBLIC HEALTH

- Cross-sectoral coordination in the public sector for improving nutrition and health
- Nutrition is a multisectoral problem needing multisectoral solutions
- Importance of the agricultural sector for improving nutrition
- Improving nutrition through social protection
- Improving nutrition through health
- Organizational barriers to cross-sectoral action

LECTURE 27:
THE ROLE OF PUBLIC HEALTH PREPAREDNESS AND RESPONSE: ADAPTATION TO CLIMATE CHANGE

- Public health in a changing climate: Challenges and determinant measures to enhance the climate resilience of health systems
- Understanding core concepts of health systems and climate resilience
- Building a healthy future: Intergenerational climate resilience and equity
- Impact of climate change on social determinants of health (SDOH)
- Ottawa Charter for Health Promotion
- Conceptual bond between public health and conservation biology
- Healthscope and its connection to climate change
- Frameworks for climate-resilient health programs
- Climate preparedness
- Climate change and diabetes

LECTURE 28:
RECAP OF IMPORTANCE OF CLIMATE-RESILIENT AGRICULTURE AND FOOD SYSTEMS IN THE CONTEXT OF PUBLIC HEALTH

- Importance of climate-resilient agriculture and food systems in the context of public health for Pakistan
- Interlinkage of agriculture and public health
- The importance of climate-resilient agriculture and food systems in addressing the agriculture-nutrition disconnect in Pakistan
- Approaches towards solutions for the agriculture-nutrition disconnect

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23. The Impact of Climate Change on Our Life: The Questions of Sustainability. (2018). Germany: Springer Nature Singapore. https://doi.org/10.1007/978-981-10-7748-7
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25. Towards Sustainable Global Food Systems: Conceptual and Policy Analysis of Agriculture, Food and Environment Linkages. (2019). Switzerland: MDPI AG.
26. Towards Zero Waste: Circular Economy Boost, Waste to Resources. (2018). Germany: Springer International Publishing.
27. Wheat Biofortification to Alleviate Global Malnutrition. (2022). (n.p.): Frontiers Media SA.

COURSE 3: CLIMATE CHANGE GOVERNANCE: THEORY, PRACTICE AND EMERGING FRONTIERS

Credit hours: 3 (28 sessions; 1.5 hours each)
Mode of assessment: Quiz, group assignment and presentation, midterm and final exam.
Relevant degree programmes: Bachelor's and master's students of geography, international relations, climate change, development studies and other relevant programmes.
Prerequisites for students: None.
Prerequisites for teachers: General understanding of climate change and impacts, adaptation and mitigation; global environmental governance.

Course objectives and description

This course offers a comprehensive introduction to climate change governance, taking students on a journey through the complex web of challenges, solutions and uncertainties in the realm of global climate governance. The course is structured around five elements, including an understanding of climate change, setting policy goals, identifying governance challenges, applying solutions, and confronting the uncertain future. Each element is developed in a way that allows instructors to teach it independently for thematic learning. By the end of the course, students possess a systematic understanding of climate governance, including relevant theories, practical examples and emerging trends.

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will demonstrate an understanding of climate change governance concepts and frameworks, encompassing global, regional, national and local dimensions.*	*C2 (Understand)*
CLO – 2	*Students will be able to understand and articulate climate governance goals, key global processes and approaches leading to multilevel climate governance policy integration for climate action.*	*C4 (Analyse)*
CLO – 3	*Students will understand different dimensions of climate action (i.e. mitigation or adaptation) and be able to apply these dimensions in different contexts (e.g. rural or urban) throughout the climate policy cycle.*	*C4 (Analyse)*
CLO – 4	*Students will understand and apply climate governance mechanisms, including policy types, negotiation processes, tools for climate action and key actors with specific reference to Pakistan.*	*C3 (Apply)*
CLO – 5	*Students will understand and apply key enablers for climate actions such as finance and circularity as well as understand emerging climate issues like greenwashing with a focus on challenges and opportunities in Pakistan.*	*C5 (Evaluate)*

Teaching methods

The course will use traditional lectures in PowerPoint format or video presentation, if applicable. Every lecture, where appropriate, will be accompanied and exemplified by relevant international and national case studies, guest lectures, role-playing exercises for climate decision-making, stakeholder-analyses exercises and group debates.

Relevance to Pakistan

A course on climate governance is highly relevant for Pakistani university students due to the country's unique challenges and impacts related to climate change. The course offers a focused understanding of governance mechanisms and challenges to systematically address multifaceted impacts at local, national, regional and global levels.
Climate change being a manifestation of global injustice requires a deep understanding of social, economic, environmental and political processes, actors and systems at global, regional and national scales to effectively devise necessary response mechanisms. A knowledge gap in this area exists within the higher education landscape in Pakistan that hinders the systematic introduction of issues relevant to climate governance. There is a need to provide both theoretical and practical insights into the complexities of climate governance to enhance students' preparedness to better navigate the impacts of climate change.

Institutional mechanisms emerge as pivotal factors in effectively addressing the impacts of climate change. This encompasses a spectrum of elements, including institutional readiness, capacities and a nuanced understanding of the intricate issues surrounding climate change. Unfortunately, Pakistan exhibits evident institutional weaknesses, impeding its ability to navigate and manage the impacts of climate change. The course aims to provide substantial insights and understanding of the vital role institutions play in climate governance, particularly in the context of Pakistan, while downscaling the emerging governance challenges for future academics, practitioners and policymakers.

Moreover, the course recognizes the need for trained professionals in Pakistan to combat climate change impacts at the local to international levels. It emphasizes the importance of developing a cohort of professionals, including policymakers at different levels, who are empowered with the theoretical knowledge and practical know-how of climate governance. This not only prepares students to address the immediate challenges posed by climate change but also positions them as contributors to the formulation of international and national policies that cater to the needs of the most vulnerable communities and ecosystems.

COURSE CONTENTS

LECTURE 1:
INTRODUCTION TO CLIMATE CHANGE SCIENCE AND IMPACTS
- Basics of climate change science
- Climate change impacts at different scales
- Climate impacts in Pakistan

LECTURE 2:
INTRODUCTION TO THEORETICAL FOUNDATIONS OF CLIMATE GOVERNANCE
- Introduction to global commons and the theory of commons
- Introduction to commons governance
- Key elements of commons governance

LECTURE 3:
GOALS AND OBJECTIVES OF CLIMATE GOVERNANCE
- Transition from resource governance to climate governance
- Climate governance
- Major elements of climate governance

LECTURE 4:
KEY ISSUES OF CLIMATE GOVERNANCE
- Key issues of climate governance: Adaptation, mitigation, loss and damage
- Governing the key issues

LECTURE 5:
MULTILEVEL CLIMATE GOVERNANCE
- Multilevel governance
- Characteristics of international climate governance
- Processes, actors and challenges of international climate governance

LECTURE 6:
CLIMATE ACTION: GLOBAL COMMITMENTS
- Major international agreements
- Paris Agreement
- Sustainable Development Goals
- Sendai Framework
- Interconnections

LECTURE 7:
INTEGRATED CLIMATE ACTION
- Integrated climate action
- Elements of integrated climate action
- Enabling factors for integrated climate action
- Challenges for integrated climate action

LECTURE 8:
ADAPTATION TO CLIMATE CHANGE: GLOBAL TO LOCAL
- A quick review
- Global governance on adaptation
- Adaptation at national and local scales
- Maladaptation and limits to adaptation

LECTURE 9:
LOSS AND DAMAGE
- Loss and damage
- Institutional mechanisms of loss and damage
- Example: Human mobility

LECTURE 10:
IMPLEMENTATION OF CLIMATE ACTION
- Integrated climate action: A quick review
- Preparing and implementing an integrated climate action approach
- Developing a climate adaptation plan on the local level
- Developing a climate adaptation plan on the national level

LECTURE 11:
CLIMATE GOVERNANCE IN CITIES
- Climate change in cities
- Entry points to urban climate action
- Urban climate action

LECTURE 12:
NATURE-BASED SOLUTIONS FOR CLIMATE CHANGE
- Understanding nature-based solutions
- Nature-based solutions and climate action
- Principles and approaches of nature-based solutions
- Implementing and governing nature-based solutions

LECTURE 13:
CIRCULAR ECONOMY
- Introduction to circular economy
- Circular economy and climate change
- Challenges to implementing circular-economy approaches
- Governing circular economy

LECTURE 14:
CLIMATE GOVERNANCE ACTORS AND STAKEHOLDERS
- Definition of stakeholders and actors
- Need for stakeholder involvement and participation
- Stakeholder analysis and mapping
- Climate change stakeholders

LECTURE 15:
CHALLENGES IN STAKEHOLDER ENGAGEMENT
- Socioeconomic and political challenges
- Cultural and informational challenges
- Monitoring and evaluation of challenges and opportunities
- Addressing challenges in stakeholder engagement for climate governance
- Methods and tools for stakeholder engagement in climate action

LECTURE 16:
ROLES OF NON-STATE ACTORS IN CLIMATE GOVERNANCE
- Definition of state actors and non-state actors
- Role of non-state actors
- Successful climate initiatives by non-state actors
- Challenges of non-state actor engagement

LECTURE 17:
IMPLEMENTATION OF MONITORING AND EVALUATION
- Introduction to monitoring and evaluation in climate action
- Developing monitoring and evaluation tools in climate adaptation projects
- Challenges and solutions

LECTURE 18:
DATA FOR CLIMATE ACTION AND GOVERNANCE
- Need for data-driven climate action
- Overview of data and data literacy
- Provision of data and case studies
- Data governance
- Challenges and opportunities

LECTURE 19:
CLIMATE BUDGETING
- What is climate budgeting?
- How to prepare a climate budget
- Local case study
- National case study

LECTURE 20:
DECISION-SUPPORT TOOLS FOR CLIMATE ACTION
- Decision support for integrated climate action
- Decision support tools for climate adaptation
- Description of selected tools

LECTURE 21:
CLIMATE CHANGE ENTREPRENEURSHIP AND INNOVATION: OPPORTUNITIES AND CHALLENGES
- Introduction to climate entrepreneurship
- Roles of drivers
- Roles of technology
- Challenges

LECTURE 22:
CLIMATE FINANCE FOR CLIMATE ACTION
- Introduction to climate finance
- International climate finance
- Instruments of climate finance

LECTURE 23:
CLIMATE LITIGATION
- Definition and key concepts of climate litigation
- Different types of climate litigation
- Processes and steps
- Global trends and examples

LECTURE 24:
EMERGING CHALLENGES OF CLIMATE GOVERNANCE
- Introduction and major challenges
- Institutional challenges
- Corruption
- Just transition challenges
- Security challenges

LECTURE 25:
MISINFORMATION, DISINFORMATION AND GREENWASHING IN CLIMATE CHANGE GOVERNANCE

- Introduction and contexts
- Disinformation, misinformation and greenwashing
- Combating misinformation, disinformation and greenwashing

LECTURE 26:
OVERVIEW OF CLIMATE CHANGE IN PAKISTAN

- Loss and damage in Pakistan
- Climate governance in Pakistan
- Institutional mechanisms in Pakistan
- Climate finance in Pakistan

LECTURE 27:
STUDENT EXERCISE

LECTURE 28:
SUMMARY LECTURE

- Recapitulation of major topics
- Takeaway messages
- Student reflections

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SUPPLEMENTARY READINGS

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6. World Bank (2023): The Climate Dictionary. The World Bank. New York, USA.
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COURSE 4: SUSTAINABLE DEVELOPMENT IN A CHANGING CLIMATE

Credit hours: 3 (28 sessions; 1.5 hours each).
Mode of assessment: Final presentation (60%); written assignments (30%); class participation (10%).
Relevant degree programs: Natural sciences, social sciences, humanities, business management and other related bachelor's and master's degree programs.
Prerequisites for students: An understanding of basic social science concepts and a genuine interest in environmental issues, sustainability and climate change.
Prerequisites for teachers: A basic understanding of climate change and development-related concepts.

Course objectives and description

This course is designed for bachelor's and master's students, with no to a very basic understanding of the concept of sustainable development. The primary objective of this course is to equip students with a comprehensive understanding of the complicated relationship between sustainable development and climate change. The course employs an interdisciplinary approach, drawing on real-world examples from different domains such as environment, society and economy. It aims to teach students fundamental concepts, challenges and emerging debates in this field. An innovative sustainable development lab component has been integrated in this course to challenge students to think out of the box and explore novel solutions to the most pressing sustainable development challenges.

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will have an in-depth knowledge about the Sustainable Development Goals and their social, economic and environmental relevance.*	*C2 (Understand)*
CLO – 2	*Students will be able to apply the theoretical skills on sustainability-related projects.*	*C3 (Apply)*
CLO – 3	*Students will be able to critically analyse key sustainability and climate-related issues.*	*C4 (Analyse)*
CLO – 4	*Students will develop problem-solving skills to find innovative solutions to the most pressing climate and sustainable development issues.*	*C5 (Evaluate)*

Teaching methods

This course entails interactive lectures comprising content slides, group discussions and case-based learning. The lecture slides are designed to engage students in meaningful debates, based on the Socratic questioning method that pushes students beyond surface-level comprehension of the topics and think about counter arguments and rebuttals. Apart from lectures, students will be required to deliver a 15-20 minutes presentation addressing a challenge within the realms of social, economic or environmental aspects of sustainable development and climate change.

Relevance to Pakistan

Integrating transdisciplinary environmental education into the existing curriculum of Pakistan is pertinent for fostering sustainable behaviours and nurturing a profound sense of responsibility in the younger generation towards the environment. This course is designed to equip students with the essential knowledge and skills needed to address the most pressing challenges pertaining to sustainable development in the context of climate change. Raising awareness about some of the key social, economic and environmental concerns is essential to Pakistan's success in meeting the Sustainable Development Goals and moving the country closer to the upper-middle income threshold by 2030, as envisioned in Pakistan's Vision 2025.

COURSE CONTENTS

LECTURE 1:
INTRODUCTION TO SUSTAINABLE DEVELOPMENT

- The concept of development
- Introduction, history and evolution of sustainable development
- Tragedy of the commons
- Sustainable development as an approach to development
- Triple bottom line

LECTURE 2:
PILLARS AND PRINCIPLES OF SUSTAINABLE DEVELOPMENT

- The three pillars of sustainable development
- Principles of sustainable development

LECTURE 3:
INTRODUCTION TO SUSTAINABLE DEVELOPMENT GOALS

- Brief introduction to the Millennium Development Goals and the Sustainable Development Goals
- SDG global performance
- Pakistan's performance on SDGs

LECTURE 4:
INTRODUCTION TO CLIMATE CHANGE
- Class activity on sustainable actions
- Introduction to climate change
- Future of the world under changing climate
- Planetary Boundaries and the Doughnut framework

LECTURE 5:
THE CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT NEXUS
- Introduction to the climate change and sustainable development nexus
- Climate impacts and vulnerability
- Adaptation and mitigation as sustainable development strategies

LECTURE 6:
SUSTAINABLE DEVELOPMENT AND ITS DISCONTENTS
- Tipping points for sustainable development
- Sustainable development as a contested concept
- The post-sustainability trilemma

LECTURE 7:
DOCUMENTARY SCREENING, DISCUSSION AND INTRODUCTION TO STUDENTS' PRESENTATIONS

LECTURE 8:
SOCIETY, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (PART I)
- Theoretical background
- Deep dive into SDGs 1, 2, 3, 4,5, 6, 10, 11 and 16

LECTURE 9:
SOCIETY, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (PART II)
- Poverty and climate change in the context of sustainable development
- Climate change and poverty nexus: Case study of Nigeria

LECTURE 10:
SOCIETY, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (PART III)
- Climate-induced migration and displacement
- Climate-induced migration in Small Island Developing States

LECTURE 11:
SOCIETY, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (PART IV)
- Gender inequality in Pakistan and globally
- Gender, climate change and sustainable development
- Challenges and barriers

SESSION 12:
SESSION FOR GROUP WORK OR INDIVIDUAL CONSULTATION

SESSION 13:
SUSTAINABLE DEVELOPMENT LAB 1: STUDENTS' PRESENTATIONS ON THE PILLAR 'SOCIETY'

LECTURE 14:
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (PART I)
- Introduction to the environmental pillar of sustainable development
- Human modifications in physical environment
- Environmental sustainability and SDGs

LECTURE 15:
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (PART II)
- Water resources for sustainable development
- Biodiversity conservation

LECTURE 16:
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (PART III)
- Renewable energy for sustainable development
- Ecotourism and environmental conservation

SESSION 17:
SESSION FOR GROUP WORK OR INDIVIDUAL CONSULTATION

SESSION 18:
SUSTAINABLE DEVELOPMENT LAB 2:
STUDENTS' PRESENTATIONS ON THE PILLAR 'ENVIRONMENT'

LECTURE 19:
CLIMATE CHANGE, ECONOMY AND SUSTAINABLE DEVELOPMENT INTERFACE (PART I)
- Introduction to the economy pillar of sustainable development
- Economic sustainability and the SDGs
- Climate change impacts on economic sustainability

LECTURE 20:
CLIMATE CHANGE, ECONOMY AND SUSTAINABLE DEVELOPMENT INTERFACE (PART II)
- Sustainable consumption and production
- Introduction to circular economy

LECTURE 21:
CLIMATE CHANGE, ECONOMY AND SUSTAINABLE DEVELOPMENT INTERFACE (PART III)
- Sustainable blue economy
- Green transportation for sustainability

SESSION 22:
SESSION FOR GROUP WORK OR INDIVIDUAL CONSULTATION

SESSION 23:
SUSTAINABLE DEVELOPMENT LAB 3:
STUDENTS PRESENTATIONS ON THE PILLAR 'ECONOMY'

LECTURE 24:
DOCUMENTARY SCREENING

LECTURE 25:
THE FUTURE OF SUSTAINABLE DEVELOPMENT
- SDGs and the 2030 deadline
- Sustainability: Looking beyond 2030
- Alternative approaches to sustainable development

LECTURE 26:
GOVERNANCE FOR SUSTAINABLE DEVELOPMENT
- Introduction to climate and sustainable development governance
- Governance tools for a sustainable future
- SDG governance in Pakistan

LECTURE 27:
FINANCING FOR SUSTAINABLE DEVELOPMENT
- Global outlook and the cost of sustainable development
- Financing for sustainable development and climate action
- Bottlenecks to accessing SDG finance for developing countries

LECTURE 28:
CALL TO ACTION - SUSTAINABLE DEVELOPMENT
AND CLIMATE ACTION IN PRACTICE
- Taking individual climate action
- Inspiring individual climate action
- Students' sustainability diaries

COMPULSORY READINGS

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2. Fulekar, M. H., & Dubey, R. S. (Eds.). (2023). Climate Change and Sustainable Development. CRC Press. https://doi.org/10.1201/9781003205548
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COURSE 5: GENDER, CLIMATE CHANGE AND DISASTERS

Credit hours: 3 (28 sessions; 1.5 hours each)
Mode of assessment: Written examination.
Relevant degrees: Anthropology, cultural studies, disaster studies, environmental sciences, gender studies, political sciences, sociology and other related fields.

Prerequisites for students: No prerequisites.
Prerequisites for teachers: A social science background and a basic understanding of climate change.

Course objectives and description

Climate change and disasters impact individuals differently depending on their gender and other intersecting social factors. These disparities frequently marginalize certain groups, limiting their opportunities for adaptation and recovery. Against this background, this course explores the intersection of gender, climate change and disasters, examining how different genders experience and respond to these crises. Students will analyze the social, political, and environmental impacts of climate change, focusing on gender norms and values that shape vulnerability and resilience. Through case studies and discussions, the course aims to provide an understanding of the intersectional perspectives necessary for effective adaptation and recovery strategies. By the end of the course, students will be equipped to critically assess and contribute to gender-sensitive approaches in climate and disaster contexts.

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will be able to describe the fundamental issues and debates related to gender, climate change and disasters.*	*C2 (Understand)*
CLO – 2	*Students will be able to apply the knowledge to everyday settings.*	*C3 (Apply)*
CLO – 3	*Students will be able to critically assess the issues related to climate change and disasters through a gender lens.*	*C4 (Analyse)*

Teaching methods

Teaching methods include a number of strategies designed to improve learning and participation of the students. Traditional lectures are presented in PowerPoint format, including relevant international and national case studies to give practical examples. Group discussions on published research articles will be used to promote critical thinking and active involvement.

Relevance to Pakistan

Pakistan is acting to increase its resilience towards climate change and disasters. To ensure that these efforts are inclusive and equitable, it is essential to leverage and acknowledge the differential impacts and adaptive capacities of different genders and marginalised groups. This course takes an essential first step for inculcating this mindset in future climate leaders who wish to strengthen inclusion and equity, while fostering a climate-resilient and disaster-proof development of Pakistan.

COURSE CONTENTS

LECTURE 1:
GENERAL INTRODUCTION TO CLIMATE CHANGE
- Definitions
- Causes of climate change
- Impacts of climate change on humans
- Closing question: Why gender matters?

LECTURE 2:
INTRODUCTION AND SIGNIFICANCE OF GENDER, DISASTER AND CLIMATE CHANGE IN THE CONTEMPORARY WORLD
- Introduction: The taxonomy of disasters
- Exploring contours of gender and disaster
- Gender, disaster and climate change data trends

LECTURE 3:
FEMINISM AND THE ENVIRONMENT: THEORETICAL UNDERPINNINGS
- Feminist environmental philosophy
- Characterization and frameworks
- Ecofeminism: Origin, positions and arguments
- Ecofeminism in the 21st century

LECTURE 4:
FEMINIST POLITICAL ECOLOGY AND MATERIALISM
- Human-nature relationship
- Capitalism/patriarchy and marginalization
- Feminist new materialism
- Social equity/justice and environment

LECTURE 5:
FEMINIST STANDPOINT THEORY AND FEMINIST POST-HUMANISM
- Knowledge constructs
- Marginalization of groups and climate events
- Feminist climate renaissance
- Trans-ecology and masculinities in climate change

LECTURE 6:
GENDER NORMS AND ROLES
- Social structures and environment
- Gender and environmental values
- Sociocultural dynamics in South Asia

LECTURE 7:
GENDERED VULNERABILITIES AND UNDERLYING CAUSES
- Deconstructing gendered exposure and vulnerability
- Contextual conditions: Social and gender structures, geography, politics and economic setting
- Gender equity and equality in the context of disaster and climate change

LECTURE 8:
CLIMATE CHANGE, DISASTER VULNERABILITIES AND GENDERED IMPACTS
- Global trends and differential impacts of climate change and disasters and slow-onset events
- Chipko movement/Toxic dumping in Philippines
- Shortcomings of the "impacts" approach to gendered vulnerabilities

LECTURE 9:
DIFFERENTIATED VULNERABILITIES AND INTERSECTIONALITY
- The concept of intersectionality
- Relationship between social categorization, climate and disasters
- Gender and sexuality in climate change and disaster
- Power, positioning and natural resource marginality

LECTURE 10:
DIFFERENTIATED VULNERABILITIES AND INTERSECTIONALITY (CONT.)
- Beyond gender: Considering race, class, ethnicity, age, economic background and more
- Intersectionality, institutions and norms
- Social stratification case studies from South Asia: Systemic oppressions and privileges

LECTURE 11:
GENDER AND HEALTH
- Relationship between gender and health
- Health effects in South Asia
- Climate change and its health impacts for women in Bangladesh

LECTURE 12:
GENDER, DISPLACEMENT AND MIGRATION
- Introducing climate migration and displacement
- Climate and disaster-induced displacement and migration
- Case studies from South Asia

LECTURE 13:
FEMINIZATION OF POVERTY AND FOOD SECURITY IMPLICATIONS
- Women and agriculture
- Causes and implications
- Women's access to food in times of crises

LECTURE 14:
GENDER AND WATER-RESOURCE MANAGEMENT
- Gender and water resources: Too little vs. too much water
- Gender and sanitation
- Gender roles in water governance

LECTURE 15:
CITIES, CLIMATE CHANGE AND DISASTER
- Urban space, climate change and disaster through a gender perspective
- Urbanization and neo risks
- Case study: Mitigation of greenhouse gases through informal waste recyclers in Delhi, India

LECTURE 16:
GENDER IN THE CLIMATE-CONFLICT NEXUS
- Climate-conflict linkages
- Gender in the climate-conflict nexus

LECTURE 17:
GENDER AND CLIMATE ACTION
- Definition and introduction to climate action
- Gender and climate action
- Challenges and opportunities

LECTURE 18:
GENDER AND CLIMATE CHANGE ADAPTATION
- Gender and climate change adaptation
- Adaptation differences between men and women
- Gender-responsive climate change adaptation

LECTURE 19:
GENDER AND CLIMATE CHANGE MITIGATION
- Climate and disaster risk mitigation
- Women, climate and disaster risk mitigation
- Case study: Women in Ghana and climate information

LECTURE 20:
INTRODUCTION TO GENDER MAINSTREAMING
- Introduction to gender mainstreaming
- Mainstreaming gender in policies, programmes and institutions
- Gender analysis as a first step

LECTURE 21:
INSTRUMENTS FOR GENDER MAINSTREAMING
- Moser framework
- Harvard Analytical Framework
- Capacities and Vulnerabilities Assessment Framework

LECTURE 22:
WOMEN IN CLIMATE ACTIVISM
- Women as agents of change
- Women in climate activism

LECTURE 23:
GENDER IN RESILIENCE, RECOVERY AND RECONSTRUCTION
- Gender perspective on disaster risk reduction and management/Women, indigenous knowledge and recovery
- Action as a gendered concept
- Case study: Climate change and indigenous women in Colombia
- Performing arts for disaster risk reduction and adaptation

LECTURE 24:
GENDER IN RESILIENCE, RECOVERY AND RECONSTRUCTION (CONT.)
- Reducing disaster risk through community resilience
- Building inclusive gender reconstruction
- Case study: Sri Lankan women's organisations responding to post-tsunami violence
- Case study: 'A we run tings', women rebuilding Montserrat

LECTURE 25:
GENDER AND CLIMATE POLICY MAKING
- Revisiting the narrative "women as victims"
- Climate change governance for all
- From policy to action

LECTURE 26:
GENDER POLICY AND PLANNING ARCHITECTURE IN PAKISTAN
- National and sub-national policies and frameworks
- Role of National Disaster Management Authority (NDMA)
- Climate insurance and agricultural workers in Pakistan

LECTURE 27:

GENDER POLICY IMPLICATIONS: CASE STUDIES FROM PAKISTAN AND SOUTH ASIA

- Victims of earthquake and patriarchy: The 2005 Pakistan earthquake
- The floods of 2010 and its aftermath from a gender perspective
- South Asia case studies

LECTURE 28:

DISCUSSION FOR A GENDER-SENSITIVE FUTURE IN PAKISTAN

- What needs to be changed in the existing policies and frameworks?
- Which gender-related issues need to be highlighted more than others?
- Reflections on the course

COMPULSORY READINGS

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10. Giddens, A. (2009). *The Politics of Climate Change*. UK: Polity Press.
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33. Warren, K. j., & Cheney, J. (1991). Ecological Feminism and Ecosystem Ecology. *Hypatia*, 179-197.

COURSE 6: ECOSYSTEM SERVICES AND CLIMATE CHANGE

Credit hours: 3
Mode of Assessment: continuous assessment tests, group work, Research paper, mid-term and final exams.
Relevant degree programs: Geography, Natural Resource Management, Environmental science, climate studies, ecology and conservation biology.
Prerequisites for students: Basic understanding of GIS and statistics, familiarity with research methods and data analysis.
Prerequisites for teachers: PhD or Master's degree (for tutorials) in Environmental Science, Geography, Ecology to Climate Science, Environmental Management. Familiarity with GIS and remote sensing applications. Have an interdisciplinary understanding of concepts and approaches as climate change and ecosystem services encompass diverse fields such as science, economics and policy.

Course Description

Ecosystems worldwide are under stress and their capacity is being degraded due to overexploitation and failure to understand the importance of the services that they provide to human well-being. Climate change has the potential to exacerbate ecosystem degradation and reduce the efficiency of ecosystem services. There is therefore need to examine the changing status of ecosystems, deepen our understanding of the services we gain from the ecosystems and the tools and techniques that support valuation of ecosystem services and decision making. This course covers the relationship between climate and ecosystem services. It introduces the concepts of climate change and ecosystem services and studies how climate change impacts on ecosystems and the services they provide to societies. It further explores the concepts of the valuation of ecosystem services, the ways in which climate change can disrupt and affect these services. Students will gain an understanding of the complex interactions between climate change, ecosystems and the benefits they provide to people.

Course Learning Outcomes (CLO)

CLOs	Learning outcomes	Bloom's taxonomy
CLO – 1	*Students will be able to define the concept of climate change, ecosystem services, its principles and limitations.*	*C1 (Remember)*
CLO – 2	*Students will be able to explain how climate change impacts on ecosystem services and comprehend the role that ecosystems play in provision of essential services apply technical data analysis skills in the mapping of impacts of climate change.*	*C2 (Understand)*
CLO – 3	*Students will be able to apply the principles of ecosystem services in analyzing real world scenarios.*	*C3 (Apply)*
CLO – 4	*Students will be able to analyze the impact of climate change on ecosystem services.*	*C4 (Analyse)*
CLO – 5	*Students will be able to evaluate the differentiated ecosystem management approaches in the contexts of adaptation and mitigation*	*C5 (Evaluate)*
CLO – 6	*Students will be able to propose innovative solutions for managing ecosystems under the context of a changing climate.*	*C6 (Create)*

Teaching methods

This course takes an inquiry-based approach to teaching and learning. Students are encouraged to take an active role in their education, while teachers act as the facilitators who help with the presentation of new material and support reflective thinking. The teacher uses class discussions, hands-on demo and other experiential learning tools to track student comprehension, learning needs and academic progress over a topic. Four summative assessments that include individual writing assessment, written test and group project will measure how well the students achieve high order thinking and learning outcomes.

Relevance to Pakistan

Pakistan is home to unique ecosystems such as the Himalayan ecosystems that provide crucial ecosystem services. At the same time, the country is vulnerable to the impacts of climate change and has experienced changes in temperature and precipitation patterns and extreme weather events. The country is also reliant on agriculture and this impacts the services provided by ecosystems. This course is therefore relevant to help in understanding ecosystem services and their crucial role in mitigating and adapting to climate change. In addition, it will contribute to the development of informed policies, strategies and practices that address the impact of climate on ecosystem services and enhance ecosystem resilience, human well-being and adaptation in a changing climate.

COURSE CONTENTS

LECTURE 1:
INTRODUCTION TO ECOSYSTEM SERVICES
- Definition and classification of ecosystem services
- How biodiversity provides ecosystem services
- Ecosystem diversity in Pakistan

LECTURE 2:
THE FUNDAMENTALS OF CLIMATE CHANGE
- Introduction to climate science and global climate patterns

LECTURE 3:
CLIMATE CHANGE CAUSES AND CONSEQUENCES
- Causes and consequences of climate change
- Current climate trends and projections
- Case Study: Climate trends in Pakistan

LECTURE 4:
DRIVERS OF ECOSYSTEM CHANGE
- Direct drivers of change
- Indirect drivers of change

LECTURE 5:
ECOSYSTEM FEEDBACK LOOPS AND TIPPING POINTS
- Feedback loops and tipping points
- Climate change as a driver of ecosystem service disruption

LECTURE 6:
PAKISTAN'S UNIQUE ECOSYSTEMS AND THEIR SERVICES
- Case study 1: Himalayan Ecosystems: Glaciers and water resources

LECTURE 7:
PAKISTAN COASTAL ECOSYSTEM SERVICES
- Case study 2: Coastal Ecosystem Services and the Indus Delta
- Case studies: Vulnerability of specific ecosystem services

LECTURE 8:
CLIMATE CHANGE IMPACTS ON ECOSYSTEMS
- Relationship between biodiversity and ecosystem
- Indicators of ecosystem service decline in biodiversity hotspot areas
- Biodiversity loss and ecosystem service decline in Pakistan

LECTURE 9:
SUPPORTING SERVICES AND CLIMATE CHANGE
- Soil fertility and nutrient cycling

LECTURE 10:
POLLINATION AND PLANT REPRODUCTION
- Pollination and plant reproduction
- Biodiversity conservation

LECTURE 11:
CULTURAL SERVICES
- Cultural heritage and landscapes
- Recreation
- Tourism
- Spiritual Values

LECTURE 12:
ADAPTATION TO CLIMATE CHANGE AND ECOSYSTEM SERVICES
- What is adaptation?
- Strategies for enhancing ecosystem resilience

LECTURE 13:
NATURE BASED SOLUTIONS AND ECOSYSTEM SERVICES
- Nature-based solutions
- Ecosystem-based approaches to adaptation

LECTURE 14:
ECOSYSTEM-BASED ADAPTATION (EBA) AND SERVICES
- Principles of EbA
- Challenges of implementing EbA
- Integration of traditional knowledge into Ecosystem based adaptation
- Case Study: Implementation of EbA in the context of Pakistan ecosystems

LECTURE 15:
IMPACT OF CHANGES IN ECOSYSTEM SERVICES ON HUMAN WELL-BEING
- Ecosystem services and their impact on human well-being
- Vulnerability of communities to changes in ecosystem services: A Pakistan case study

LECTURE 16:
ECOSYSTEM SERVICES AS CLIMATE CHANGE BUFFERS
- Ecosystems as natural buffers and their contribution to climate resilience
- Case studies of healthy ecosystems providing buffering services during climate events
- Identifying key ecosystem services for climate resilience

LECTURE 17:
CIRCULAR ECONOMY, SUSTAINABLE PRODUCTION, ECOSYSTEM SERVICES AND CLIMATE CHANGE
- Principles of circular economy and their support for ecosystem services and climate change Mitigation

LECTURE 18:
CIRCULAR PRACTICES IN INDUSTRY AND GOVERNMENT
- Circular practices in industry and agriculture
- Case study: Global, regional and local circular economy initiatives and their impacts on ecosystems

LECTURE 19:
COMMUNITY ENGAGEMENT AND COMMUNICATION FOR ACTION ON CLIMATE CHANGE AND ECOSYSTEM SERVICES
- Role of local communities in preserving ecosystem services
- Participatory approaches in conservation projects

LECTURE 20:
EFFECTIVE COMMUNICATION WITH USERS OF ECOSYSTEM SERVICES
- Strategies for effective communication with diverse audiences
- Overcoming challenges in environmental messaging

LECTURE 21:
CLIMATE CHANGE, ECOSYSTEM SERVICES AND SOCIAL EQUITY
- How to ensure equity in the distribution of ecosystem services in the face of a changing climate
- Environmental justice and ecosystem management

LECTURE 22:
SOCIAL EQUITY IN ECOSYSTEMS
- Vulnerability disparities in ecosystems
- Addressing environmental justice in ecosystem management

LECTURE 23:
MAINTENANCE OF ECOSYSTEM SERVICES THROUGH SUSTAINABLE PRACTICES
- Sustainable land-use practices that support preservation and health of ecosystem services
- Agroecology for preservation of ecosystem services

LECTURE 24:
PAYMENT FOR ECOSYSTEM SERVICES
- Payment for ecosystem services
- Localized case studies in Pakistan

LECTURE 25:
ECOSYSTEM SERVICES, FUTURE PROSPECTS AND POTENTIAL ACTION
- Climate change and emerging challenges to ecosystem services
- Innovation opportunities in the preservation of ecosystems services

LECTURE 26:
ROLE OF GOVERNMENTS IN MANAGING ECOSYSTEMS
- The role of government and global collaboration in maintaining robust ecosystem services in a changing climate

LECTURE 27:
RESILIENCE AND AGROECOSYSTEMS
- Characterizing agroecosystems
- Resilience in agroecosystems
- Evaluating resilience in agroecosystem
- Climate resilient development pathways

LECTURE 28:
DISCUSSION ON THE COURSE
- Key concepts and insights gained
- Open discussion on the future of ecosystem services and climate change
- Future directions in ecosystem services research

COMPULSORY READINGS

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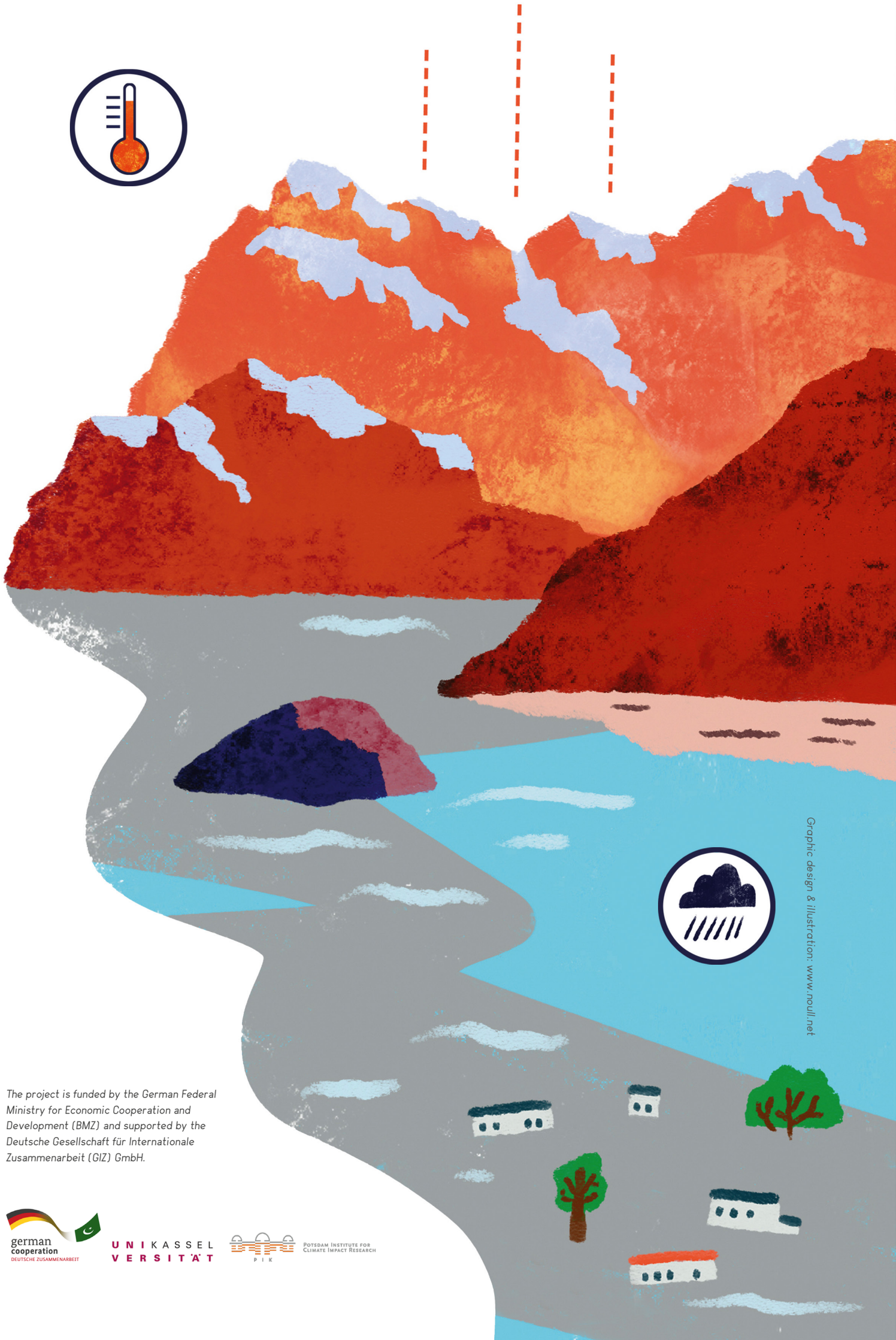

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