ICAR-National Dairy Research Institute
Karnal-132001, Haryana

Courses offered that teach specifically on climate science and/or environmental sustainability at ICAR-NDRI, Karnal

Introduction

The ICAR-National Dairy Research Institute (NDRI), Karnal offers courses that explicitly teach climate science and environmental sustainability. These topics are integrated into both foundational and advanced academic programmes in alignment with the curriculum prescribed by the Indian Council of Agricultural Research (ICAR). The Institute adopts a multidisciplinary approach to ensure that students develop a strong understanding of environmental challenges, climate change, and sustainable agricultural systems.

1. Foundational Course: Environmental Studies and Disaster Management

At the foundational level, NDRI offers the course "Environmental Studies and Disaster Management", which provides comprehensive coverage of environmental sustainability concepts. This course introduces students to natural resources such as land, water, forests, and energy, along with issues related to their over-exploitation and sustainable use. The course includes detailed content on environmental pollution, biodiversity conservation, ecosystem functioning, and sustainable development. Importantly, it explicitly addresses climate science topics, including global warming, climate change, ozone layer depletion, and their environmental and societal impacts.

In addition, the course covers natural and man-made disasters, including floods, droughts, cyclones, and industrial hazards, along with disaster management strategies at national and global levels. Practical components such as field visits, environmental assessments, and laboratory analysis of water quality further strengthen applied understanding of sustainability issues.

2. Advanced Course: Risk Management and Climate Change Adaptation (EXT 605)

At the postgraduate level, NDRI offers a specialized course titled “Risk Management and Climate Change Adaptation” (EXT 605), which directly focuses on climate science and adaptation strategies in the context of Indian agriculture. This course is specifically designed to address the challenges posed by climate change and agrarian distress. It provides both theoretical and applied knowledge on risk management, vulnerability assessment, and climate adaptation strategies. The course adopts a multidisciplinary perspective, incorporating technical, socio-economic, policy, and institutional dimensions.

A dedicated component of the course focuses on climate change science, including basic concepts, impacts of climate change, and its implications for agricultural systems. It further explores climate change adaptation and mitigation, including vulnerability assessment frameworks, identification of adaptation options, and integration of climate considerations into development planning. The course also includes a specialized module on Climate Smart Agriculture (CSA), which emphasizes the development of climate-resilient farming systems, use of climate information services, and extension strategies to support farmers in adapting to changing climatic conditions.

3. Experiential and Applied Learning

Both courses emphasize experiential learning through practical components. Students engage in:

- Hands-on use of risk and vulnerability assessment tools
- Case studies on climate change impacts and adaptation strategies
- Field visits to disaster management authorities and climate-smart agricultural sites
- Development of district and village-level climate adaptation plans

These activities ensure that students are able to apply theoretical knowledge to real-world challenges**.**

4. Alignment with Sustainability Goals

The courses offered at NDRI are aligned with national priorities such as the National Action Plan on Climate Change and ICAR research agendas. They also support global frameworks such as the

United Nations Sustainable Development Goals, particularly those related to climate action, sustainable agriculture, and environmental protection.

5. Conclusion

NDRI clearly offers structured and well-defined courses that specifically address climate science and environmental sustainability. Through a combination of foundational environmental education and advanced, specialized training in climate change adaptation and risk management, the Institute ensures that students are well-equipped to understand and address sustainability challenges in the agricultural and dairy sectors.

Annexure: Details of the courses provided in the institute for environment and climate change

1. Course offered in undergraduate programme (B. Tech): Environmental Studies and Disaster Management

Objectives

1. Understand different resources such as mineral resources, food resources, water resource, energy resources, natural resources and land resources
2. Gather knowledge about environmental pollution, soil pollution, air pollution and thermal pollution
3. Acquaint themselves with waste land reclamation, ecosystems and their management
4. Learn regarding biodiversity and its conservation, natural disaster and manmade disaster along with their management

Theory

Multidisciplinary nature of environmental studies; definition, scope and importance; Natural resources: renewable and non-renewable resources, natural resources and associated problems; Forest resources: use and over-exploitation, deforestation, case studies; Timber extraction, mining, dams and their effects on forest and tribal people; Water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems;

Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles; Ecosystems: concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of ecosystems as forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and its conservation: introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards; Solid waste management: causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution.

Social issues and the environment: from unsustainable to sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management.

Environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Dies, wasteland reclamation; Consumerism and waste products; Environment protection act; Air (prevention and control of

pollution) act; Water (prevention and control of pollution) act; Wildlife protection act. Forest conservation act; Issues involved in enforcement of environmental legislation; Public awareness.

Human population and the environment: population growth, variation among nations, population explosion, family welfare programme; Environment and human health: human rights, value education, HIV/ aids; Women and child welfare; Role of IT in environment and human health.

Natural disasters- meaning and nature of natural disasters, their types and effects; Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion.

Man-made disasters- nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster management- effect to migrate natural disaster at national and global levels; International strategy for disaster reduction; Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community based organizations and media, Central, state, district and local administration; armed forces in disaster response; disaster response; police and other organizations.

Practical

Pollution case studies; Case studies- visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain; Visit to a local polluted site urban/rural/industrial/agricultural; Study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.; Collection of polluted water/ effluent sample, sampling of polluted water/ effluents; Estimation of solids, pH, EC, DO, COD, BOD, Cl^-, F^-, $CO3^{2-2}$ & HCO^{3-}, Ca^{2+} & Mg^{2+}, K^+ and Na^+.

Course offered in the Doctoral programme in the institute: Risk Management and Climate Change Adaptation

Present agriculture and allied sectors in India face tremendous challenges on multiple fronts. Agrarian distress and the climate change impacts together pose grave dangers to food, nutritional

and ecological security. As change agents, extension professionals in particular and agricultural graduates in general need to equip themselves with knowledge and skill sets required to navigate the climate change scenario so as to help reduce risk and vulnerability. Hence, this customised course.

V. Aim of the Course

The course is designed to provide both basic and applied knowledge on the subjects of risks management and climate change adaptation with reference to Indian agriculture. This course will approach the subjects from a multidisciplinary perspective - technical, socio-economic, political, financial, and regulatory. It aims to equip students to identify, evaluate and evolve ways to address (mitigate and manage) risks and climate change.

Theory

Block 1: Risk Management in Agriculture

Unit 1: Understanding Risk and Distress

Introduction to risk, risk management, uncertainty, sensitivity and distress, general risk theory, risk analysis methods, risk perception and decision making, indicators of risk and distress in agriculture – identification, selection and assessment, understanding the agrarian distress in Indian agriculture, sources of distress in Indian farming – changing farm size, land use, cropping patterns, pricing policy, markets and terms of trade, typology of crisis in agriculture; droughts, floods and Indian agriculture, distress and farmer suicides – causes and socio-economic consequences.

Unit 2: Managing Risk and Distress

Ways to reducing/managing risk and distress in Indian agriculture; crop and life insurance; developing support systems; planning, implementation and evaluation of risk/distress management programs; institutional frameworks for risk and disaster management - NDMA & SDMAs; developing district agriculture contingency plans; risk management by diversification; good practices and lessons from other countries; responses of government, non-government and extension system to agrarian crisis; National Farmers Policy.

Unit 3: Extension Professionals and Risk Management

Understanding socio-psychological and behavioural dimensions of farmers under risk/distress; risk perception and communication; helping farmers manage farm level risks – mobilising resources, linking with markets, strengthening capacities; working with village level risk management committees; operational skills for preparing contingency and disaster management plans; institutional and extension innovations in managing risk and distress; policy and technological preferences for dealing with drought and flood.

Block 2: Adapting to Climate Change

Unit 1: Introduction to Climate Change Science

Unit 2: Introduction to Climate Change Adaptation and Mitigation

Introduction to Climate Change Adaptation, Conducting a vulnerability assessment (CVI and SEVI frameworks), Identifying and selecting adaptation options, Global, national and state level initiatives and plans to support climate change adaptation, private sector and civil society initiatives and activities; Mainstreaming climate change adaptation into development planning, Financing climate adaptation and budgetary allocations for programmes, Gender and climate change adaptation, Agricultural development programmes and strategies towards climate change adaptation and mitigation, Community based and Ecosystem based adaptation strategies, preparing evidence based intervention plans for vulnerability reduction at micro and macro-levels.

Unit 3: Climate Smart Agriculture (CSA) and Extension & Advisory Services

Climate smart agriculture; Developing climate smart and climate resilient villages; Stakeholders and determinants involved in climate smart agriculture; Climate smart agriculture and EAS; Innovative extension approaches used in CSA; Climate information services, Farmers perceptions about climate change; Farm and household level manifestations and adaptation strategies; Barriers and limits to adaptation; Farmers feedback on performance of extension methods; Skills, competencies and tools required for extension professionals at different levels and development departments in up scaling CSA.

Practicals

- Hands-on practice in using risk assessment/analysis tools
- Case studies on risk / distress assessment in agriculture - Indian and global
- Lessons / Experiences from NICRA Project in agriculture and allied sectors
- Developing criteria, indicators and indices for assessment of risk, vulnerability and resilience
- Hands-on practice on the use of vulnerability and risk assessment tools and techniques
- Case studies on success stories of climate change adaptation and community based initiatives
- Developing district and village level intervention plans for climate change adaptation
- Field visits to State Disaster Management Authority
- Case studies on climate smart agriculture / villages from India and world
- Case studies on impact assessment of crop insurance programs, disaster management programs
- Capstone project on documenting ITKs and local practices related to reducing risk / climate resilience agriculture

Teaching Methods/Activities

- Lecture
- Assignment (Reading/Writing)
- Student's Book/Publication Review
- Student presentation
- Group Work
- Student's interview of key policy makers
- Case Analysis and case studies Guest Lectures
- Review of policy documents

Learning Outcome

After successful completion of this course, the students are expected to be able to:

- Appreciate the scientific foundation of risk management and climate change science and relate the key learning to the job of an extension professional
- Utilise methods and tools for risk and climate related vulnerability assessments and adaptation strategies in the context of Indian agriculture / farming scenario
- Utilise material in scientific publications relevant for risk management and climate change adaptation and critically reflect on their benefits and limitations for decision making

3. Natural Resources and Production economics

- **Characteristics and classification of natural resources;** sustainability issues in natural resource use; property rights; externalities; transaction costs; need for collective action; role of economics in natural resource accounting, planning, management and policy formulation; social welfare function; allocation of renewable and non-renewable resources (forests, fisheries, minerals, water, land, etc.) under various market structures; valuation of non-market resources; government programmes for conservation and development of natural resources; climate change, mitigation and policies; environmental regulations.
- **Principles of farm management:** marginal returns, opportunity cost, input–output, output–output and input–input relationships; time comparison and comparative advantage; cost principles; farm efficiency measures and financial analysis; farm planning and budgeting; farm records; measurement and management of risk and uncertainty in agriculture; diversification and insurance in agriculture and allied sectors.
- **Production functions:** forms and applications—linear, quadratic, square root, Spillman, cubic, semi-log, Cobb–Douglas, constant elasticity of substitution (CES), variable elasticity of substitution (VES), etc.; dualities between production, cost and profit functions; derivation of supply and factor demand functions from production and profit functions; optimization of resource allocation; resource-use efficiency and returns to scale; frontier production function; total factor productivity; decision-making under risk and uncertainties.

4. Climatology and Livestock Production

Why this course?

This course is important to know the climatic changes that affect the health and production of livestock and vice versa.

Aim of the Course

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of the animal house and assessing the heat tolerance of bovines.

Theory

Unit I (4 Lectures)

Climatology and agro-climatic regions of India. Study of climatic factors and their measurement. Climatic stress in livestock (heat stress/cold stress): effects, measurement and amelioration. Temperature-humidity index and thermo-neutral zone. Adaptation and acclimatization.

Unit II (4 Lectures)

Light: natural and artificial, photoperiod, mechanism of light action and responses. Application in livestock production.

Unit III (4 Lectures)

Performance of livestock introduced in different climates. Micro-climate modification in animal houses. Livestock and global warming.

Unit IV (4 Lectures)

Climate-resilient livestock production systems. Natural disasters—effects on livestock and mitigation measures.

Practical

Visit modern weather forecast stations. Assessment of climate: microclimatic conditions within the animal house. Measurement of temperature, relative humidity, wind velocity and intensity of light. Ambient temperature. Construction of climographs and hythergraphs. Heat tolerance test in bovines.

Teaching Methods: Blackboard, PowerPoint presentations, ICT, group discussions and farm visits.

Learning Outcome: The student is expected to know the different climatic conditions and adaptations for better production and managing livestock.