सत्यमेव जयते

CLIMATE AND DISASTER RESILIENT AGRICULTURE MANAGEMENT

TRAINING MANUAL



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Resilient India - Disaster Free India

National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)



Climate and Disaster Resilient Agriculture Management

TRAINING MANUAL

National Institute of Disaster Management (NIDM)

(Ministry of Home Affairs, Government of India)

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Climate and Disaster Resilient Agriculture Management Training Manual

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Authors

Prof. Anil K. Gupta, Head - Division of Environment, Climate Change and Disaster Risk Management, NIDM, Govt. of India, New Delhi, India.

Ms. Richa Srivastava, Research Consultant - NIDM, Govt. of India, New Delhi, India.

Dr. Sanayanbi Hodam, Research Associate - NIDM, Govt. of India, New Delhi, India.

Ms. Swati Singh, Consultant - NIDM, New Delhi, India.

Dr. G. Rabindra Chary, Project Director – AICRPDA and Former Director, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad.

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Dr. Akhilesh Gupta
Senior Advisor (DST) &
Head Strategic Programmes,
Large Initiatives and
Coordinated Action Enabler (SPLICE) &
Climate Change Programme

Department of Science and Technology (DST)
Government of India
Technology Bhavan, New Mehrauli Road,
New Delhi-110016

MESSAGE



Global food security is one of the most pressing issues for humanity, and agricultural production is critical for achieving this. Over the past century, enormous progress has been achieved worldwide in improving human welfare. Societies have changed radically through quantum leaps in technology, rapid urbanization, and innovations in production systems. However, billions of people still face pervasive poverty, gross inequalities, joblessness, environmental degradation, disease and deprivation. In addition to these challenges, climate change is one of the major concerns. Many agricultural practices both traditional as well as scientific innovations can be used to reduce the emission of greenhouse gases thus reducing the impact of global warming on climate change.

Proper strategies are needed not only to save people from disaster, but also to build resilience towards disaster. Educating people about the types and nature of disaster and ways to build resilience is most important as we can save ourselves only by putting our consolidated effort to beat the disaster. Department of Science and Technology has always been appreciating and encouraging innovative ideas in different scientific and technological fields to bring in a better, greener, healthier and a food secured future and will continue doing in time to come. Over the years we have achieved significant breakthroughs in developing and demonstrating replicable technology packages and field models in several sectors with involvement of its partners Science and Technology (S&T) based field groups and S&T institutions.

I compliment National Agriculture Disaster Management Plan (NADMP) team of NIDM for the excellent contribution in the form of NADMP based on which this training manual has been prepared. I believe this training manual on "Climate and Disaster Resilient Agriculture Management" will guide, help and facilitate in enhancing capacities of the trainees about Disaster Risk Reduction and Climate Change Adaptation in the agriculture sector.

(Dr. Akhilesh Gupta)

Maj Gen Manoj Kumar Bindal
VSM

Executive Director

राष्ट्रीय आपदा प्रबंधन संस्थान
(गृह मंत्रालय, भारत सरकार)
National Institute of Disaster Management
Ministry of Home Affairs, Govt. of India
Plot No. 15, Pocket 3, Block-B, Sector-29,
Rohini, Delhi-110042

FOREWORD



Agriculture contributes to a major portion of India's economy by way of supporting food, livelihoods, agribusiness, agroindustry and a range of other sectors. However, Indian agriculture is often threatened by natural disasters like flood, drought, cyclone, etc. Besides this, agriculture sector also suffers due to the impact of natural and anthropogenic disasters on infrastructure, resources, ecosystem services and associated human populations.

Hence, it is critical to make agriculture sector resilient and sustainable to ensure food security and protect Indian economy and, thereby, save lives and livelihood of Indian farmers. The poorest people in the community are affected by food insecurity and disasters; and therefore, there is a need to be prepared to mitigate and manage disasters. Poor access to reliable and timely market information for the farmers, absence of supply & demand forecasting, poorly structured and inefficient supply chains, inadequate cold storage facilities and shortage of proper food processing units, large intermediation between the farmers and the consumers are some of the major causes for the losses.

Though, there are visible improvements brought by the adoption of management practices through on-farm and off-farm operations in this sector, there are also growing risk of disaster related damages and losses to agriculture systems. NIDM has recently developed the National Agriculture Disaster Management Plan (NADMP) for the Ministry of Agriculture and Farmers' Welfare which addresses multi-hazard risk and vulnerabilities, multi-layer approach to resilience building, and covering all aspects of agriculture system in India as a whole with focus on agriculture sector as depicted under the allocation of business to the Ministry. This training module has been developed to support the capacity building activities. I am sure that the contents of this publication will be useful to trainers and professionals working on different aspects of agriculture and allied sector.

(Manoj Kumar Bindal)

Dr. Anil Kumar Gupta
Project Director-NADMP
Professor and Head- Environment, Climate and Disaster Risk Management Division

National Institute of Disaster Management (NIDM), New Delhi, INDIA
Ministry of Home Affairs, Govt. of India
Plot No. 15, Pocket 3, Block-B, Sector-29, Rohini, Delhi-110042

PREFACE



Agriculture is the major source of economy and livelihoods for people in most developing countries. In India, agriculture has key roles in Indian economy and provides food and livelihood activities to much of the Indian population. Nevertheless, Indian agriculture, like the India's landscapes is vulnerable to multiple disasters of natural and anthropogenic nature, and also aggravated by the impact of climate change. India's more than 68% net sown area is prone to drought, which varies temporally and spatially, and doesn't include urban agriculture. Besides this, agriculture sector is affected regularly by other climate disasters, extremes and uncertainties related with pest attacks, diseases, fire, damage by elephants, hails, frost, floods, storms and cyclones, land-degradation, migration, post-harvest damages/losses, agro-industrial and associated business risks, and damage to infrastructure, establishments and services by geophysical disasters, etc. The sector includes horticulture, agroforestry, poultry, rangeland, fisheries, and natural resource management systems, etc. Through, there are visible improvement brought through adoption of management practices through on-farm and off-farm operations in this sector, there are also growing risk of disaster related damages and losses to the agriculture systems.

Looking to the need of the nation, its people and businesses, making agriculture system in the country to be resilient to the risk of disasters, is crucial, also for ensuring livelihoods, food security, health, environmental quality and economic resilience. Therefore, National Institute of Disaster Management has recently prepared National Agriculture Disaster Management Plan (NADMP) for the Ministry of Agriculture and Farmers Welfare utilizing the legal mandate under the Disaster Management Act 2005 and the National DM Policy 2009. Drawing the lessons from the preparation of NADMP, this module has been especially designed with the aim to provide an insight to the trainees and build capacity of all the people working in agriculture and allied sector about the Disaster Risk Reduction (DRR)-Climate Change Adaptation (CCA) in the agriculture sector.

I am sure that the contents of this publication will be useful to trainers, professionals and related stakeholders working on different aspects of agriculture and allied sector.

(Prof. Anil K Gupta)

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I, on behalf of the team acknowledge Maj. Gen. Manoj Kumar Bindal, ED, NIDM for his encouragement, motivation and support throughout. The preparation of this training manual has been expedited with the help of Ms. Richa Srivastava, Dr. Sanayanbi Hodam, Ms. Swati Singh and Dr. G Rabindra Chary. I owe to their sincere efforts and contributions.

I extend sincere thanks to the NADMP Working Groups members who helped in developing the National Agriculture Disaster Management Plan, namely, Dr. V. K. Sehgal, Principal Scientist, IARI, New Delhi, Dr. Himanshu Pathak, Director, ICAR - NRRI, Cuttack, Dr. P. Krishnan, Principal Scientist, NAARM, Hyderabad, Dr. Shibendu Shankar Ray, Director, MNCFC, New Delhi, Shri K. K. Singh, Scientist-F and Dr. S. D. Attri, Scientist-F, IMD, New Delhi, Shri Anup Kumar Srivastava, Senior Consultant, NDMA, New Delhi, Shri. Vijay Soni, Under Secretary, Drought Management Division, Department of Agricultural Cooperation & Farmers' Welfare, New Delhi. Their inputs have been very helpful in preparing this manual.

Guidance and inputs from Dr. Akhilesh Gupta, Advisor, Climate Change Programme, DST-GOI, Shri Amitabh Gautam, then Joint Secretary (Drought Management Division), Dr. Namita Priyadarshee, Joint Secretary and Shri Balram Prasad Bimal, Deputy Secretary (DM), MoAFW, GoI, are gratefully acknowledged. I also acknowledge the valuable inputs and suggestions from Dr. Shailendra Nath Pandey, Freelance Development Consultant, Dr. Anand Kumar, Consultant, IPE Global, Smt. Preeti Tahlani, Scientist-SD, MNCFC, New Delhi, Ms. Shweta Bhardwaj, Junior Research Fellow (CAP-RES), NIDM and Mr. Michael Islary, Junior Consultant, NIDM in this endeavour.

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(Prof. Anil K Gupta)

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List of Abbreviations

CCA	Climate Change Adaptation
DRR	Disaster Risk Reduction
DM	Disaster Management
NMSA	National Mission on Sustainable Agriculture
NAPCC	National Action Plan on Climate Change
RAD	Rainfed Area Development
PKVY	Paramparagat Krishi Vikas Yojana
MOVCDNER	Mission Organic Value Chain Development for North Eastern Region
NRAA	National Rainfed Area Authority
SLUSI	Soil Land Use Survey of India
NBM	National Bamboo Mission
SMAF	and Sub-Mission on Agroforestry
RUGMY	Rajiv Gandhi Udyami Mitra Yojana
SFURTI	Scheme of Fund for Regeneration of Traditional Industries
RISC	Rural Industry Service Centre
KCC	Kisan Credit Cards
NIPHM	National Institute of Plant Health Management
PMFBY	Pradhan Mantri Fasal Bhima Yojana
IPM	Integrated Pest Management Scheme
NDMP	National Disaster Management Plan
NFSM	National Food Security Mission
KUY	Krishi Unnati Yojana
NMOOP	National Mission on Oilseeds & Oil Palm
ACABC	Agri Clinics and Agri Business Centres

SFDRR	Sendai Framework for Disaster Risk Reduction
SDGs	Sustainable Development Goals
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
PMKSY	Pradhan Mantri Kisan Sampada Yojna
CIPHET	Central Institute of Post-Harvest Engineering & Technology
UNFCCC	United Nations Framework Convention on Climate Change
NAFCC	National Adaptation Fund for Climate Change
MoAFW	Ministry of Agriculture and Farmers' Welfare
FPOs	Farmers' Producer Organization
NADMP	National Agriculture Disaster Management Plan
ToT	Training of Trainers

Pre Training Assessment

Context and Description of the Session (0.5 hrs)

The session shall consist of either written or oral question-answer/discussion round or under the perception level of the participants at the entry level of the training course. This would be repeated at the end of the course (post training session) during valediction to understand the impact of the course by facilitation and comparison of entry and exit behavior of the participants. A film can also be shown to trigger the expression of participants prevailing knowledge and/or perception on aspects of climate change and disaster risks related to agriculture and allied services.

Learning Objectives

- To compare the entry and exit behavior of the trainees
- To evaluate the knowledge and skills gained from the training
- To assess perceived competency of participants on Climate Change Adaptation (CCA), Disaster Risk Reduction (DRR), agriculture and related disaster risks
- To carry out a formal internal evaluation methodology using questionnaires

Methodology

- To compare the entry and exit behavior of the trainees
- To evaluate the knowledge and skills gained from the training
- To assess perceived competency of participants on Climate Change Adaptation (CCA), Disaster Risk Reduction (DRR), agriculture and related disaster risks
- To carry out a formal internal evaluation methodology using questionnaires
- Question-answers
- Discussion
- Ice-breaking games
- Film Show-Khet Chorab Naahi produced by Gorakhpur Environment Action Group (https://www.earthcarefilms.com/filming_community_ struggles_ khet_chorab_nahi.html)

Guidance

- Questionnaire based assessment of the participants' perception at the entry level (and also at the exit level) may be carried out.
- The questions shall be identified/ framed by the course director/coordination

team looking into the course module's scope, participants profile and duties/background, and context of the film being screened.

- It is advised that the course coordinator / trainers keep pre-developed notes as own tips and hints for delivering course session.

The resource person for this session is expected to have a broad knowledge of all aspects associated with agriculture and allied sectors, climate change and disaster risks and the national and international framework for dealing with the subject, ideally a team of two or three resource persons with background of agriculture, environment & earth science, environmental law and geo informatics, having prior experience of disaster management and can correlate with agriculture.

Training Design and Training Plan

A basic training manual for improving the capacity of various stakeholders (Government Authorities, policy makers, practitioners and communities) towards climate and disaster resilience agriculture management.

The training manual focuses on following two research questions:

- What are the key factors within regions that contribute to resilience or multiply vulnerability?
- What specific policy interventions could help to bridge the vertical gap between the integrated national policy framework and local contexts and the horizontal gap between actions within sectoral development programs to integrate agriculture and disaster dichotomy within the system and practice? In answering this we intend to focus on the local, regional, state and international perspectives of agriculture and related disasters and challenges associated with interlinking the sector.

Aim

Is to promote and support training capacity building on disaster resilient agriculture systems and integration into planning process towards sustainable development.

Key objectives are the following:

At the end of the training, participants will be able to:

- Enumerate the linkages of agriculture system with CCA, DRR and sustainable development and their associated impacts and challenges.
- Identify risk management practices and different adaptation packages to address the vulnerability of agriculture sector.
- Explore risks management tools for agriculture producers and enterprises.
- Describe the resilience and its practical framework in agriculture.

- Link National and International perspectives in relation to agriculture and disaster management.
- Analyze institutional and technical capacities for disaster risk reduction and climate change adaptation in agriculture and enhance coordination mechanisms.

Target Group/Audience

The module is developed considering the performance gaps and training needs of the following target participants:

(i) Senior to middle level officials from the state and district level officials from line departments

(ii) Executives/professionals from other Government agencies/boards, programmes/schemes, including public sector undertakings

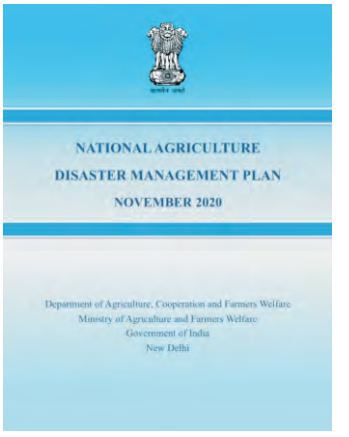
(iii) Members/representatives of non-governmental and community organizations engaged in activities related to assessment, planning, implementation or monitoring of disaster management, environment and development

(iv) Faculty members/professionals from training, education and research institutes/centres, State Agriculture Universities and other master trainers related to environment/ecology, disaster management, land and water, agriculture, rural development, forestry, etc.

(v) Private Sector: Officials/ professionals involved in agriculture and allied sectors, rural development, watershed management, risk management, water supply, environmental-health, waste management, power, industries, communication, etc.

Contents and Structure of the Manual

National Institute of Disaster Management has prepared National Agriculture Disaster Management Plan for the Ministry of Agriculture and Farmers' Welfare, Government of India. As a follow up activity, the training manual on **Climate and Disaster Resilient Agriculture Management** has been designed. it offers a training tool along with course guidelines and contents for promoting an integrated approach. The purpose of this training manual is to enable the participants in developing a holistic view of addressing challenges posed by the climate change and extreme events through development process. The manual comprehensively provides theory and practical information and exercise developed from various literatures available on the subject across a range of sources. It consists of five modules:



A. Agriculture in India: Challenges and Opportunities
B. Approach for Resilient Agriculture
C. Building Resilience in Agriculture Sector
D. Management and Governance
E. Mainstreaming Climate Change Adaptation and Disaster Risk Reduction

The details of modules are following:

Module A: Agriculture in India: Challenges and Opportunities

LU: A1-Role of agriculture in strengthening Indian economy
LU: A2-Understanding climate change impacts on agriculture and food security
LU: A3-Sustainable agriculture and role of disaster resilience

Module B: Approach for Resilient Agriculture

LU: B1- Disaster prevention and mitigation measures
LU: B2- Ecosystem based adaptation
LU: B3-Infrastructure for disaster resilient agriculture

Module C: Building Resilience in Agriculture Sector

LU: C1-Vulnerabilities and risk management in major food crops
LU: C2-Vulnerabilities and risk management in major cash crops
LU: C3-Vulnerabilities and risk management in horticultural crops
LU: C4-Vulnerabilities and risk management in animal sector

Module D: Management and Governance

LU: D1-Agro-industry
LU: D2-Agrochemicals and health
LU: D3-Agriculture insurance and credit loans
LU: D4-Management of perishable goods and agro-processing

Module E: Mainstreaming Climate Change Adaptation and Disaster Risk Reduction

LU: E1-Community action

LU: E2-Government and non-government programmes and schemes

LU: E3-Developmental plan and inter sectoral coordination/convergence

Conclusion and Summing-up, Post-training Assessment and Course Follow-up Recommendations

Tips to use the Manual for Training

Each learning unit has been developed to enable learning through discussions, presentations and involvement of the trainee groups. Following are the important

methods that can be applied to make the learning easy and interesting for the participants:

(i) Question-Answer/Quiz Sessions: These sessions have been kept to evaluate understanding of concepts of agriculture and allied sectors, ecosystem services, disasters, climate change and development.

(ii) Group discussions/work/: Group activity is included in each learning unit to facilitate knowledge on developing skills related to analysis, planning and formulating strategies.

(iii) After each group work, a presentation session has to be included to motivate the participants in knowledge grasping, participation and sharing.

(iv) Table-top/classroom exercises have to be done to enhance ability of focused discussion in the group.

(v) Field Visits have to be organized to facilitate understanding of data collection, group action and situation analysis.

(vi) Case studies have to be conducted to provide success stories/field experiences connect in knowledge and ground reality.

Selection of Trainees

The criteria for selecting the trainees may be as given below:

Target level of Trainees	Senior to middle level officials/professionals/agency representative
Nature of the Group	Heterogeneous (from various departments, agencies and academic institutions), with representation of women colleagues.
Qualification	At least graduation and preferably post-graduation, having written and spoken ability in English/Hindi. Computer knowledge is desirable.
Medium of Instructions	Mainly English with blend of Hindi

Pre-requisite for the Trainer/Course Faculty

A team consisting of minimum three faculties may be required to organize the training programme. One of the team members shall be from the region where training is being planned to be organized. Other criteria for course faculty/trainer may be as follows:

Eligibility	Expert of agriculture and related ecosystem as well as Disaster Management with a good knowledge on Agriculture, Environment & Climate change/Natural Resource Management and Developmental Planning Issues.

Training Approach	Friendly and informal approach and have ability to involve heterogeneous group at a single platform.
Role of Trainer	Motivating the participants to bring them at similar level of knowledge and experience sharing.
Training/Learning Process	• Provide reading materials during registration (or preferably can be mailed in advance). • Involve the participants through group exercises, video clippings and quiz sessions, etc.

Expected Benefits

(i) Enhancing capacity of the Government Officials/DM Professionals/ Environmental Scientists and Managers/Planners and other stakeholders developed in understanding issues of agriculture and allied sectors, ecosystem, CCA & DRR mainstreaming into developmental planning.

(ii) Enhancing overall capacity of administration, academic institutions and non-governmental organizations improved in planning, coordination and strategy making.

(iii) Overall sensitization of line departments to understand agriculture and allied sectors and their relationship with disaster management. Improved ability to collaborate with each other both horizontally and vertically for achieving sustainable development.

Instructions for Manual Use

(i) The manual can be implemented by local, project, municipality, state level or departmental level (National or state/UT level with suitable modification utilizing its flexibility). For example, agriculture departments can take lead in organizing training programs for such heterogeneous group through coordination with the line departments, academic institutes and other agencies. At national level, courses may be organized by Ministries, Institutes/Universities and leading NGOs, whereas at state level the course may be organized by State Administrative Institutes, SIRDs, WALMIs, Forest Institutes, Ecology Commissions, Environment Directorates, Council for Science & Technology or Disaster Management Institutes/Centres.

(ii) Learning shall be facilitated by a trained trainer in relevant subject and preferably in a Training of Trainers (ToT) course on this module. Appropriate resource persons shall be identified and invited as speakers/moderators for taking up the case studies and field survey based technical sessions.

(iii) It is advisable to conduct Training of Trainers (ToT) courses in every State in order to build their capacities in conducting training programs at sub-national level.

(iv) Each learning unit includes case studies, group work etc. The course facilitator shall ensure that the Module has been taught in light befitting the target group's background, time and resources available.

(v) Entire module is designed in a way to complete it within the given duration of about 5 days, depending upon the field visit exercise.

(vi) At the end of the training, a feedback session shall be conducted by the facilitators in order to understand the opportunities and shortcomings of the Module. These feedbacks shall be compiled and appropriately included in the future training programs.

Action Plan/Post-Training Assignment

It is well understood that training has more impact on the ground if the mechanism for follow-up is in place. During the first activity in this module, participants review the gaps identified throughout the training in order to identify the changes they might be able to make in their own departmental/organizations' work. Working as a group, they will:

- Identify areas for future action;
- Develop criteria for prioritizing future actions;
- Prioritize these actions according to the criteria;
- Create an action plan (and framework for writing an assignment);
- Assignment submission guidelines.

This manual presents an opportunity for capturing the motivation that participants have at the end of training and for them to return home with a tool the action plan to help them to focus on changes they want to make when faced with the day-to-day challenges of work. The action plan should help them build these changes into their routines, creating demands and eventually those of the department/organization.

Module A

Agriculture in India- Challenges and Opportunities

A basic training manual on Climate and Disaster Resilient Agriculture Management is an overview or refresher course for sensitization of professional/officials of general district administration.

Background

Indian Agriculture is the third largest contributor to the Indian economy and majority of Indian population finds its livelihood in this sector (Figure A1).



Figure A1. Importance of Agriculture Sector
(Data Source: Annual Report, MoAFW, 2017-18)

To support its large and growing population, India made a significant progress in agricultural production, doubling its food grain production capacity from 108 million tonnes in 1970's to 264 million tonnes in 2013-14 (Swaminathan and Bhawani, 2013) and has reached from a stage of self-sufficiency to surplus agricultural produce (Ahmad and Haseen, 2012; Swaminathan and Bhawani, 2013). The "Green Revolution," which began in the late 1960s that transformed India from a food grain

importer to a food grain exporter, is to thank for this development. In the crop year of 2019-20, the food grain production was estimated to reach a record 295.67 million tonnes (MT) (IBEF, 2021).

Role of agriculture in strengthening Indian Economy

India is expected to achieve the ambitious goal of doubling farmers' income by 2022. Agriculture is the primary source of livelihood for about 58 per cent of India's population. The Indian food industry is poised for huge growth, increasing its contribution to world food trade every year due to its immense potential for value addition, particularly within the food processing industry (Figure A2 and A3).

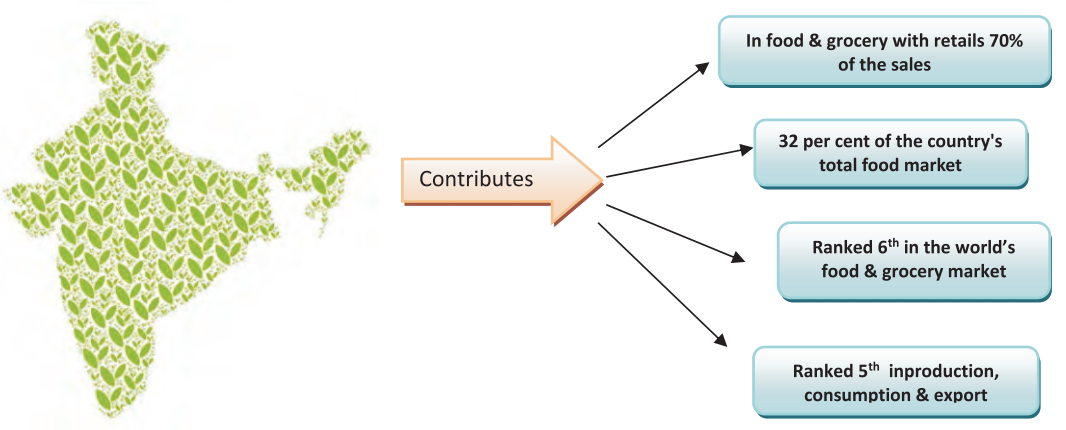


Figure A2. Status of Indian Agriculture in International Food Market

The agriculture sector in India is expected to generate better momentum in the next few years due to increased investments in agricultural infrastructure such as irrigation facilities, warehousing and cold storage.

Indian agricultural sector, as of 2018, is the second highest producer of farm output at world level and also provides largest livelihood (50% employment of Indian work force) in India (India Economic Survey, 2018) especially in rural areas. Consequently, Government policy support and other opportunities have triggered various arena of progress like green revolution, a white revolution, a yellow revolution and a blue revolution.



Figure A3. Impact of Indian Agriculture on Indian Economy

At present, India stands as the greatest producer of jute, milk & pulses, second largest producer of cotton, fruits, groundnut, rice, sugarcane, vegetables & wheat and also leads in the production of fish, livestock, plantation crops, poultry & spices. In the year 2017-18, total estimated food grain production was 275 million tonnes. India is the world's largest producer, consumer & importer of pulses. India produces 25% of world production, 27% of the total global consumption & imports 14% of pulses. India stands first in world's largest milk production (milk production in 2017-18 was 165 million tonnes), has second largest cattle population and accounts for 10.9% of world's fruit and 8.6% of world's vegetable production (FAO, 2021). India has the largest livestock population of around 535.78 million, which translates to around 31% of the world population. Milk production in the country is expected to increase to 208 million tonnes in Financial Year 2021 from 198 million tonnes in Financial Year 2020 (IBEF, 2021).

Key Challenges of Indian Agriculture

In 2016, harvest and post-harvest losses of India's major agricultural produce was estimated at Rs 92,651 crore ($13 billion) - almost three times as high as the 2016-17 budget for the agriculture sector. About 16 percent of fruits of vegetables, valued at Rs 40,811 crore ($6 billion), were lost between 2012 and 2014. Poor access to reliable and timely market information for the farmers, absence of supply & demand forecasting, poorly structured and inefficient supply chains, inadequate cold storage facilities and shortage of proper food processing units, large intermediation between the farmers and the consumers are some of the major causes for the losses. One of the biggest issues the agricultural sector in India is facing is low yield. India's farm yield is 30-50% lower than that of developed nations.



Poor infrastructure, low use of farm technologies and best farming techniques, decrease of soil fertility due to over fertilization and sustained pesticide use are leading contributors to low agricultural productivity. Indian farms are small (70% are less than 1 hectare, the national average is less than 2 hectares) and therefore have limited access to resources such as financial services, credit (or lenders), support expertise, educational services or irrigation solutions.

In the short-term, yield directly impacts a farmer's cash flow and the ability to respond to fluctuations in the market. In long-term, yield limits a farmer's ability to invest into their farm's future to increase productivity and decrease risks associated with their crops (via inputs such as seeds, fertilizer, crop insurance, market/weather info, livestock health support, etc.) but also to invest into their families in areas such as education, healthcare, training, etc. (https://www.startupindia.gov.in/content/sih/en/agriculture). These factors have multiplier impact on the farmer's livelihood and income and also undermine the ability of the agriculture sector and its potential to become a part of the solution to the problem of endemic poverty of the farmers and the agricultural labor (Niti Aayog Report, 2012). Agriculture in India is largely depending on monsoon. As a result, production of food-grains fluctuates year after year. A year of abundant output of cereals is often followed by a year of acute shortage. Increasing population and related socio-economic problems including poverty and hunger, poor water use efficiency, water scarcity, extreme weather events like flood as well as drought and unequal access to the water are common concern of the agriculture sector. Importantly, farming revenues is not raising much even as India's income rises. In fact, the ratio of total agriculture income to total population is relatively flat across countries regardless of per capita income. Rising GDP means growth of non-agricultural incomes. Today's agriculture policies fail to recognize how crop choices, input costs, and the supply chain are intertwined, perpetuating marginal farming (Tongia, 2019).

The Indian government has set a goal of doubling farmers' income by 2022, a $5 trillion economy, and improved living standards by 2024. Indian agriculture, like the India's landscapes is vulnerable to multiple disasters of natural and anthropogenic nature, and also aggravated by the impact of climate change. Unlike anytime in the past, India's agriculture challenge has to be understood concurrently in many dimensions (Gupta, et al., 2019).



Context

This is a basic training module on sustainable agriculture development through adaptation to climate change and disaster resilience. It integrates the common risk factors, key sectors and green growth opportunities towards the strategic management framework of agriculture resilience. The module is developed as an overview or refresher course for sensitization of authorities or officials working in the field of agriculture and allied services across their key departments and those dealing with development, disaster management, environment and climate action related professional /officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc., towards integration of disaster management and resilience into the agriculture developmental processes.

There are three learning units delineated under this module:

LU: A1-Role of agriculture in strengthening Indian Society and Economy

LU: A2-Understanding climate change impacts on agriculture and food security

LU: A3-Sustainable agriculture and role of disaster resilience

Delivery Chanel:

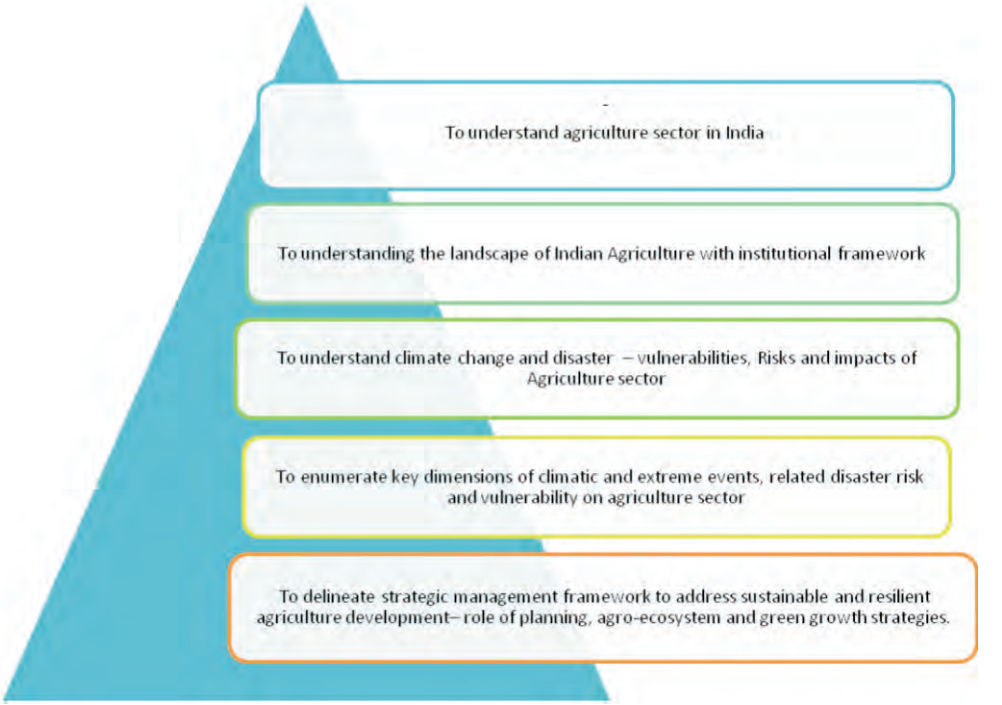


Duration

About three hours including the inaugural session.



Training objectives

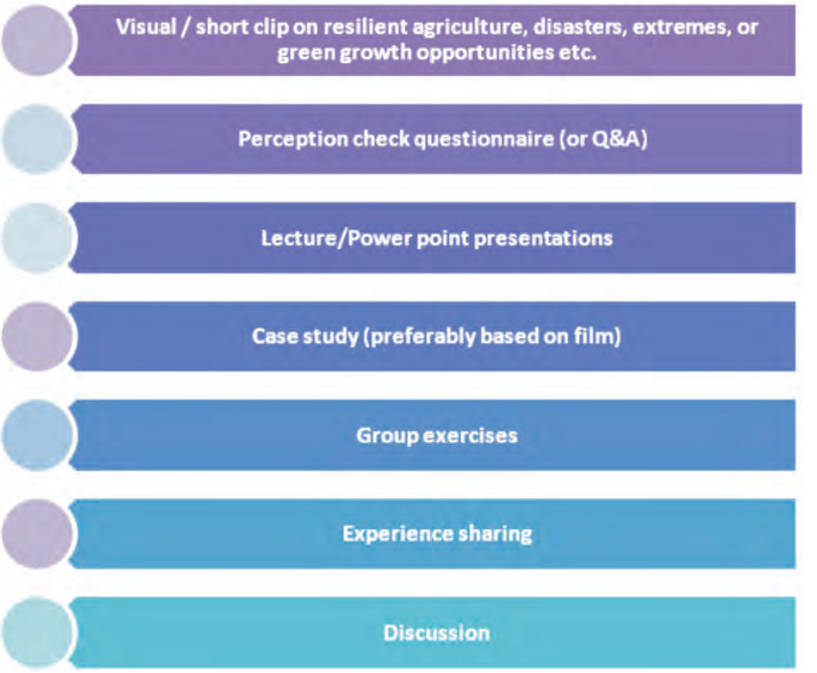


Guidance



- Sharing of expectations from both sides - from participants as well as from the faculty/trainers and course director/ coordination team is important, to start from and finally define the learning scope to be fulfilled by the end of the module delivery.
- Other expectations regarding ground rules for participants, trainers, etc. to be communicated at the beginning of the course.
- Discussion on role of the participating trainees in agriculture systems management and its relevance to resilience building would be useful in familiarization in heterogeneous background.

Methodology



Trainers' Hint

The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/ introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest/work, organization, state/district, previous exposure on disaster and its' management etc. Introduction round can also be done separately and relatively comprehensive. Even a small and formal introduction round during the inaugural session and detailed introduction of participants can be organized with the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiate some level of group participation process to continue during the entire training course. In case of 'no formal inaugural function', the programme director and coordinators/ trainers shall explain to the participants about the programme objectives, contents, limitations, the process of participatory learning and some general ground rules of the course, if any.



LU-A1

A1 Role of agriculture in strengthening Indian Economy

Background

India is expected to achieve the ambitious goal of doubling farm income by 2022 and at present, India stands as the greatest producer of Jute, milk & pulses, 2nd largest producer of cotton, fruits, groundnut, rice, sugarcane, vegetables &wheat and also leads in the production of fish, livestock, plantation crops, poultry & spices. In the year 2017-18, total estimated food grain production was 275 million tonnes. India is the world's largest producer, consumer & importer of pulses. India produces 25% of world production, 27% of the total global consumption & imports 14% of pulses. India's milk production in 2017-18 was 165 million tones & counts as world's largest milk production. India has world's second largest cattle population and accounts for 10.9% of world's fruit and 8.6% of world's vegetable production (FAO, 2021) as shown in Figure A1.1.

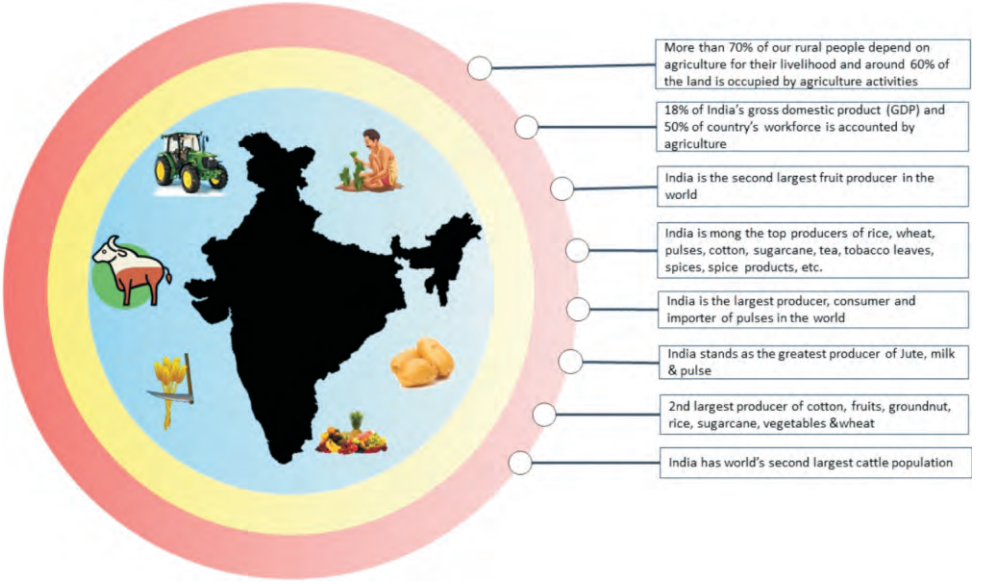


Figure A1.1. Contribution of Indian Agriculture in the economy

Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life (IFPRI, 2021). Food security incorporates a

measure of resilience to future disruption or unavailability of critical food supply due to various risk factors including droughts, shipping disruptions, fuel shortages, economic instability, and wars.

Hazards such as floods, tsunamis, droughts and other risks can weaken food security and severely impact agricultural activities. Consequently, this has an impact on market access, trade, food supply, reduced income, increased food prices, decreased farm income and employment. To improve food security, agricultural development is important. Natural disasters create poverty, which in turn increases the prevalence of food insecurity and malnutrition (Tirivangasi, 2018). The poorest people in the community are affected by food insecurity and disasters; hence, there is a need to be prepared as well as be in a position to manage disasters. Food insecurity following any disaster is not only because of damage of food reserves but also due to the damage of means of living, livelihood and assets of people. Disasters and crises that affect food and nutrition security go beyond natural disasters; therefore, FAO promotes a multi-hazard approach to strengthen the resilience of livelihoods against disasters and ensure food and nutrition security. Also, major region of the country comes under very high vulnerability to climate change as shown in Fig. A1.2 which is another major concern for Indian agriculture

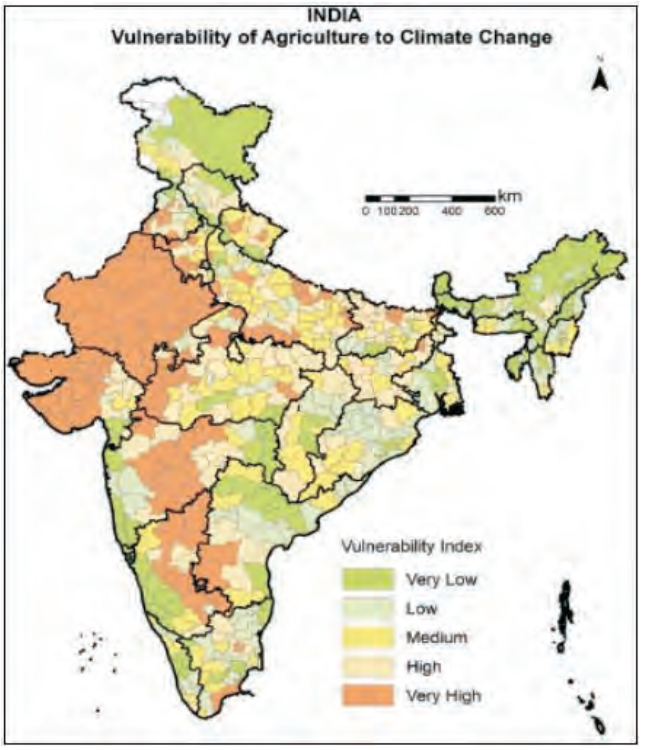


Figure A1.2 Vulnerability of Agriculture to Climate Change
(Source: Ramarao, C.A., et.al 2019)

On the other hand, the increase of population has caused a massive shrinkage of land for agriculture but created a greater demand for agricultural products; this has led to a sharp increase in food prices. The marginal and the small holdings together constitute over 78 per cent of the total.This is compounded by our increasing tendency to depend on a narrow mix of food crops. Thus, the food production systems have become vulnerable to biotic and abiotic stresses. The cultivators in the early periods of civilization managed such stresses by adopting sustainable agronomic practices like shifting cultivation, mixed cropping, crop rotations and so on. As such, to ensure food security, sustainable agriculture development is needed. Agriculture plays a critical role in transforming economies to reach the goal, along with achieving other essential development goals like ensuring food security and improving nutrition. Therefore, in order to end hunger and under nutrition while accelerating economic growth, a sustainable agricultural transformation must become a reality.

Learning Objectives	Methodology
• To understand agriculture sector in India. • To learn the share of workforce in core agriculture, on farm and allied sectors. • To understand the landscape of Indian agriculture with institutional framework.	• One session • Lecture and power point presentation • Question-answer sessions • Discussion
Guidance	**Recommended readings**
• This session is intended to give conceptual clarity about role of Indian agriculture in strengthening society and economy. The different components of agriculture like fisheries and allied activities should also be discussed in brief.	• MoAFW. (2018). Annual Report 2017-18. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi. • Niti Aayog. (2012). Report of working group on risk management in agriculture: for the eleventh five year plan 2007-2012. Government of India Report. • Swaminathan, M.S. & Bhavni, R.V. (2013). Food Pro duction and Availability. Essential Prerequisites for Sustainable Food Security. *Indian Journal of Medical Research, 138,* pp. 383-391
• The session being the first learning unit of this module should be taken up involving discussion mode so that trainees can come out with their own ideas and experiences in understanding different role of agriculture in strengthening India society and the role it plays in food security	• Gupta, A. K., Hodam, S. Chary, G. R., Prabhakar, M., Sehgal, V. K., Srivastava, R., Swati, S. and Bhardwaj, S. (2019). Roadmap of Resilient Agriculture in India. Thematic paper released on International Symposium on Disaster Resilience and Green Growth for Sustainable Development organized by Centre for Excellence on Climate Change, NIDM, New Delhi (India), 26th-27th September 2019

Guidance	Recommended readings
• Lecture and Presentation should use pictorials and easy examples as possible to set the context for next Learning Units in this module.	• Ahmad, F. & Haseen, S. (2012). The Performance of India's Food grains Production: A Pre and Post Reform Assessment. *International Journal of Scientific and Research Publications, 2(3)*, pp.1-15. • Ministry of Agriculture, GoI. (2011). Guidelines for extending green revolution in Eastern India. Retrieved from http://agricoop.nic.in/Admin_Agricoop/Uploaded_File/BGREI.pdf on 21 July 2016.

LU-A2

A2 Understanding climate change (CC) impacts on agriculture and food security

Background

Agriculture is one of the most disaster affected sectors. Agricultural activity is adversely affected by any unforeseen weather change or variations in physical conditions. This gets accentuated in case of cyclones, floods and droughts resulting in disruption of people's livelihood and adding to the risk, damage and stress of disasters as a substantial part of the population of substantial importance depends on agriculture for its livelihood. Agriculture sector is negatively impacted by increased frequency and severity by natural hazards and disasters largely caused by climate change (FAO, 2021). The increased frequency and severity of climate related hazards and risks induced by climate change are adding a new dimension to the existing disaster risk profile of India. The agriculture Ministry in a recent report (2018) has claimed that climate change is projected to impact agricultural productivity with increasing severity from 2020 onwards and could rise as much as 40% by 2100 unless appropriate adaptation measures are undertaken in the agriculture sector.

In order to ensure food security and also to strengthen our Indian economy, different challenges before, during and after the process of cultivation needs to be understood and addressed

Challenges	Description
Food insecurity	Chronically undernourished population
	Increasing population, limited land
	Rampant urbanization
	Burgeoning middle class, unsustainable lifestyle, food wastage
	Declining agricultural land
Water insecurity	Growing water stress
	Declining per capita water availability
	Agriculture becoming water intensive
	Overexploitation of groundwater
	Drought and flood
	Upstream - downstream dependence on water

Challenges	Description
Energy insecurity	Food production becoming energy intensive
	Energy required in transportation
	Energy required in storage
Social insecurity	Forced migration
	Small and marginal farmers
	Education and awareness
	Gender
Climate variability	Changing weather pattern, erratic rainfall
	Glacial melt water
	Uncertainty in water availability

Climate change affects not only food production but it also affects the four dimensions of food security which are as below:

- **Availability:** Loss in production and indirect environmental inputs
- **Access:** Infrastructure damage, asset losses; loss of income and employment opportunities
- **Stability:** Increased livelihood risks; pressure on food prices; higher dependency on food imports
- **Utilization:** Human health risks and nutrition

Food security is threatened by climate change because of the following reasons:

CC has the potential to undermine advances in poverty alleviation and sustainable development.

CC will affect the health and productivity of crops, livestock, fish and forests and dependant rural livelihoods.

CC will increase hunger and malnutrition, in particular in Southern Africa and South Asia including India.

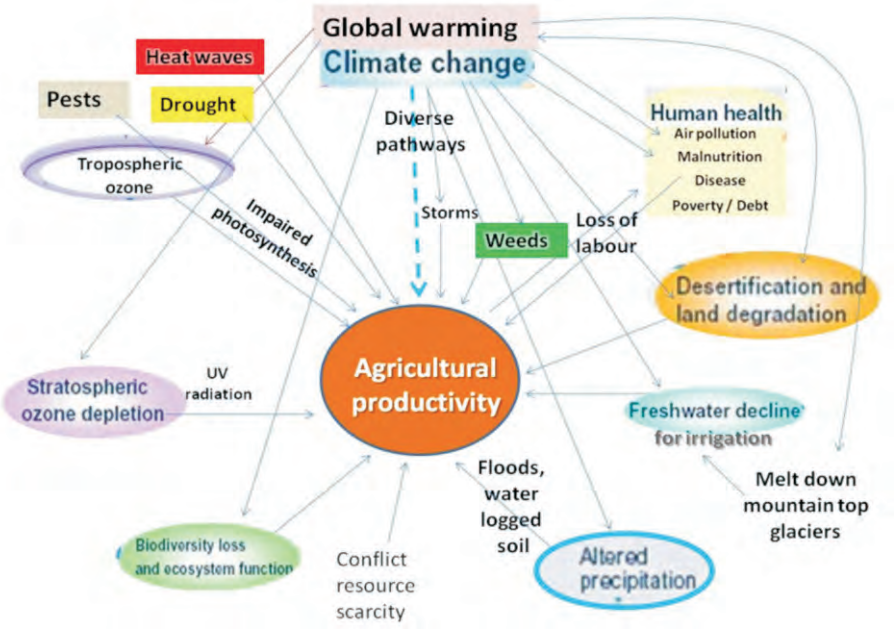


Figure A2. 1 Impact of CC on agriculture sector

(Source: https://foodsecurityfoodjustice.com/2017/01/21/the-adverse-impact-of-climate-change-on-food-security/)

There are multiple types of vulnerabilities associated with the agriculture sector owing to varied roots causes like high population growth, rapid-urbanization, increasing industrialization, rapid development within high risk seismic zone, environmental degradation, etc. These vulnerabilities have been categorized in four major types viz. environmental vulnerability, social vulnerability, economic and systematic vulnerability and physical vulnerability.

Learning Objectives	Methodology
• To understand the impacts of climate change and related disasters on agriculture sector. • To understand different types of vulnerabilities and associated risks related to agriculture. • To compare past trends of disaster on agriculture sector as well as understand the projected impacts of climate change.	• Film screening to understand climate change on agriculture sector (GEAG documentary) • Lecture/power point presentation • Case study (preferably based on film) • Group exercises • Experience sharing • Discussion
Guidance	**Recommended readings**
• The session includes theoretical mode of teaching. However, informal discussions shall be facilitated by the trainers to make the sessions interesting.	• FAO. (2019). Agriculture-related investments in disaster risk reduction and management. Rome. 24 pp.

Guidance	Recommended readings
• A table-top exercise and quiz session have been suggested to facilitate the discussions. • The session could be divided into three presentations i.e., concept & terminologies, impact of climate change on agriculture and food security and disaster risks. • Describe in detail the four types of vulnerabilities with the class: environmental, social, economic and physical.	• Kaur, H. and Kaur, S. (2017). Climate change impact on agriculture and food security in India. Journal of Business Thought, 7. pp:35-68. • FAO. (2021). Climate Change Programme and Projects. food and Agriculture Organisations of the United Nations. http://www.fao.org/climate-change/programmes-and-projects/projects/en/ Last assessed on 27th August 2021.

LU-A3

A3 Sustainable agriculture and role of disaster resilience

Background

Climate related disasters have a huge impact on the lives and livelihood of people, particularly the poor. Droughts, floods, heavy rainfall events, heat wave, cold wave, hailstorms and frost are expected to impact agriculture further in future. The impacts of climate change are evident on agriculture production and livelihoods of many, particularly in developing countries. Thus, in such scenarios, promoting climate resilient agriculture is the need of the hour to safeguard food security, enhancing income and livelihoods of rural communities.

Sustainable agriculture

Agricultural sustainability refers to the ability to maintain the quality and quantity of agricultural products for an extended period of time. According to a study on sustainable agriculture, there are four essential things to consider in sustainable agriculture: evolving human needs over time, effective natural resource management practises, and maintenance or enhancement of quality of environment and conservation of genetic diversity resources (Gupta, et al. 2004). While there is noticeable change in this sector as a result of the implementation of management practices in on-farm and off-farm operations, there is also an increasing risk of disaster-related damages and losses to agriculture systems. The severity and frequency of climate hazards are also increasing and it was expected that by 2020 the increase in severity will have adverse impact on agricultural activity. Considering the need of nation, its people and businesses, taking action towards climate resilient agriculture is crucial for better livelihood, food security and health.

The institutional mechanisms that ensure coordinated action across different ministries are the National

Climate resilient agriculture: Climate Resilient Agriculture can be defined as 'agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for future generations' (Cordaid, 2016). Climate Resilient Agriculture is a system meant to transform the current systems, along with wider perspective than increased production only. Its mandate is to support food production systems at local, regional and global level that are socially, economically as well as environmentally sustainable. It aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible (FAO website, 2016).

Source: Cordaid, 2016.

Disaster Management Cell (NDMC), National Centre for the Calamity Management (NCCM), National Disaster Response Force (NDRF), State Disaster Response Force (SDRF), Crop Weather Watch Group (CWWG) and National Agriculture Insurance Scheme (NAIS). NDMC monitors drought situations, NCCM monitors all type of calamites, NDRF and SDRF were formed under Disaster Management Act, 2005 and they provide immediate drought relief to the affected people and NAIS provide financial support. Other Institutions like Central Research Institute for Dryland Agriculture (CRIDA) with its network centers on All India Coordinated Research Project for Dryland Agriculture (AICRPDA) and Agrometeorology (AICRPAM), Indian Agricultural Research Institute (IARI); Central Arid Zone Research Institute (CAZRI); Indian Council of Forestry Research and Education (ICFRE) etc. are also involved in drought management.

Need of National Agriculture Disaster Management Plan-Rationale

Case Study: Sustainable Agriculture for Enhanced Resilience (SAFER) in Indonesia

This project aimed at increasing people's resilience to natural disasters in 10 remote, drought-prone villages in Indonesia's East Nusa Tenggara province. Farmers face dramatic changes in climate and rainfall patterns in this area yet had little information about drought-resilient agricultural practices and had received little or no support for adapting to changing circumstances. The project supported 1,500 smallholder farmers (40 percent of whom were women) who had faced extremely low food production as a result of erratic rainfall and recurrent, prolonged dry seasons over the previous 5 to 6 years. Disaster risk reduction and climate change adaptation principles were incorporated to increase the resilience of at-risk communities, and protect and enhance the local ecosystems and human resources needed to reduce overall vulnerability. Improved farming systems included the promotion of soil and water conservation, training in farm management, encouraging crop diversification through cultivation of local stress-resilient food-crop varieties, and promoting farming practices and technologies. The practices optimized the use of locally available inputs such as cow dung as fertilizer and plants with crop-protection qualities i.e. those that retain moisture or that repel pests. Government agricultural extension officers participated in SAFER training on appropriate farming techniques to strengthen their capacity to continue supporting their communities after the end of the project.

Source: CRS. (2016). Sustainable agriculture for enhanced resilience (SAFER), Indonesia. Retrieved from https://www.crs.org/sites/default/files/crs-files/sustainable-agriculture-for-enhanced-resilience.pdf.

In order to prevent the creation of new risks, reduce and mitigate severe effects of disasters, NIDM has prepared a National Agriculture Disaster Management Plan (NADMP) in accordance with the National Policy on Disaster Management, 2009. The vision of this Policy is to "build a safe and disaster resilient plan by developing a holistic, proactive, technological driven, and community based Soil and water conservation Physical measures Agronomic measures Biological measures 17 strategy through a culture of prevention, mitigation, preparedness and response". While the national plan will pertain to disaster management for the entire nation, the hazard specific nodal ministries and departments notified by the Government of India will prepare detailed Disaster Management (DM) plans specific to a particular disaster. As per Section 37 of the DM Act, every ministry and department of the Government of India, including the hazard-specific nodal ministries, shall prepare comprehensive DM plans detailing their contribution in the domains of disaster prevention, preparedness, response, and recovery (NDMP, 2016). Prime Minister's Agenda 10 on Disaster Risk Management draws an integrated approach towards implementing the Sendai Framework for Disaster Risk Reduction, Paris Climate Agreement and the SDGs, through its Agenda 1, i.e. all sectors to imbibe the principles of disaster risk management, and utilizes the legal mandate under the Disaster Management Act 2005 and the National DM Policy 2009. National Institute of Disaster Management (NIDM) is mandated under DM Act, 2005 to support Government/Ministries and related agencies in developing their policies, plans, capacity building and research in DM.

Learning Objectives	Methodology
• To understand the concept of sustainable agriculture. • To know disaster management planning and its role in agriculture sector. • To know and understand the existing policy framework for disaster risk reduction in agriculture.	• Lecture/power point presentation • Case study (SAFER, Indonesia) • Group exercises • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is intended to give background on how sustainable agriculture can help in strengthening disaster resilience in India. • It provides many hands on examples, most which are also presented in detail in the session handout. • Handouts containing brief of policies and plans can be given to participants	• Gupta, A. K., Nair, S. S., Wajih, S. A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114. • Gupta, A. K., Hodam, S. Chary, G. R., Prabhakar, M., Sehgal, V. K., Srivastava, R., Swati, S. and Bhardwaj, S. (2019). Roadmap of Resilient Agriculture in India. Thematic

Guidance	Recommended readings
	paper released on International Symposium on Disaster Resilience and Green Growth for Sustainable Development organized by Centre for Excellence on Climate Change, NIDM, New Delhi (India), 26th-27th September 2019. • Gupta, A. K. & Yunus, M. &Agarwal, D. And Siddiqui, A. (2004). Sustainable Agriculture: An Ecointrospection for India. DOI: 10.13140/RG.2.2.27973.86248 • CRS. (2016). Sustainable agriculture for enhanced resilience (SAFER), Indonesia. Retrieved from https://www.crs.org/sites/default/files/crs-files/sustainable-agriculture-for-enhanced-resilience.pdf.

Module

B

Approach for Resilient Agriculture

A basic training manual on *Climate and Disaster Resilient Agriculture Management* is an overview or refresher course for sensitization of professional/officials of general district administration.

Background

Indian farmers are faced with increasing biophysical and socioeconomic challenges in agricultural production and climate change and related disasters have posed additional challenges to meet the growing demand. Though the green revolution movement that started in late 1960's made the country self-sufficient in food production, but simultaneously it has deteriorated the natural resource base of the country including land, soil and water. Thus, along with increasing the food production, it is pertinent to adapt agriculture practices that are sustainable and resilient. Today, the time demands that farmers need to adapt to the changing climate in order to sustain crop yields and farm income. Enhancing resilience of agriculture to climate variability and risk is of very important for protecting livelihoods especially of small and marginal farmers. In the context of climate variability and associated disasters like flood, drought, hailstorm, and other extreme climatic events, farmers need to adapt quickly to enhance their resilience to increasing threats of climate change. Efficiency in resource-use, environmental and social safeguards, sustainability and long-term development of agriculture has greater importance as shown in Figure B1.

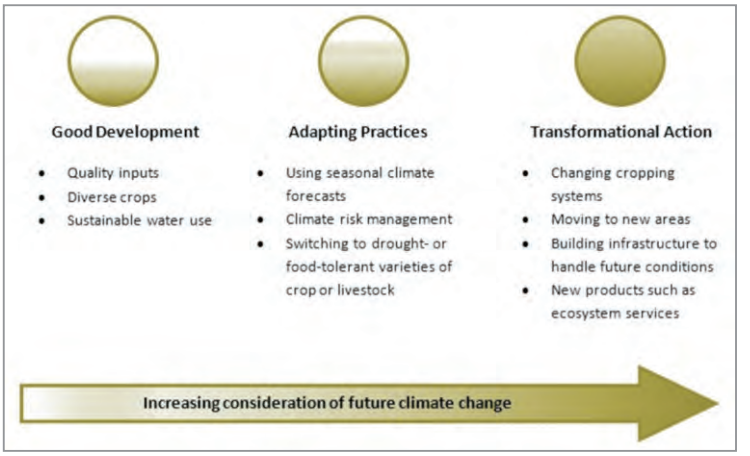


Figure B1. Towards resilient agriculture practices
(Source: https://www.climatelinks.org/blog/tailoring-climate-smart-agriculture-approaches-achieve-resilient-outcomes)

To encourage the agriculture that is environmentally sustainable and disaster resilient, new approaches for development are required. The approaches must build on diverse solution and must enhance adaptive and transformative capacity to respond to adverse changes. Resilient agriculture has been defined as "one that meets both food and development needs over both short-term and long-terms, from local to global scales, without destabilizing the earth system" (Bennet et al., 2016). Agro-ecological approaches for resilient agriculture involves the application of integrated ecological, economic and social principles to the transition of small holder farming systems towards greater resilience (FAO, 2021). Thus, a resilient agriculture addresses food security, markets and ecosystem resilience as shown in Figure B2.

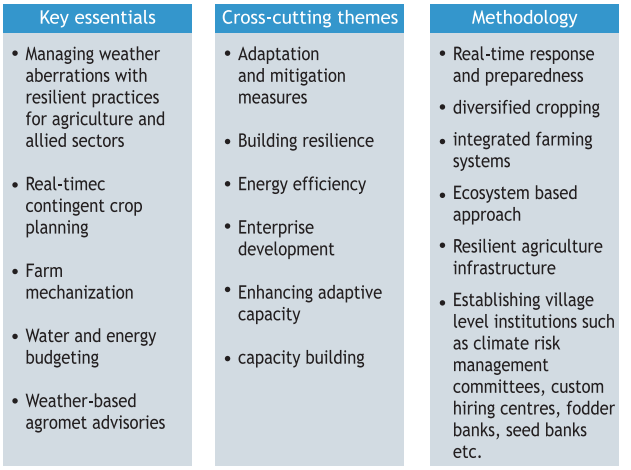


Figure B2. Approach for resilient agriculture
(Source: Adapted with changes from WOTR, 2013)

Context:

This is a second basic training module of the manual which focuses on different approaches including role of ecosystem and ecosystem-services for sustainable agriculture development and resilience and climatic and disaster risks. It discusses ecosystem functions and benefits in supporting good and services to people and businesses in agriculture and in reducing risks by enhancing coping capacity, reducing social, physical, and environmental facets of vulnerability. The module is developed as an orientation or sensitization course for authorities or officials of agriculture sector local and those dealing with developmental, disaster management, environment and climate action related professional /officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc. towards integration of disaster management and resilience into the agriculture developmental processes.

There are three learning units delineated to under this module:

LU: B1- Disaster prevention and mitigation measures

LU: B2- Ecosystem based adaptation

LU: B3- Disaster resilient agriculture infrastructure

Delivery Chanel:

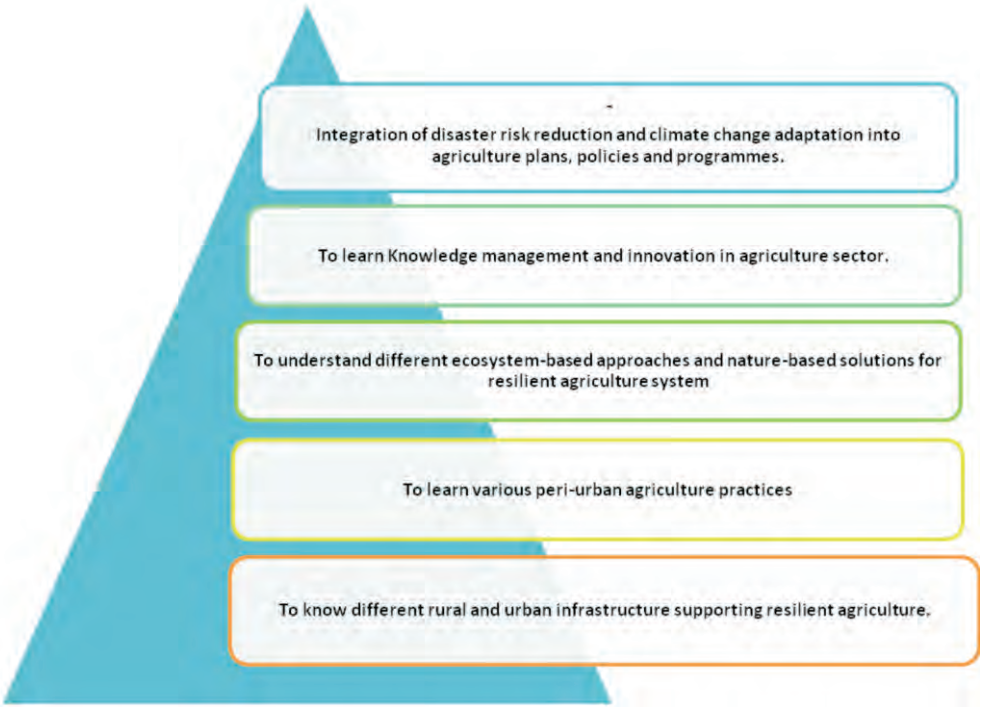


Duration:

About three hours including the inauguration session



Training objectives

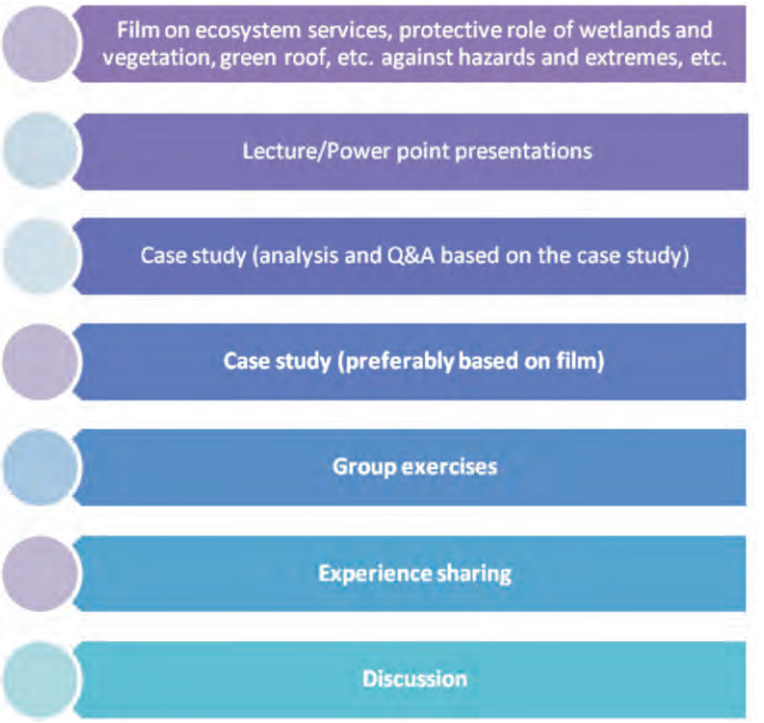


Guidance

- Recap of previous module learning and past experiences, and examples from both sides - from participants as well as from the faculty/trainers would be useful.
- Discussion on understanding of ecosystems – their structure, functions, benefits in general and then bringing orientation towards specific functions supporting agriculture systems and in particular towards adaptation and resilience would be important strategy.
- Case examples in the discussions /case study analysis would be value addition to the learning process.



Methodology:



Trainers' Hint



The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest/work, organization, state/district, previous exposure on disaster and its management etc. Introduction round can also be done separately and relatively comprehensive. Even if a small and formal introduction round during the inaugural session, a more informal and detailed introduction of participants can be organized with the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiate some level of group participation process to continue during the entire training course. In case of 'no

formal inaugural function, the programme director and coordinators/trainers shall explain to the participants about the programme objectives and contents, limitations, the process of participatory learning and some general ground rules of the course, if any.

Material required:

Course Brochure, Programme Schedule, Pen, Bag, Notepad, Projector, Laptop, Flip Charts, Markers, Microphones, tec.

LU-B1

B1 Disaster Prevention and Mitigation measures in Agriculture

Background

Risk prevention is preventing the creation of new risks of disasters. Such risks may be created unwillingly by the Departments directly through public investments or indirectly through the facilitation of private investments that are vulnerable to the risks of disasters. Therefore, every investment should go through risk audit to check if new programmes, activities or projects have the potential to create new risks of disasters. If such investments cannot be avoided these must be protected by safeguarding through adequate structural and non-structural prevention measures so that the benefits of investments are fully protected from risks of disasters. For example, assets of the agriculture department like offices, equipments and others should be located at places which have lesser chances of getting affected by a hazardous event. The main idea here is what the department can do within its mandate to increase the idea of risk prevention. The methodology for implementing risk prevention is shown in Figure B2.1.

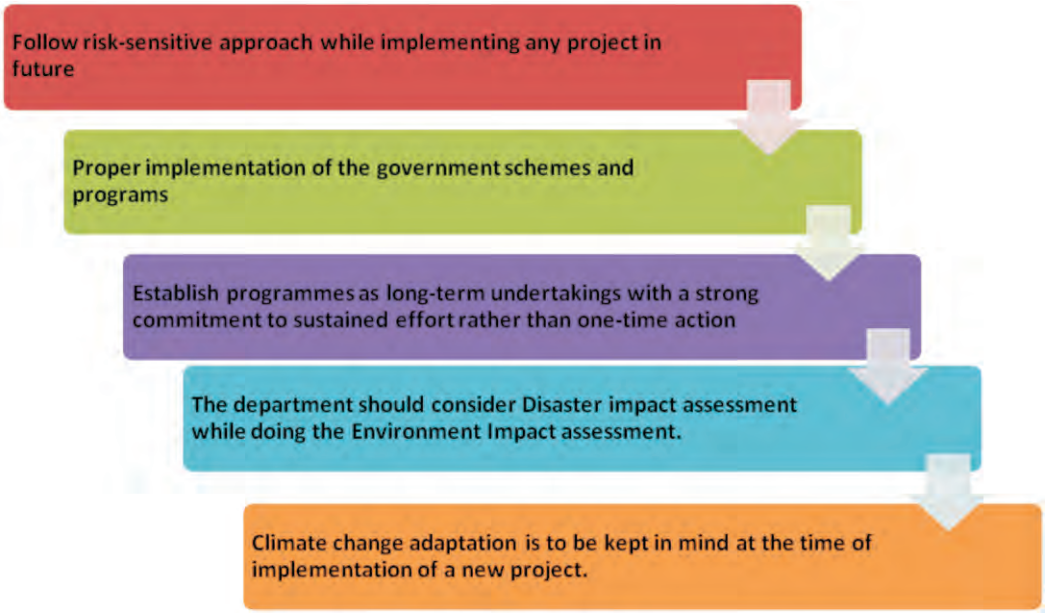


Figure B2.1. Methodology for implementing risk prevention

Mitigation Strategies

Mitigation means various structural (physical) and non-structural (soft measures) measures undertaken to limit the adverse impact of hazards, environmental degradation and technological hazards. The term "adaptation measure (or option)" describes an activity, like plantation, that serves to protect livelihoods from negative impacts that are driven by climate change, for example floods. Adaptation measures can serve other purposes as well, e.g. increasing biodiversity, but the main characteristic of an adaptation measure is that it addresses changes that can be related back to climate change.

Table B2.1. Different mitigation strategies that can be taken up by the department for different hazards

Strategies	Flood	Drought	Heat wave	Cold wave& Frost	Pest / Diseases Attack	Hail storms	Landslides	Cyclones	Tsunami	Fire	Untimely High intensity rainfall event
Change in timing of sowing/planting and harvesting											
Undertaking mid-season corrections and crop life-saving measures wherever possible											
Reducing harvest/ storage losses											
Protection of young seedlings/ crops from flood											
Protective measures to save assets and livestock											
Enabling farmers to preserve investments and retain capacity to undertake next cropping (financial provision)											
Planning disaster response activities											
Precautionary measures to protect infrastructure (e.g. growth centres, food silos, embankments, etc.)											
Alternate water usage and buffering programs to provide water security											
Crop Insurance coverage											
Livestock insurance											
Public private partnership as a tool											
Extension support											

Disaster risk reduction (DRR) includes actions (programmes, projects and/or measures) and instruments expressly aimed at reducing disaster risk in endangered regions, and mitigating the extent of disasters. Community-based adaptation, in

particular, can build on the existing participatory approaches that are often already in place for disaster risk reduction. It is now realized that process of mitigation should incorporate long term preventive and protective measures by adopting appropriate strategies for disaster prone areas. The mainstreaming of Disaster Risk Reduction (DRR) and Climate Change Adaptation features into development planning of sectoral departments is one of the key areas identified and incorporated in the plan.

Learning Objectives	Session and Methodology
• To learn about early warning systems in agriculture • To understand knowledge management and innovation • To know different tools/ Decision support systems (DSS) • To understand mainstreaming DRR and CAA into the policies and programmes of MoAFW	• One session • Lecture and power point presentation • Question-answer sessions • Discussion • Case studies
Guidance	**Recommended readings**
• This session is intended to give conceptual clarity about disaster prevention and mitigation strategies in agriculture. The different components of agriculture like fisheries and allied activities should be discussed in brief. • This module should be taken up involving discussion mode so that trainees can come out with their own ideas and experiences in understanding different mitigation strategies in agriculture. • Lecture and Presentation should use pictorials and easy examples as possible to set the context for next Learning Units in this module.	• Watershed Organization Trust (2013): Towards Resilient Agriculture in a Changing Climate Scenario, December 2013. • FAO. (2021). Agroecology Knowledge Hub. Food and Agriculture Organisations of the United Nations. http://www.fao.org/agroecology/database/detail/en/c/1242116/Last assessed on 27th August 2021. • Sinclair, F., Wezel, A., Mbow, C., Chomba, S., Robiglio, V., and Harrison, R. (2019). "The Contribution of Agroecological Approaches to Realizing Climate-Resilient Agriculture." Rotterdam and Washington, DC. Available online at www.gca.org.

LU-B2

B2 Ecosystem based Adaptation

Context

Healthy and robust ecosystem is one of the best defenses against any natural disasters and also contributes towards the resilience (Gupta & Nair, 2012, Singh et al, 2013). However, unsustainable pattern of development along with anthropogenic climate change have weakened the health of these ecosystems and have reduced their capacity to protect against natural hazards. According to Millennium Ecosystem Assessment Report, 2005, approximately 60% of the ecosystem services have been degraded or used unsustainably and protection from natural hazard is one of those degraded services. One of the important findings of the report says that in the past 50 years humans have changed ecosystems more rapidly and extensively than in any comparable period of human history which has resulted into substantial and irreversible loss in the diversity of life on earth.

Integrated management of land, water and living resources that promotes conservation and sustainable use provides the basis for maintaining ecosystem services, including those that contribute to reduce disaster risks. Sendai Framework for Action, Sustainable Development Goals as well as Paris Climate Agreement has laid emphasis on building resilience by protecting natural ecosystems.

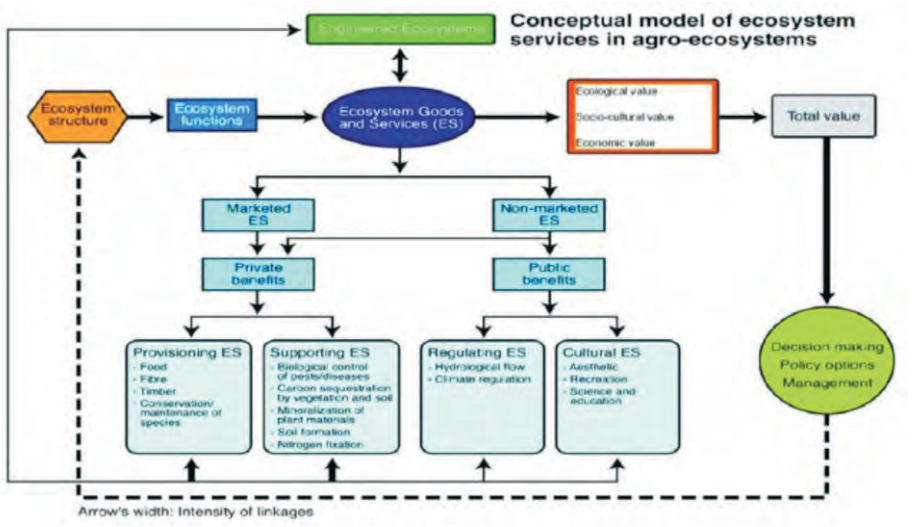


Figure B2.1. Ecosystem services in agricultural landscape
(Source: Sandhu and Wratten, 2013).

Agriculture in urban and peri-urban areas may include a wide range of activities such as fisheries, poultry, goat rearing, horticulture, floriculture, dairy farming, arable farming, etc. The prominent characteristic of peri-urban area includes a concentration of poor people from inner-city, rural migrants and/or marginal local farmers. Urban fringe areas in Asia, for instance, are characterized by densely populated intensive smallholder agriculture. A forest, wildlife or bird habitat or ecotourism site can also be found in the peri-urban agro-ecosystem. As these areas have reasonably well-developed transportation, access to city markets, cheap migrant labour force and qualified urban professionals, peri-urban areas are valuable locations for several industries and businesses. However, natural resources in these areas exhibit complex pressures from the use of land for, clay pits, quarries, sewage-disposal tanks and garbage dumps. This poses livelihood challenges for the poor inhabiting rural-urban fringes.

Urbanization and industrialization affect agriculture in the peri-urban areas as it leads to land-use changes. Cultivation practices change the agriculture land-use. Access to urban ready markets for agriculture produce and seasonal labour opens up the possibility of commercially cultivating high-value, perishable crops such as leafy vegetables, replacing storable crops such as cereals and pulses. Industries and their derivative trade and commerce activities offer new labour opportunities for cultivators and agricultural labourers, leading to a change in occupational structures (Te lintelo et al., 2002).



Learning Objectives	Methodology
• To understand ecosystem services provided by agricultural landscape. • To understand different nature-based solutions (NBS) as a part of ecosystem adaptation and innovation • To learn agro ecology-specific watershed based interventions/practices and their contribution towards ecosystem based adaptation	• One session • Case study related to ecosystem based adaptation • Power point presentation • Lecture and discussion • Question and answer

Guidance	Recommended readings
• Case study and pictorial presentation (with glimpses from the field) would help the participants understand the basics of ecosystem based adaptation in the context of agro-ecosystems • Conceptual understanding of the nature-based solution and how it is related to larger ecosystem • Discussion on integration with agriculture planning may be included in the session.	• Gupta, A. K., Singh, S., Katyal, S., Chopde, S., Wajih, S. A., Kumar, A., (2016). Training Manual on Climate Resilient and Disaster Safe Development - Process Framework, NIDM, New Delhi (India), GEAG, Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016). • Gupta, A. K., Wajih, S. A., Mani, N. and Katyal, S. (2017). Vulnerabilities of Urban Poor Children and Urban/Peri-urban Ecosystem Based Resilience (Policy Paper). GEAG Gorakhpur, UP and UNICEF India. • Gupta, A. K., Mani, N., Sarkar, B.B., Singh, S. and Katyal, S. (2019). Developing Disaster Risk Resilient Cities. Gorakhpur Environmental Action Group (GEAG), Gorakhpur (UP), National Institute of Disaster Management, New Delhi, India and United Nations Children's Fund (UNICEF), India. September 2019. Pages 72.

LU-B3

B3 Infrastructure for Disaster Resilient Agriculture

Context

Agriculture and allied sectors play a pivotal role in India's economy. But the sector is under continuous threat of risks, which are exacerbated by a variety of factors, ranging from frequent natural disasters, climate variability and change, uncertainties in yields and prices, weak rural infrastructure, imperfect markets and lack of appropriate financial services including design of risk mitigation instruments such as credit and insurance. These factors have multiplier impact on the farmers' livelihood and incomes and also undermine the ability of the agriculture sector and its potential to become a part of the solution to the problem of endemic poverty of the farmers and the agricultural labor (NITI Aayog Report, 2012). Increasing population and related socio-economic problems including poverty and hunger, poor water use efficiency, water scarcity, extreme weather events like flood as well as drought and unequal access to the water are common concern of the agriculture sector. The infrastructure challenges faced by Indian agriculture could be divided into two sub-groups as per the crop cycle, as shown in Table below:

Crop-production related infrastructure	Post-harvest value addition, Storage and transportation
Small and fragmented landholdings & land ownership, inadequate irrigation facilities, inadequate plant protection facilities for community action, land tenure system, poor farm mechanization and inadequate custom hiring centres for farm implements.	Inadequate infrastructure for processing and post-harvest value addition, inadequate storage facilities, inadequate transport and marketing facilities, problems of storage during transport, inadequate facilities for capacity building and skill development.

A diverse set of resilient infrastructure is required for sustenance of social well-being, developmental activities and fulfilling the growing needs of an agriculture sector. Infrastructure provides critical social and economic services to the agriculture sector where they are located and the boundaries of services go to regions beyond that (TERI, 2014). Important physical infrastructure of agriculture sector includes: irrigation facilities, irrigation equipment, electricity, transport & buildings for storage, etc. In addition, environmental infrastructure such as land and water resources provides foundational support to this physical structure. Social infrastructure includes farmers and others who are directly and indirectly dependent on agriculture for their livelihood.

Role of peri-urban agriculture in developing disaster resilience

Peri-urbanization is a dynamic process that changes the land use in the margins of growing cities and towns (large and small), often displaying a form, structure and interaction that is unique and geared to support the urban centre, across many sectors. The peri-urban area, due to its dynamic nature (Figure B4.1) and setting at the urban-rural interface, has often fallen between the cracks of "rural" and "urban" development planning.

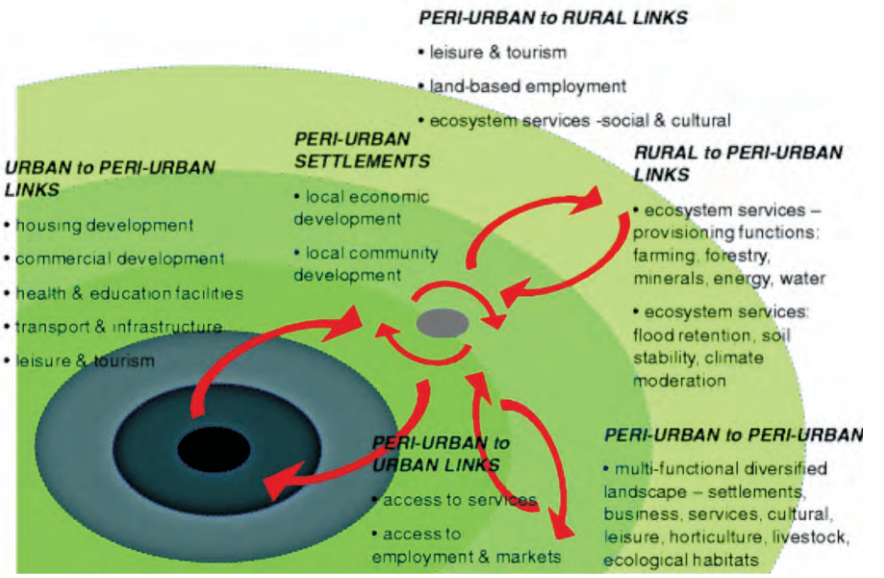


Figure B3.1. Dynamics of Peri-urbanization
(Source: Ravetz J., Fertner C., Nielsen T.S. ,2013)

In terms of water bodies, open and green fields, and orchards, the peri-urban environment is a fast-changing, semi-natural ecosystem that provides natural resources for growing cities. The peri-urban ecosystem, which lies between the urban and regional limits and the rural climate, offers a variety of facilities, including water catchment, forestry, tourism, and sustainable farming, as well as a distinct atmosphere and way of life. (Narain et al, 2013; Mitra et al, 2015). They are considered important in the context of food security, water and energy security, economic security, market linkages and provide breathing space for recreational activities. Peri-urban agriculture also provides livelihood security and increases household income (Thornton, 2008), along with supplying nutritious and healthy food to the city residents as well as vulnerable populations living in the area, and its role in terms of various ecosystem services are vital (Thornton, 2008; Mitra et al, 2015).

Learning Objectives	Methodology
• Learn basic concepts of disaster resilient infrastructure in agriculture and allied sector • To understand peri-urban agro-ecosystem, its setting, need and linkages to urban and rural systems. • To connect theoretical understanding with ground experiences.	• One Session • Power point presentation • Case study examples • Lecture and discussion • Question and answer
Guidance	**Recommended readings**
• The trainer should have in-depth brief in context of agriculture infrastructure. • The session being the first learning unit of this module should be taken up in a discussion mode so that trainees can come out with their own ideas and experiences in understanding different climatic risk in urban areas & vulnerability of infrastructure to these risks. • Lecture and presentation should be as pictorial and understandable as possible. • Knowledge of various concepts of infrastructure safety against disasters and climate risks. • The module is designed to have a lot of discussion rather than just giving theoretical knowledge. • The trainer is advised to encourage trainees to share their experiences during different sessions. • Case studies and group discussions are recommended to conduct more comprehensive training.	• Bach C., Gupta, A. K., Nair, S. S and Birkmann, J. (2013). Critical Infrastructures and Disaster Risk Reduction. National Institute of Disaster Management and Deutsche Gesellschaftfür Internationale Zusammenarbeit GmbH (GIZ), New Delhi, 72p. • AEA. (2009). An Overview of Systemic Interdependencies of the UK National Infrastructure. American Economic Association. http://beckfordconsulting.com/wp-content/uploads/2008/10/Modernising-National-Infrastructure-Draft-2009.pdf. Last assessed on 27th August 2021. • Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). Urban Resilience and Sustainability through Peri-Urban Ecosystems. New Delhi: GEAG, ICLEI South Asia, ACCCRN.NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation

Module

C

Building Resilience in Agriculture Sector

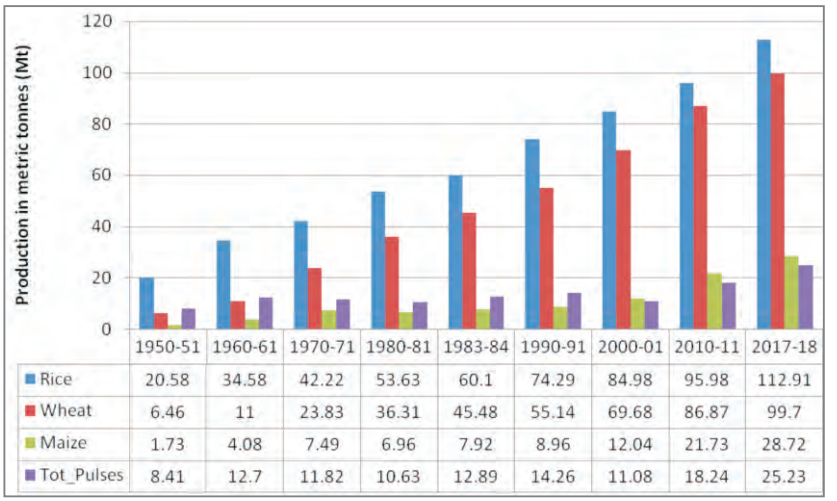
A basic training manual on Climate and Disaster Resilient Agriculture Management is an overview or refresher course for sensitization of professional/officials of general district administration

Background

Agriculture and allied sector forms the backbone of Indian economy as it engages more than 50% of the workforce and contributes about 17% to the country's Gross Value Added (GVA). The total geographical area of the country is 328.7 million hectares, of which 140.1 million hectares is the reported net sown area and 198.4 million hectares is the gross cropped area with a cropping intensity of 142% (Land Use Statistics 2014- 15). The net area sowed works out to be 43% of the total geographical area. The net irrigated area is 68.4 million hectares. Government of India has taken several steps for its development in a sustainable manner. Steps have been taken to address climate change through National Mission on Sustainable Agriculture, improve soil fertility through the Soil Health Card Scheme; to provide improved access to irrigation and enhanced water efficiency through Pradhan Mantri Krishi Sinchai Yojana (PMKSY); to support organic farming through Paramparagat Krishi Vikas Yojana (PKVY); and to support the creation of a unified national agriculture market to boost the income of farmers.

Food crops

Country witnessed record food grain production in 2017-18 which is 284.83 million tonnes, which is approximately 10 million tonnes higher than the production of preceding year. Total production of rice during 2017-18 was 112.91 million tonnes, wheat 99.70 million tonnes, and coarse cereals 46.99 million tonnes and pulses 25.23 million tonnes. A comparative analysis of production of major food crops (Figure C1) shows that India has become self-sufficient in food grain production since 1950



	1950-51	1960-61	1970-71	1980-81	1983-84	1990-91	2000-01	2010-11	2017-18
Rice	20.58	34.58	42.22	53.63	60.1	74.29	84.98	95.98	112.91
Wheat	6.46	11	23.83	36.31	45.48	55.14	69.68	86.87	99.7
Maize	1.73	4.08	7.49	6.96	7.92	8.96	12.04	21.73	28.72
Tot_Pulses	8.41	12.7	11.82	10.63	12.89	14.26	11.08	18.24	25.23

Figure C1. Major food crops production from 1950-2018
(Source: Agriculture Statistics at Glance, 2018).

Cash crops

Cash crops are commercial crops which are produced by farmers to earn money. Major cash crops of India are sugarcane, tobacco, jute, oilseeds and cotton. Total oilseeds production in the country during 2017-18 is of 31.31 million tonnes, total production of sugarcane is 349.78 million tonnes, and cotton is 34.89 million bales.

Horticultural crops

Horticulture sector has become one of the major drivers of growth in agriculture sector. This sector provides employment opportunities across primary, secondary and tertiary sectors. Horticulture sector comprises of fruits, plantation crops, vegetables, tuber crops, mushrooms, spices, flowers, aromatic plants, etc. This sector enables a balanced healthy diet for large population. The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. Presently horticulture has established its credibility in improving income through increased productivity, generating employment and in enhancing exports. Consequently, horticulture has moved from rural confines to commercial venture. India has witnessed increase in horticulture production over the last few years. The percentage share of horticulture output in agriculture has become 33%.



Animal sector

Animal production (livestock, large and small ruminants, fisheries, poultry) and agriculture are intrinsically linked, each being dependent on the other, and both are crucial for overall food security. Animal sector is an important subsector of the agriculture in Indian economy. It forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household. As per estimate of NSS 68th Round (July 2011-June 2012) survey on employment and unemployment, 16.44 million workers were engaged in the activities of farming of animals, mixed farming, fishing and aquaculture. India has vast resources of livestock and poultry, which plays a vital role in improving the socio-economic conditions of rural masses. There are about 300 million bovines, 65.07 million sheep, 135.2 million goats and about 10.3 million pigs as per 19th Livestock Census in the country.

Building the concept of resilience in agriculture sector

Since, major population of the country derive their livelihood from agriculture and allied sector, it becomes important to understand various risk factors associated with it to make it resilient and sustainable. According to FAO resilience work (FAO, 2016), there are three main groups of shocks that govern agriculture sector which includes natural hazards, food chain crises and protected crises as described in Table C1 below.

Table C1. Understanding shocks of agriculture sector

Natural Hazards	Food chain crises	Protracted crises
Economic damages resulting from natural hazards caused by geophysical hazards such as earthquakes, tsunamis and landslides, as well as hydro-meteorological hazards, including storms, floods, droughts and wild fires are increasing	The human food chain is under continued threat from an alarming increase in the number of outbreaks of transboundary animal and plant pests and diseases, as well as food safety and radiation events.	One of the most challenging to fight hunger, malnutrition and poverty.
Climate-related disasters, in particular, are increasing worldwide and expected to intensify with climate change.	Avian influenza, locust infestations, army-worm, fruit flies, food-borne pathogens and mycotoxins are just few examples of threats to the human food chain that have detrimental effects on food security, human health and livelihoods	They are driven by a combination of recurring causes - human-made factors and natural hazards, food crises, breakdown of livelihoods and food systems and insufficient governance and institutional capacity to deal with the resulting crisis
Disproportionately affect food insecurity, poor people who derive their livelihoods from agriculture.	Climate change is in part responsible for a rise in food chain emergencies	

Source: Increasing the resilience of Agricultural livelihoods (FAO, 2016)

Different threats of the agriculture system can be addressed through integrated and holistic planning approach as shown in the Figure C1. The resilience issues should be addressed with a focus on the local and regional context in which farming systems operate because farms, farmers' organizations, service suppliers and supply chain actors are embedded in local environments and functions of agriculture.

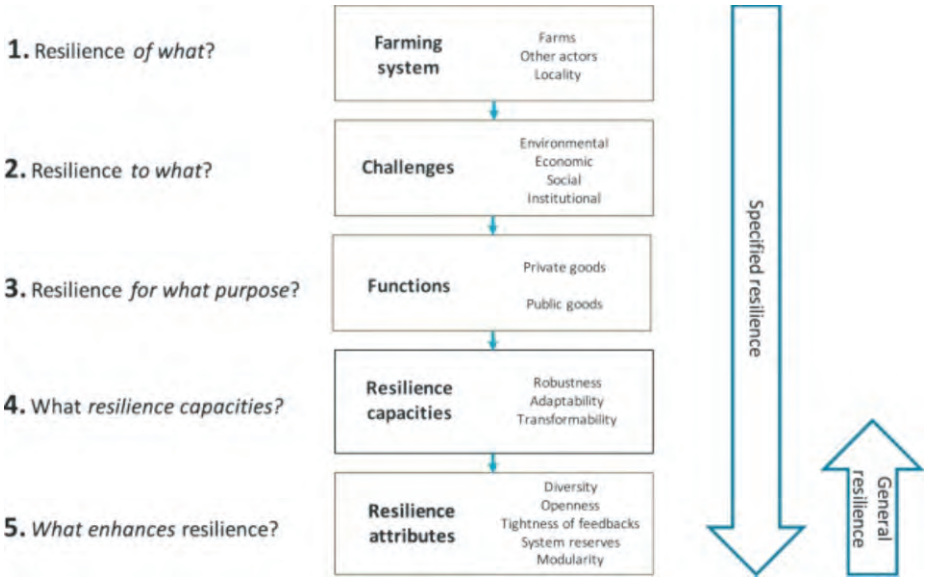


Figure C2. Framework to assess the resilience of farming systems (Source: Meuwissen, et al. 2019).

FAO framework for agriculture resilience is based on four pillars as crisis and disaster risk governance, monitoring and early warning, prevention and vulnerability reduction, and emergency preparedness and response. Agricultural livelihoods can only be protected from multi-hazards if adequate disaster risk and crisis governance is present at all levels. Monitoring crises and disaster risks helps to prevent, prepare for and reduce the impact of shocks and avoid a full-blown humanitarian crisis. Reducing the root causes of vulnerabilities of individuals and communities whose livelihoods depend on crop, livestock, fish, trees and other renewable resources is also fundamental. When disasters, conflicts and/or epidemics strike, we must be prepared to respond quickly and effectively to save lives and livelihoods and reduce the impact of these crises.

Context

This is the third and heart of the training manual which focuses on building resilience in agriculture sector. It discusses different aspects of crops including major food and cash crops, horticultural crops and livestock in the context of understanding

vulnerabilities, risks and challenges being faced in the changing climate. The module also highlights various risk management practices, adaptation packages as well as approaches for resilient food crops for sustainable agriculture. The module is developed as an orientation or sensitization course for authorities or officials of agriculture sector local and those dealing with developmental, disaster management, environment and climate action related professional /officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc. towards integration of disaster management and resilience into the agriculture developmental processes.

There are four learning units delineated under this module:

LU: C1-Understanding vulnerabilities and risks of major food crops

LU: C2-Understanding vulnerabilities and risks of major cash crops

LU: C3-Understanding vulnerabilities and risks of horticultural crops

LU: C4-Understanding vulnerabilities and risks management of animal sector

Delivery Chanel:

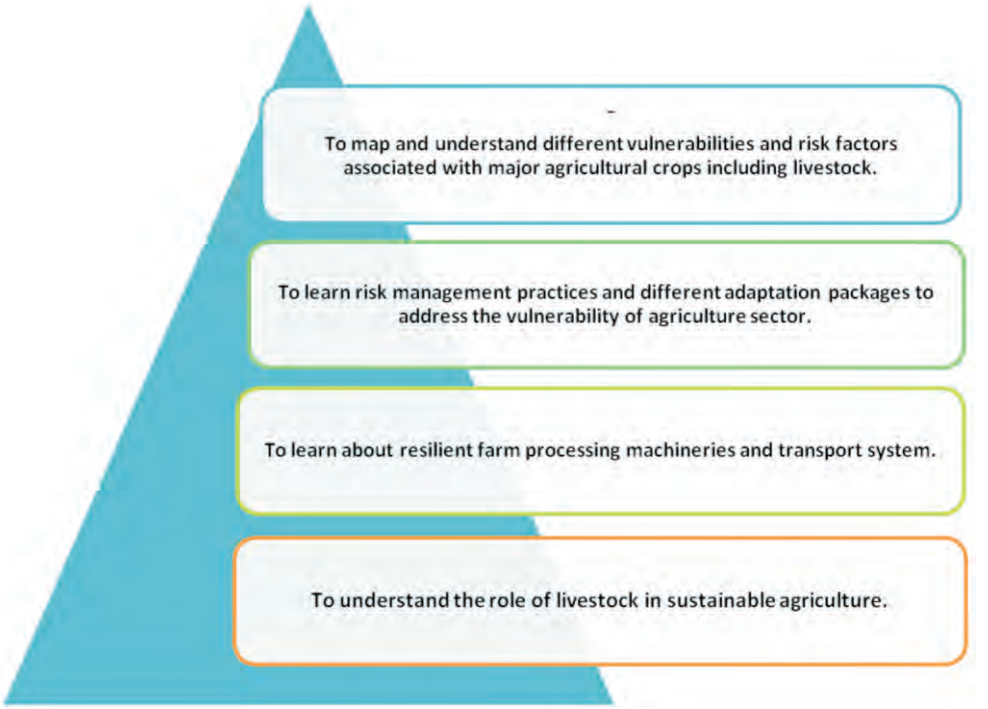


Duration:

About three hours including the inauguration session.



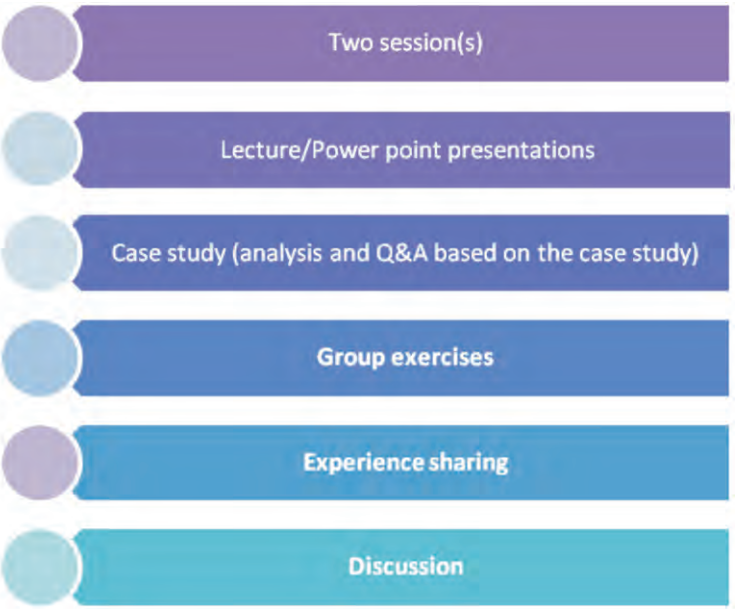
Training objectives



Guidance

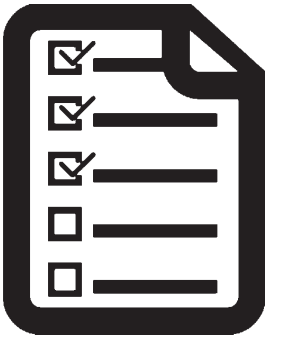
- Recap of previous module learning and past experiences, and examples from both sides - from participants as well as from the faculty/trainers would be useful.
- This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems.
- Case examples in the discussions /case study analysis would be value addition to the learning process

Delivery Chanel:



Trainers' Hint

The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/ introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest/work, organization, state/district, previous exposure on disaster and its management, etc. Introduction round can also be done separately and relatively comprehensive. Even if a small and formal introduction round during the inaugural session, a more informal and detailed introduction of participants can be organized with the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiate some level of group participation process to continue during the entire training course. In case of 'no formal inaugural function', the programme director and coordinators/ trainers shall explain to the participants about the programme objectives and contents, limitations, the process of participatory learning and some general ground rules of the course, if any.



LU-C1

C1 Major food crops

Background

To support its large and growing population, India made a significant progress in agricultural production, increasing its food grain production capacity from 108 million tons in 1970's to 284.83 million tonnes in 2017-18 (MoAFW, 2018-19) and has reached from a stage of self sufficiency to surplus agricultural produce. Major food crops of India are rice, wheat, millets, maize and pulses. State wise production of some of the major food crops in India have been shown in the Table C1.1.

Table C1.1. Production of major food crops

Rice production		Wheat production		Maize production		Pulses production	
State	(In Mha)	State	(In Mha)	State	(In Mha)	State	(In Mha)
WB	14.97	UP	31.88	Karnataka	3.55	MP	8.11
Punjab	13.38	Punjab	17.85	Maharashtra	3.54	Rajasthan	3.39
UP	13.27	MP	15.91	MP	3.54	Maharashtra	3.3
AP	8.18	Haryana	11.16	TN	2.64	UP	2.21
Bihar	7.91	Rajasthan	9.19	Telangana	2.57	Karnataka	1.86
TN	7.28	Bihar	5.74	Bihar	2.42	AP	1.22
Odisha	6.53	Gujarat	3.1	AP	2.3	Gujarat	0.93
Telangana	6.25	Maharashtra	1.62	Rajasthan	1.64	Jharkhand	0.85
Assam	5.16	Uttarakhand	0.91	UP	1.48	TN	0.55
Chhattisgarh	4.73	Himachal Pradesh	0.59	WB	1.13	Chhattisgarh	0.54
India	112.91	India	99.7	India	28.72	India	25.23

Source: Agricultural Statistics at a glance, 2018

Understanding vulnerabilities and risks

Natural disasters such as floods, droughts, hailstorms, cyclones, insect attacks, and other are occurring frequently every year which affects Indian Agriculture. Its occurrence and severity are also continuously increasing, and agriculture is affected at large extent by these disasters since it depends directly on the climate, weather, water and land. Some of the impacts are loss of crops, contamination of water bodies, increased risk of getting disease, destruction of agricultural infrastructure, etc.

When hazard strikes at vulnerable areas or amidst vulnerable population, it leads to disasters and pose risk to the affected area or population. At this juncture, the capacity or resources available within the area or with the population help them cope with or reduce this risk. The identified hazards pose different levels of risk depending on various factors such as frequency of occurrence and probable impact.

Table C1.2. Different element at risks

Category	Hazards/Risks	Flood	Drought	Heat waves	Cold waves & Frost	Pest Attack/ Diseases	Hail storms	Landslides	Cyclones	Tsunami	Fire	High intensity rainfall event	Earthquake
Cropping Resources	Damage to very large areas (>50%)	H	H	M	M	L	H	L	H	H	L	M	
	Crop submergence (> 7 days)	H							H	H		M	
	Partial (25%) or complete crop damage (>70%)	H	H			L	M	L	H	H	M	M	
	Saline inundation	M							H	H			
	Sand cast and soil erosion	H							H	H		H	
	Reduction in crop production	H	H			L	M	M	H	H	M	M	
	Lodging of crop				L		M					M	
	Shattering of flowers/pollens /grains					M	M				M	H	
	Reduction in crop quality	H	H	H	H	H	H	H	H	H	H	H	
Infrastructure/ property resources	Irrigation resources	H							H	H			
	Roads	H							H	H			
	Communication channels	H							H	H		M	
	Storage facilities (cold storage, seed banks etc)	H					H		H	H	H		H
	Establishments (buildings)	H					H		H	H	H		H
Human Resource	Marginalised farmers	H	H	M	M	M	H	M	H	H	H	M	M
	Vulnerable social groups	H	H	M	M	M	M	M	H	H	H	M	M
Services	Advisory	H	L	L	L	L	L	L	H	H	L	L	H
	Financial	H	H	L	L	L	L	L	H	H	L	L	L
	Market	H	M	L	L	M	M	M	H	H	M	M	L

(Source: NADMP, 2020)

Resilient food crops and risk management practices

Mitigation means various structural (physical) and non-structural (soft measures) measures undertaken to limit the adverse impact of hazards, environmental degradation and technological hazards. The term "adaptation measure (or option)" describes an activity, like plantation, that serves to protect livelihoods from negative impacts that are driven by climate change, for example floods. Adaptation measures can serve other purposes as well, e.g. increasing biodiversity, but the main characteristic of an adaptation measure is that it addresses changes that can be related back to climate change. Table C1.3. shows different mitigation strategies that can be taken up for different hazards.

Table C1.3. Different mitigation strategies that can be taken up for different hazards

Strategies	Flood	Drought	Heat waves	Cold waves & Frost	Pest Attack/ Diseases	Hail storms	Landslides	Cyclones	Tsunami	Fire	Untimely High intensity rainfall event
Change in timing of planting and harvesting											
Undertaking mid-season corrections and crop life-saving measures wherever possible											
Reducing harvest/ storage losses											
Protection of young seedlings/ crops from flood											
Protective measures to save assets and livestock											
Enabling farmers to preserve investments and retain capacity to undertake next cropping (financial provision)											
Planning disaster response activities											
Precautionary measures to protect infrastructure (e.g. growth centres, food silos, embankments, etc.)											
Alternate water usage and buffering programs to provide water security											
Crop Insurance coverage											
Livestock insurance											
Public private partnership as a tool											
Extension support											

Some of the risk management practices for water saving and improving crop yields are ridge and furrow method, broad bed furrow, sowing across the slope, compartmental

bunding, conservation furrow, sub soiling, laser levelling, plastic mulching, rice straw, mechanical loosening of soil treatment, trench cum bunding, system for rice intensification (SRI).

Learning Objectives	Methodology
• To understand vulnerabilities and risks associated with major food crops of India. • To learn risk management practices and adaptation packages. • To understand on farm processing scenario and challenges. • To understand and learn the concept of resilient food crops.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process	• Rajkumar, R. H., and Satishkumar, U. (2014). Effect of soil and water conservation measures (field bunds) on soil moisture content in Beeralagudda micro watershed. An Asian Journal of Soil Science, 9(1): 149-151. • Ravindra Chary, G., Srinivasarao, C., Srinivas, K., Maruthi Sankar, G. R., Nagarjuna R. K. and Venkateswarlu, B. (2013). Adaptation and Mitigation Strategies for Climate Resilient Agriculture. Central Research Institute for Dryland Agriculture, ICAR, Hyderabad, India.p.362 • Chaudhry, M. R., Aziz. A., Malik and M. Sidhu., (2004). Mulching Impact on Moisture Conservation Soil Properties and Plant Growth. Pakistan Journal of Water Resources, 8(2):1-8. • Bhardwaj., R. L. (2013). Effect of mulching on crop production under rainfed condition - a review. Agri. Reviews, 34(3): 188-197. • Jat, M. L., Gathala, M. K., Ladha, J. K., Saharawat, Y.S., Jat, A. S., Vipin Kumar, A. S. (2009); Sharma, S.K.; Kumar, V.; Gupta, R.K. Evaluation of precision land leveling and double zero-till systems in the rice-wheat rotation: Water use, productivity, profitability and soil physical properties. Soil Tillage Res. 2009, 105, 112-121. • Kaur, B., Singh, S., Garg, B. R., Singh, J. M. and Singh, J. (2012). Enhancing Water Productivity through On-farm Resource Conservation Technology in Punjab Agriculture. Agricultural Economics Research Review Vol. 25(No.1) 79-85.

LU-C2

C2 Major cash crops

Background

Major cash crops of India are sugarcane, tobacco, jute, oilseeds and cotton. Total oilseeds production in the country during 2017-18 is of 31.31 million tonnes, total production of sugarcane is 349.78 million tonnes, cotton is 34.89 million bales and production of Jute & Mesta estimated at 10.07 million bales.

Risk management practices and adaptation packages

The risk management practices for cash crops should include following adaptation packages

- Promote natural resource based integrated and climate resilient sustainable farming systems that ensure increase in productivity and possibility, maintenance and increase of soil fertility, natural resource conservation, and minimize dependence of farmers on external inputs.
- Reduce cost of cultivation through sustainable integrated organic farming systems and other inputs thereby enhancing farmer's net income per unit of land.
- Protect environment from hazardous inorganic chemicals by adoption of eco-friendly low cost traditional techniques and farmer friendly technologies.
- Institutional development in the form of clusters and groups with capacity to manage production, processing, value addition and certification management.
- Direct market linkages with local and national markets.

Learning Objectives	Methodology
• To understand vulnerabilities and risks associated with major cash crops of India. • To learn risk management practices and adaptation strategies. • To understand on farm processing scenario and challenges. • To understand and learn the concept of resilient cash crops.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion

Guidance	Recommended readings
• This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process	• Singh D., Chopde S. K., Raghuvanshi S. S., Gupta A. K., Guleria S. (2018). Climate resilient disaster risk management: Best practices compendium. Department of Relief and Rehabilitation, Govt of Maharashtra and Climate Change Innovation Programme-Action on Climate Today (ACT). P 62.

LU-C3

C3 Horticulture crops

Background

India has witnessed increase in horticulture production over the last few years. Significant progress has been made in area expansion resulting in higher production. Over the last decade, the area under horticulture grew by 2.6% per annum and annual production increased by 4.8%. During 2017-18, the production of horticulture crops was 311.71 Million Tonnes from an area of 25.43 Million Hectares. The production of vegetables has increased from 101.2 Million Tonnes to 184.40 Million Tonnes since 2004-05 to 2017-18 and production of fruits has increased from 50.9 Million Tonnes to 97.35 Million Tonnes since 2004-05 to 2017-18 (MoAFW, 2018). Apart from nutritional benefits, the production of vegetables improves the economy of the farmers and provide employment. The contribution of vegetables remains highest (59 – 61%) in horticulture crop productions over the last five years. India is the second largest producer of Vegetables and Fruits and India's contribution to global market is significant. Production of major horticulture crops for the year 2018-19 is shown in Table C3.1.

Table C3.1. Production and productivity of major horticulture crops for the year 2018-19

Crops	Production	Productivity (MT/Ha)
Fruits	96754	14.82
Vegetables	187474	27.96
Flowers	2858	8.43
Aromatic & Medicinal crops	889	1.24
Plantation crops	17991	4.78
Spices	8590	2.10
Others	113	0.00
Total	314669	12.16

Source: Annual Report, 2018-19 (MoAFW)

Risk associated with horticulture crops includes

- ✓ Non-availability of quality planting materials of high yielding varieties which is identified as a major constraint in achieving the desired productivity of these crops.

- ✓ Imperfect coordination between supplies and demand, seasonality and perishable nature of horticulture crops and its storage plays an important role in the marketing.
- ✓ Lack of infrastructure facilities like nurseries.
- ✓ Pest infestation.
- ✓ Lack of skill to deal with horticulture crops.

Risk management strategies and adaptation packages

Risk management strategies that could be adopted for horticultural crops have been provided in the Table C3.2.

Table C3.2. Risk Management Strategies for Horticultural Crops

Strategies	Description
Production of planting material	Hi-tech nursery, upgrading nursery infrastructure, strengthening of existing Tissue Culture, seed production for vegetables and spices, seed infrastructure (for handling, processing, packing, storage etc. of seeds meant for use as seed material for cultivation of horticulture crops).
Creation of water resources	Rainwater harvesting and efficient utilization, Community tanks/ farm ponds/percolation tanks, on farm water reservoirs with lining with different materials.
Integrated nutrient and pest management	Promotion of IPM/INM, Disease forecasting unit, Bio control lab, Plant Health Clinics.
Organic farming	Vermicompost units.
Mechanization	Land development, tillage and seed bed preparation equipments.
Post harvest	Integrated pack house with facilities for conveyer belt, sorting, grading units, washing, drying and weighing, Cold Storage (Construction, Expansion and Modernisation), Refrigerated Transport vehicles.
Marketing infrastructure	Terminal markets, Wholesale markets, Rural Markets/Apnimandies/Direct markets, Retail Markets/outlets (environmentally controlled), Static/ Mobile Vending cart/ platform with cool chamber.

Learning Objectives	Methodology
• To understand vulnerabilities and risks associated with horticultural crops of India. • To learn risk management practices and adaptation packages. • To understand on farm processing scenario and challenges. • To understand and learn the concept of resilient horticultural crops.	• One session • Lecture/power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions/ case study analysis would be value addition to the learning process	• GOI. (2018). Horticultural statistics at a glance. Ministry of Agriculture and Farmers Welfare, Government of India. • MIDH. (2014). Mission for integrated development of Horticulture: operational guidelines. Ministry of Agriculture and Farmers Welfare. • Singh D., Chopde S. K., Raghuvanshi S. S., Gupta A. K. and Guleria S. (2018). Climate resilient disaster risk management: Best practices compendium. Department of Relief and Rehabilitation, Govt. of Maharashtra and Climate Change Innovation Programme-Action on Climate Today (ACT). P 62

LU-C4

C4 Animal sector

Background

The animal sector is considered to be pillar of agriculture system and plays a significant role in poverty reduction, food security, livelihood security and agriculture development. Livestock play a crucial role in nutrient management and when used as draft, animals boost productivity in regions where there is low mechanization. India has vast resource of livestock and poultry, which plays a vital role in improving the socio-economic conditions of rural masses. There are about 300 million bovines, 65.07 million sheep, 135.2 million goats and about 10.3 million pigs as per 19th Livestock Census in the country (Annual Report, 2018-19, Ministry of Animal Husbandry, Dairying and Fisheries). The production in different sectors of livestock is highlighted in Table C4.1.

Table C4.1. Production in different sectors of livestock

Livestock production	Livestock production and agriculture are intrinsically linked, each being dependent on the other, and both are crucial for overall food security. According to estimates of the Central Statistics Office (CSO), the value of output livestock sector was about Rs. 9,17,910 crore at current prices during 2016-17 which is about 31.25% of the value of output from agricultural and allied sector.
Milk production	India continues to be the world's largest milk producer. Milk Production during 2017-18 was 176.3 million tonnes.
Egg production	In the last four decades, India's poultry production has progressed from an unscientific farming method to a commercial production system with cutting-edge technological interventions. Currently the total Poultry population in our country is 729.21 million (as per 19 Livestock Census) and egg production is around 95.2 billion during 2017-18.
Wool production	Wool production declined marginally at the end of Eleventh Five Year Plan (2011-12) to 44.7 million kg from 45.1 million kg in the end of Tenth Five Year Plan (2006- 07).
Meat production	The Meat production has registered a healthy growth from 2.3 million in 2006-07 to 7.7 million tonnes in 2017-18.

Fisheries production	The country has vast potential for fisheries in view of our long coastline of 8,118 km apart from the inland water resources. During the financial year 2017-18, the total fish production in India is estimated at 12.61 Million tonnes. India is the world's second-largest fish producer and second-largest aquaculture country.

Source: Annual Report, 2018-19 (Ministry of Animal Husbandry, Dairying and Fisheries)

Sustainable and resilient management practices for livestock

- Improve productivity and input use by implementing a multi-level system for feed resources and an associated management plan.
- Minimize potential negative impacts on natural resources by prohibiting the destruction of natural ecosystems, optimizing water and land use, and treating of residual waters.
- Reduce GHG emissions and improve the systems' capacity as carbon sinks.
- Ensure animal welfare, meaning that animals are healthy, comfortable, well-fed, safe, can behave naturally, and are not subject to pain, fear and stress.
- Minimize food safety risks through sanitary protocols and animal health monitoring.
- Implement mechanisms for the verification of the animal's origin and breeding process throughout the supply chain.

Learning Objectives	Methodology
• To understand vulnerabilities and risks associated with horticultural crops of India. • To learn the role of livestock in sustainable agriculture. • To learn risk management practices and adaptation packages.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process	• FAO. (2021). Animal Production. Food and • Agriculture Organization of the United Nations available at http://www.fao.org/animal-production/en/ • World Bank. (2020). Agriculture brief available at https://www.worldbank.org/en/topic/agriculture/brief/moving-towards-sustainability-the-livestock-sector-and-the-world-bank SAN. (2021). Sustainable Livelihood Production. Sustainable Agriculture available at https://www.sustainableagriculture.eco/sustainable-livestock-production

Module

Management and Governance

A basic training manual on Climate and Disaster Resilient Agriculture Management is an overview or refresher course for sensitization of professional/officials of general district administration

Background

The agriculture and allied sectors are subject to a great many uncertainties. Yet, more people in India earn their livelihood from this sector, than from all other economic sectors put together. The risk in agriculture sector is associated with negative outcomes from imperfectly predictable biological, climatic and natural hazards and price variables. These variables include natural adversities (for example, pests and diseases) and climatic factors not within the control of the farmers. The other uncertainties also include adverse changes in both input and output prices.

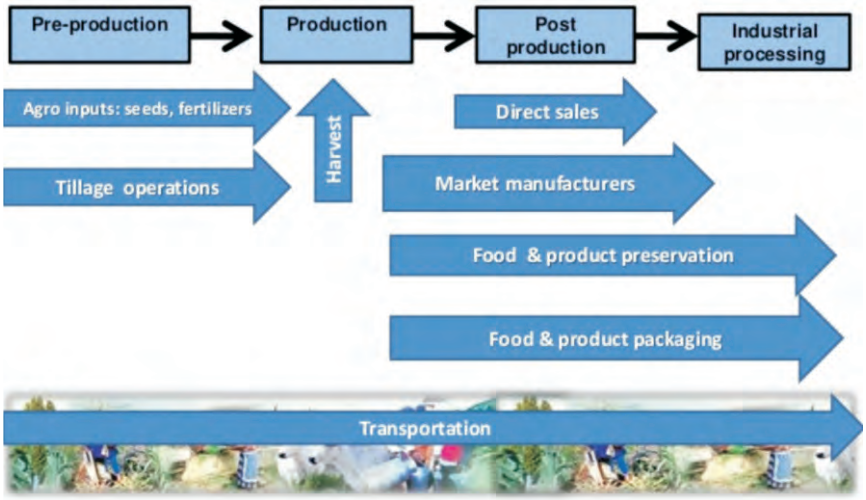


Figure D1. A Simple Value Chain
(Source: https://www.agriculturenigeria.com/research/actors-in-agricultural-value-chains/)

Disasters destroy critical agricultural assets and infrastructures like farms, farm equipment, storage structures, agriculture produce, horticulture crops, animals, livestock, post harvest processing units etc. Disasters of very high magnitude can change agriculture trade and cause losses to industry that are based on agriculture produce for example textiles and food processing industries. A strong and dynamic agro- processing sector plays a vital role in diversification and commercialization of agriculture, enhancing shelf life, ensuring value addition to agricultural produce, generation of employment, enhancing income of farmers and creating markets for export of agro foods. The objectives of disaster resilient agro-industry are shown in Figure D2.

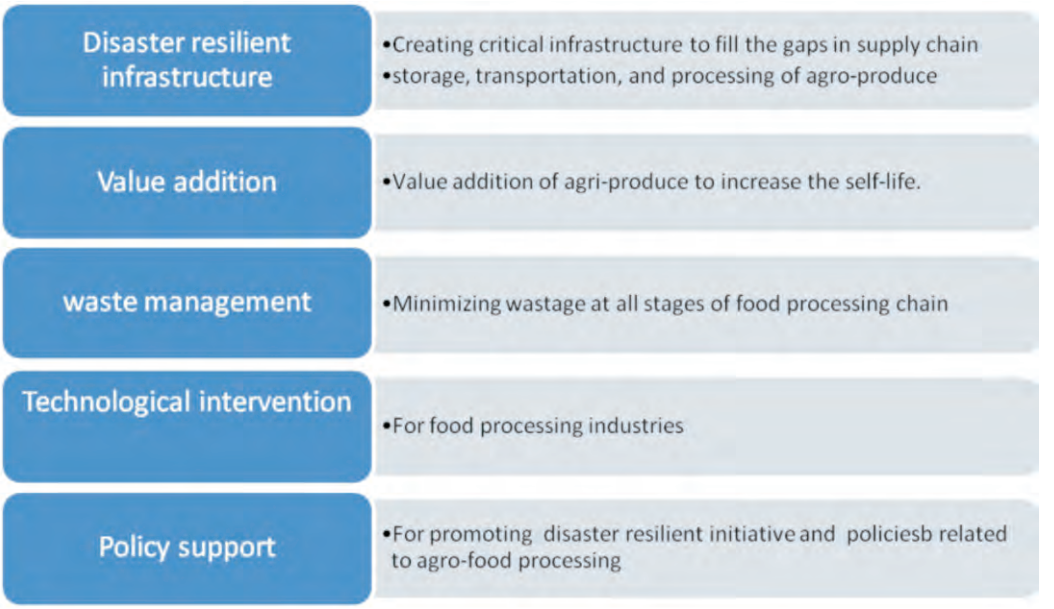


Figure D2. Objectives of disaster resilient agro-industry

Understanding disaster risk in agricultural value chain

Agricultural value chain may disintegrate due to various degrees of risks posed by disasters. Disaster events disconnect one component from another that increases the vulnerability. As explained by Miller in hazard-prone and highly vulnerable regions, input suppliers may be unwilling to take the risk of providing inputs to producers on credit. Consequently, these producers are less likely to increase their productivity and potentially decrease their vulnerability by using fertilizers or growing improved varieties. Similarly, brokers or buyers may neglect regions where crop failures are common, reducing the linkages between producers in these regions and markets and potentially limiting their earning potential (Hill and Pittman, 2012).

Table D1. Overview of disaster risk in agricultural value chain

Value chain component	Disaster risk		
	Exposure	Vulnerability	Resilience
Input Suppliers	Critical transportation, reduced demand for inputs, presence of early or storage infrastructure, reduced capacity for warning systems	In exposed locations, producers to pay for inputs including monitoring provided on credit.	Presence of early warning systems including monitoring systems. Networks for information provision and dissemination. Presence of decision support systems. Policies enabling markets and market access. Well-designed risk sharing/transfer programs. Flexible and diversified livelihoods. Sound financial management and access to credit. Appropriate and efficient resource use. Research, technology and innovation. Effective social capital and network
Producers	Land, crops, infrastructure, equipment, households, etc. in exposed locations	Decreased production. Reduced quality of production Asset losses and liquidity. Limited technology. Reduced access to markets. Livelihood implications.	
Intermediaries	Critical transportation infrastructure in exposed locations.	Increased transaction costs. Reduced quality of commodity. Reduced volumes of commodity.	
Processors	Critical transportation or storage/preservation infrastructure in exposed locations.	Reduced quality of commodity. Reduced volumes of commodity	
Marketers	Critical transportation or storage/preservation infrastructure in exposed locations	Loss of market access	
Consumers	Critical transportation or storage/preservation infrastructure in exposed locations	Increased food prices. Decreased food quality Inability to access food supplies. Food and nutritional insecurity. Loss of livelihood	

(Source: Miller, 2008)

Natural disasters, climate variability and change, yield uncertainties, fluctuating prices, poor infrastructure, and market uncertainties are all factors that exacerbate agricultural risks in India. Lack of financial services including limited span and design of risk mitigation instruments, such as credit and insurance further increases the risks and vulnerability of agriculture at all level of disaster cycle. These factors jeopardise farmers' livelihoods and wages, as well as the agriculture sector's sustainability and ability that contributes to sustainable development goals. Risk Transfer is a tool that

enables a concerned party to share/transfer a portion of the disaster risk to another party, for a certain fee. This party can be the government itself or the microfinance institutions. The absence of disaster insurance means that the government has to bear a huge cost for compensation and rehabilitation work in post-disaster situations.

Context

This is the fourth training module of the manual which focuses on building resilience in agro-industry sector focusing on postharvest management. It discusses different aspects of agri-business in the context of understanding vulnerabilities, risks and challenges being faced in the changing climate. The module also highlights various risk management practices, adaptation packages as well as approaches for value-chain analysis, usage of agrochemicals and insurance schemes for sustainable agriculture. The module is developed as an orientation or sensitization course for authorities or officials of agriculture sector, local and those dealing with developmental, disaster management, environment and climate action related professional /officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc., towards integration of disaster management and resilience into the agriculture developmental processes.

Four learning units have been delineated to cover this module. They are as below:

LU: D1-Agro-industry

LU: D2-Agrochemicals and Health

LU: D3-Agriculture insurance and credit loans

LU: D4-Management of Perishable goods and agro-processing

Delivery Chanel:

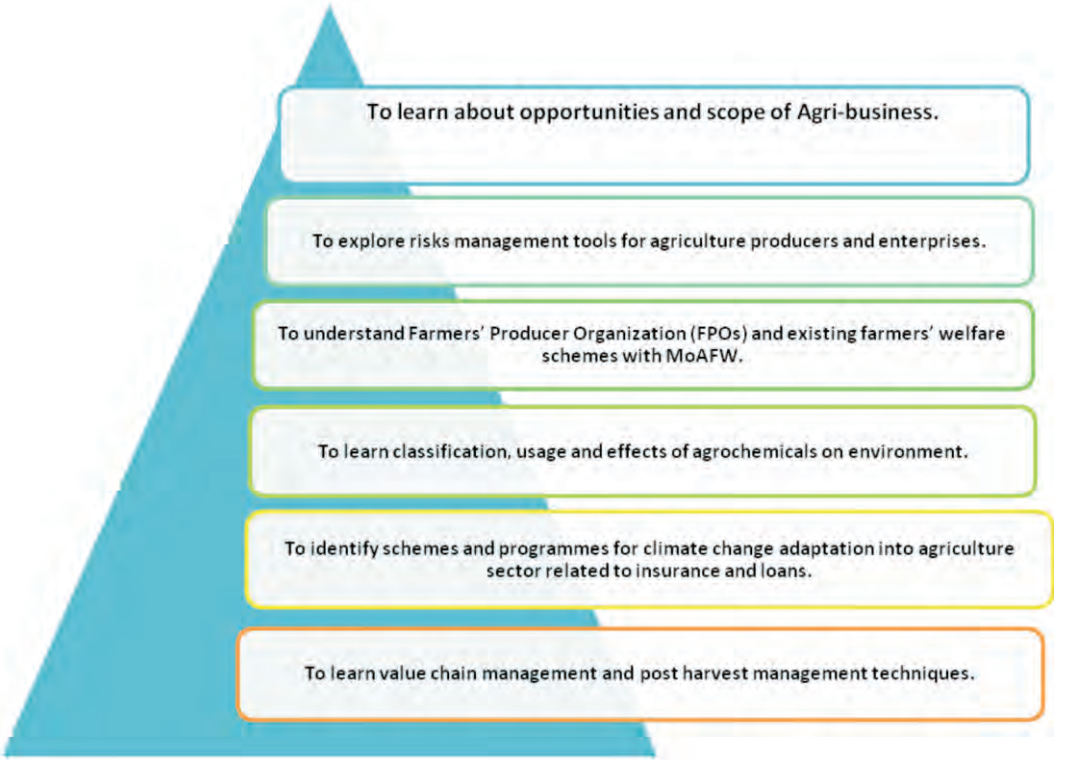


Duration:

About three hours including the inauguration session.



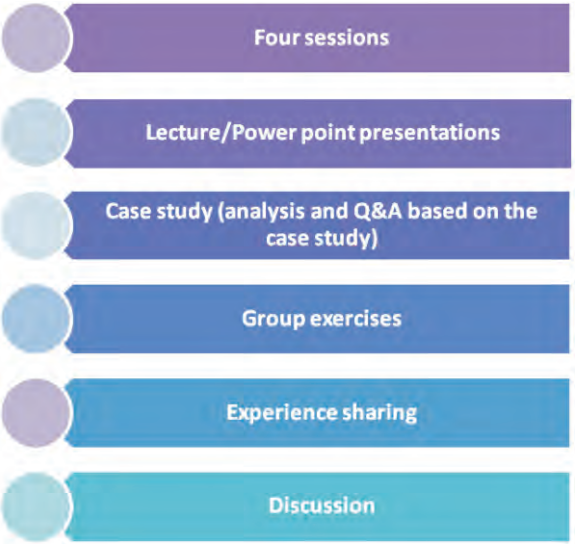
Training objectives



Guidance:

- Recap of previous module learning and past experiences, and examples from both sides - from participants as well as from the faculty/trainers would be useful.
- Discussion on understanding of ecosystems - their structure, functions, benefits in general and then bringing orientation towards specific functions supporting agriculture systems and in particular towards adaptation and resilience would be important strategy.
- Case examples in the discussions /case study analysis would be value addition to the learning process.

Methodology:



Trainers' Hint

The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/ introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest / work, organization, state / district, previous exposure on disaster and its management, etc. Introduction round can also be done separately and relatively comprehensive. Even if a small and formal introduction round during the inaugural session, a more informal and detailed introduction of participants can be organized with the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiate some level of group participation process to continue during the entire training course. In case of 'no formal inaugural function', the programme director and coordinators/trainers shall explain to the participants about the programme objectives and contents, limitations, the process of participatory learning and some general ground rules of the course, if any.



Material required:

Course Brochure, Programme Schedule, Pen, Notepad, Bag, Laptop, Projector, Flip Chart, Markers, Microphones, etc.

LU-D1

D1 Agro-industries

Background

An agriculture based industries and business tends to be a large-scale business operation and includes farming, processing and manufacturing and the packaging and distribution of product. This business sector encompasses farming and related commercial activities. It covers the supply of agricultural inputs, the production and transformation of agricultural products. Agribusiness includes all the activities within the agricultural food and natural resource industry involved in the production of food and fiber. Agribusiness provides people with food, clothing, and shelter. It also provides jobs for millions of people in science, research, engineering, education, advertisement, government agenda and their distribution to final trade organizations, and commodity organizations. Scopes of agri-business are given below in Table D1.1.

Table D1.1. Scope of Agribusiness

Scope	Description
Agro-climatic condition	India is endowed with varied agro-climate, which facilitates production of temperate, sub-tropical and tropical agricultural commodities
Growing demand	Export can be harnessed as a source of economic growth. As a signatory of World Trade Organization, India has vast potential to improve its present position in the World trade of agricultural commodities both raw and processed form. The products line include cereals, pulses, oilseeds and oils, oil meal, spices and condiments, fruits and vegetables, flowers, medicinal plants and essential oils, agricultural advisory services, agricultural tools and implements, meat, milk and milk products, fish and fish products, ornamental fish, forest by products etc
Fisheries	The vast coastal line, inland, fresh-water resources provides enormous opportunity for production of marine and inland fish and ornamental fish culture gaining popularity with increase in aesthetic value among the citizens of India.

Scope	Description
Livestock	The livestock wealth gives enormous scope for production of meat, milk and milk products, poultry products etc.
Compost	Organic farming has very good scope in India. The farmers can be encouraged and educated to practice organic farming in niche areas and crops.
Seed production	Seed production has the highest potential in India since improved and stress tolerant varieties and hybrids play a major role not only in enhancing the productivity but also to achieve resilience to climate risks.
Micro-irrigation	Micro-irrigation systems and labor saving farm equipment have good potential for the years to come due to declining groundwater level and labor scarcity for agricultural operations like weeding, transplanting and harvesting.
Other employment	The enhanced agricultural production throws open opportunities for employment in marketing, transport, cold storage and warehousing facilities, credit, insurance and logistic support services

Challenges and risks of agri-businesses

Lowering the risks of hazard and disasters in food supply/value chain is pertinent to ensuring the resilience of the food systems. Agro-industries and value chains provide linkages between global food system actors and mechanisms through which food travels from producers to consumers. As populations grow there are emerging pressures on agricultural systems that are increasing their vulnerability and exposure to disasters. The various challenges of agribusiness are shown in Table D1.2.

Table D1.2. Challenges of Agribusiness

Categories	Description
Technological challenges	Transfer of technology, including know how and information, customization and capacity building are crucial in empowering the farmer to raise productivity and adopt sustainable agricultural practices. Given the complexity of geographical spread, diversity of crops and the large number of farmers involved in agriculture, innovative models of engagement are essential to ensure robust sustainable agricultural practices as well as avenues for livelihood creation.
Policy challenges	Policy reforms in the agriculture sector need to cognize for several conflicting needs impact the value chain from the farmer to consumer. There is also need for an enabling policy framework that boosts the provision of rural infrastructure so that wastage can be eliminated and farmers can receive better returns.
Institutional challenges	Agribusiness sector is characterized by much functional and institutional inefficiency. All the marketing functions being performed in transferring the agricultural products from producer to consumer exhibit inefficiency. The functioning of wholesale markets is not satisfactory due to many reasons like lack of storage facilities, unhygienic display sites, exploiting behavior and illegal deductions by the market intermediaries, lack of availability of accurate and transparent market information, nonprime setting mechanism, lack of market research and development efforts, lack of production and price forecasts etc.
Climatic and disaster challenges	Agriculture is an important part of the Indian economy because it provides food and income to a large portion of the population. Indian agriculture sector is greatly affected by natural and human induced hazards and disasters, like, Drought, Flood, Cyclone, Hails, Frost, Diseases, Pest attacks, Fire, Land degradation, animal menace, Chemical pollution, Migration, post-harvest damages/losses, Agro-industrial risks, damage to infrastructure, establishments and services etc.

Learning Objectives	Methodology
• To learn opportunities and scope of agri-business • To understand risks management tools for agriculture producers and Enterprises • Understanding Farmers' Producer Organizations (FPOs) • Existing farmers' welfare schemes with MoAFW • Role of Self Help Groups (SHGs)	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to exclusive agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process	• Komarek, A. M., De Pinto, A., and Smith, V.H. (2020). A review of types of risks in agriculture: what we know and what we need to know. Agricultural Systems, 178: 1-10. https://www.sciencedirect.com/science/article/pii/S0308521X18312034 • Sundar, I. (2016). Agribusiness scope, opportunities and challenges in India. International journal of Economic and Business review, 4(7): 171-178. https://eprawisdom.com/jpanel/upload/articles/1110pm24.Dr.I.Sundar.pdf • Hill, H. and Pittman, J. (2012). Agriculture and Disaster Risk Reduction. Draft contributing paper submitted to the UNISDR's GAR 13. Unpublished manuscript. Agriculture and AgriFood Canada, Saskatoon, Canada. https://www.preventionweb.net/english/hyogo/gar/2013/en/bgdocs/Hill%20and%20Pittman,%202012.pdf

LU-D2

D2 Agrochemicals and Health

Background

These are the generic name given to chemicals either fertilizers, pesticides, insecticides, etc. that are used in agricultural to facilitate plant growth and protection. Though, they improve crop production, indiscriminate use of chemicals has detrimental impact on environment and creates disastrous consequences. Apart from the effects on crops and the food chain, agrochemicals have a wide area of application. Due to these many uses, they seep into the surrounding land and water bodies, therefore having a widespread effect. Regarding their impact on crops, excessive use of such chemicals generates a significant amount of residues. These residues cause nutrient imbalance and quality reduction of agricultural produce.

Classification of agrochemicals

These chemicals may be classified as pesticides, plant growth regulators, fertilizers and soil conditioner as shown in Figure D2.1 and the types of agrochemicals are shown in Table D2.1.

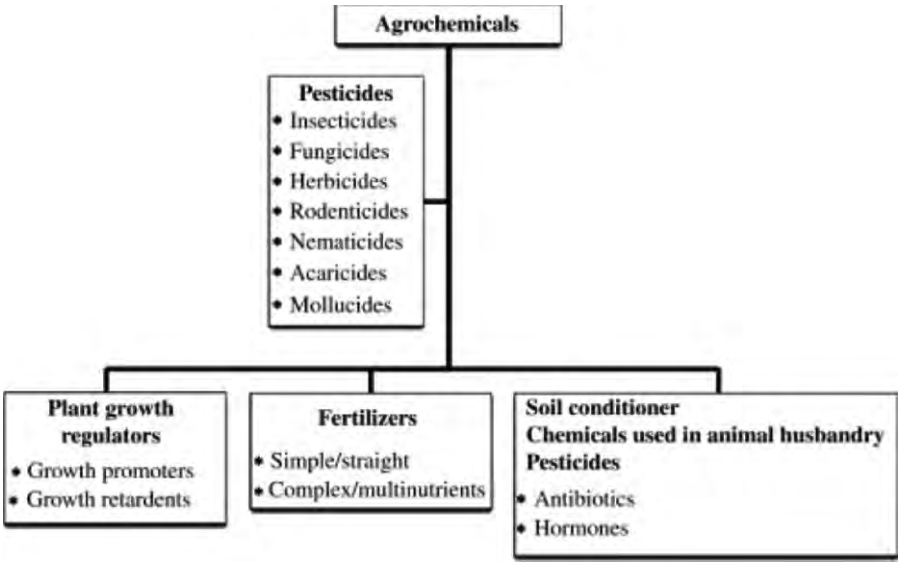


Figure D2.1. Classification of agrochemicals.
(Source: Koli et al. 2019)

Table D2.1. Types of agrochemicals

Types	Description
Pesticides	Pesticides are a substance used to destroy or control some types of plants or organisms (pests), which are harmful to cultivated plants or to animals. It works by poisoning pests.
Insecticides	It is used to destroy insects and can kill eggs and larvae. Examples are organochlorides, organophosphates, carbamates and pyrethroids.
Herbicides	Control or kill weeds and herbs. Example Gramoxone, Glyphosphate
Fungicides	Used to control fungi and oomycetes, example mankocide
Algaecides	Used for controlling algae
Rodenticides	Used to prevent spread of rodents like rat, mice.
Molluscicides	Used to control molluscs like snails and snugs.
Nematicides	Used to control or kill nematodes. Example: Furadan
Fertilizers	These are chemical compounds used for promoting plant growth, mainly used to mitigate nutrient deficit in the soil. It can be divided into two groups: organic and inorganic
Soil conditioners	It is used to keep soils in good condition and enhance soil aeration and water holding capacity e.g. includes manures, compost,

Impact of Agrochemicals

Agrochemicals play essential role in increasing food productivity but also have effect on environment affecting the health of human beings and animals (Figure D2.2).

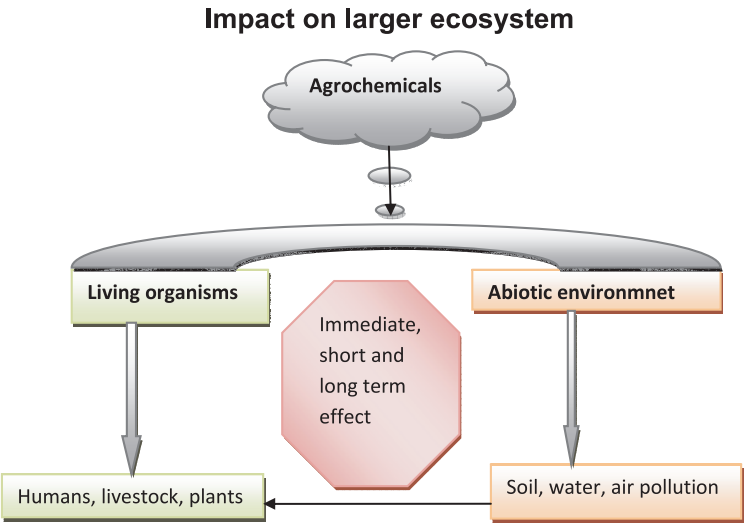


Figure D2.2. Impact of Agrochemicals on ecosystem

Impact on soil system: May kill beneficial bacteria, increase nitrate level, alter the pH of the soil, have residual effect, kill soil organisms, increase toxicity and reduce soil quality.

Impact on water system: Water becomes unfit for consumption, leads to eutrophication and death of aquatic animals.

Impact on air: Residues and particles may lead to air pollution, lead to lowering of humidity and increase temperature.

Impact on human health: Causes variety of health complications, eyes and skin irritation, affect nervous system, causes cancer and causes reproductive problems (Figure D2.3).

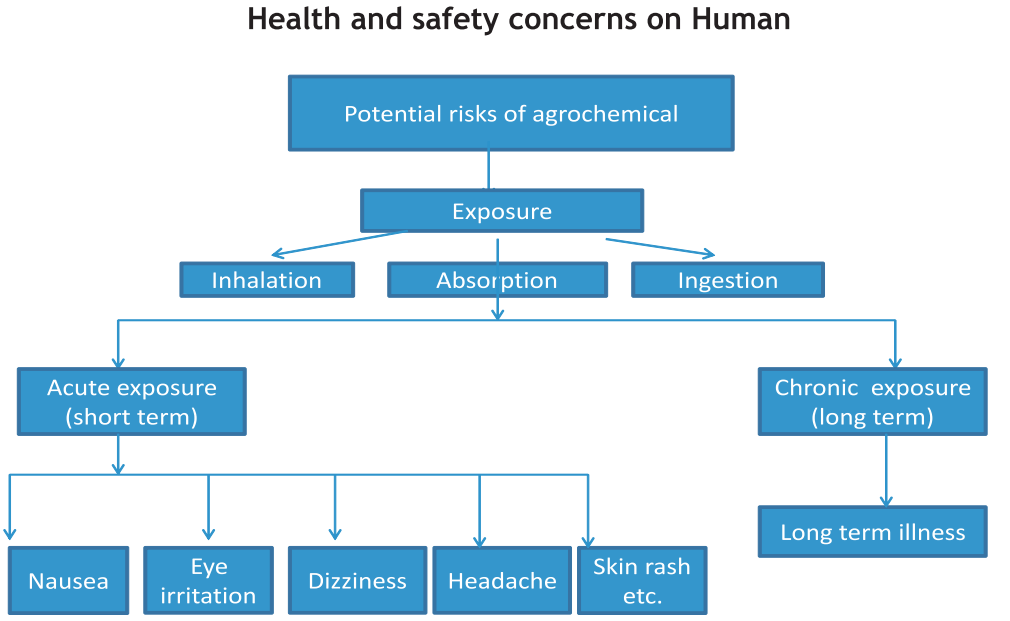


Figure D2.3. Impact of Agrochemicals on Human Health

Learning Objectives	Methodology
• To learn classification, usage and effects of agrochemicals on health. • To understand the impact of agrochemicals on environment. • To learn management of agrochemicals.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion

Guidance	Recommended readings
• This session is related to agro-chemicals and its management; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process.	• Koli, P., Bhardwaj, N. R., Mahawar, S. K. (2019). Agrochemicals: Harmful and beneficial effects of climate changing scenarios. Climate change and agricultural systems, 65-94. https://www.sciencedirect.com/science/article/pii/B9780128164839000049

LU-D3

D3 Agriculture insurance and credit loans

Background

The DM Act 2005 has clearly mandated upon the Government to ensure that the funds are provided by the Ministries and Departments within their budgetary allocations for the purpose of disaster management. The Act has stressed upon the need for mainstreaming of the Disaster Risk Management by way of making definite budgetary arrangements for the purpose by the respective Ministries and Departments within their overall agenda. The 13th Finance Commission recognized the importance of mitigation funds in the context of disaster management for the first time. The 15th Finance commission has proposed for measurable performance-based incentives for States and at appropriate level of government in the field of disaster management and sustainable development goals. The 15th Commission has also suggested for the review of financial arrangements across the three components of disaster management i.e. mitigation, response and reconstruction. The other funds are green climate fund of (UNFCCC), Tribal Development Fund, National Adaptation Fund for Climate Change (NAFCC), Climate Change Fund, etc., as shown in Table D3.1.

Table D3.1. Respective Funds of Different Organizations

Fund name	Organization	Description
15th Finance Commission Green Climate Fund	Ministry of Finance	Disaster resilient infrastructure
	Ministry of Environment, Forest and Climate Change	Solar rooftop program channelized through NABARD. Restoring ecosystems in three coastal states in partnership with UNDP in Andhra Pradesh, Odisha and Maharashtra. Promotion of climate resilient livelihood options (e.g. sustainable farming of mud crabs).
Tribal Development Fund	NABARD, Ministry of Finance	• Sustainable agriculture practices. • Sustainable and participatory livelihood programs. • Health care and other support to tribal. • Enabling women participation • Capacity building through trainings

Fund name	Organization	Description
		• Support to traditional economic activities • Non-farm based livelihoods • Establishing marketing linkages
National Adaptation Fund for Climate Change	NABARD is the National Implementing Entity	Funding adaptation projects under NAPCC and SAPCCs in particular agriculture and water Strengthening awareness and increasing adaptive capacity. Diversification of livelihood options at local levels. Climate resilient agricultural interventions at landscape level in NABARD funded watershed projects. Scaling out climate resilient practices through FPOs.
Climate Change Fund	NABARD	Activities aimed at addressing climate change impacts. Training and capacity building related to adaptation and mitigation measures. Addressing gender issues.

Risk Transfer and Disaster Insurance

Risk Transfer is a tool that enables a concerned party to share/transfer a portion of the disaster risk to another party, for a certain fee. This party can be the government itself or the microfinance institutions. The absence of disaster insurance means that the government has to bear a huge cost for compensation and rehabilitation work in post-disaster situations. At present there are four insurance mechanisms under the Ministry of Agriculture and Farmers' Welfare as shown in the table below.

Insurance name	Key objectives
Pradhan Mantri Fasal Bhima Yojana	Insurance protection for food crops, oilseeds, annual horticultural crops/commercial crops notified by State Government
Weather based crop insurance scheme	Insurance protection for notified crops, oil seeds, horticultural and commercial crops
Coconut Palm Insurance Scheme **Unified Package Insurance Scheme**	Insurance protection for coconut palm growers To provide financial and comprehensive risk coverage of crops, assets, life and student safety to farmers

Learning Objectives	Methodology
• To understand the concept of agriculture insurance and credit loans • To identify schemes and programmes for climate change adaptation into agriculture sector.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to concept of insurance and credit in agricultural systems; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process.	• MoAFW. (2019). Annual Report 2018-19. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India. • Chand, R. (2017). Doubling farmer's income: rationale, strategy and prospects. NitiAayog, Government of India Report. • Planning Commission. (2007). Risk Management in agriculture: for eleventh five year plan (2007-12). Government of India Report. • Miller, C. (2008). Risk mitigation and management for agricultural investment: investment and resource mobilization. Food and Agricultural Organization. http://www.fao.org/docs/up/easypol/526/3-5_risk_management_background_155en.pdf

LU-D4

D4 Management of perishable goods and agro-processing

Background



Most often, the post harvest losses from natural disaster are neglected. It is not only the standing crops that are being destroyed by natural disasters, the already harvested agricultural produce that are stored in warehouses, godowns, market yards, agriculture farm houses, etc. are also affected much by the disasters. Farmers have very poor storage infrastructure and transportation facilities which become more critical for perishable fruits, vegetables, fish etc. Pandey, 2018 reported that the proportions of the produce that farmers are unable to sell in the market are 34 per cent, 44.6 per cent, and about 40 per cent for fruits, vegetables, and fruits and vegetables combined. These losses are accounted more when natural disasters occur. As a result, adequate and appropriate storage systems should be in place where natural hazards will not impact them, and agro-processing facilities in rural areas should ideally be located near to the points of production. This will not only save the produces from natural disaster but will also enhance the production. A nation-wide study on quantitative assessment of harvest and post-harvest losses for 46 agricultural produces in 106 randomly selected districts was carried out by Central Institute of Post-Harvest Engineering & Technology (CIPHET), Ludhiana. The aforesaid study considers the quantitative loss as the material rendered "unfit for human consumption". The different stages considered for assessment of losses are harvesting, collection, thrashing, grading /sorting, winnowing/cleaning, drying, packaging, transportation, and storage depending upon the commodity. Estimates of harvest and post-harvest loses of crops/commodities provide the information about the range of losses in different operations and market losses including disasters. Economic value of harvest and post-harvest losses is also shown in Table D4.1

Table D4.1. Economic value of harvest and post-harvest losses, 2015

S.no.	Crop commodity	Sectorial total loss (in Rs crores)
1	Cereals	20698
2	Pulses	3877
3	oilseed	8278
4	Fruits	16644
5	Vegetables	148
6	Plantation crops and spices	9325
7	Livestock produce	18987
	Total	92651

(Source: https://mofpi.nic.in/sites/default/files/selection.pdf.pdf)

The major challenges of agro and food processing industries are supply chain infra gaps (like processing, storage and distribution facilities), inadequate linkages between production and processing, seasonality of operations, institutional gaps, lack of product development and innovation and disasters and climate hazards. It is essential to build sustainable supply chains.

Management of perishable goods and agro-processing:

A well-developed food processing sector with higher level of processing helps in the reduction of wastage, improves value addition, promotes crop diversification, ensures better return to the farmers, promotes employment as well as increases export earnings. This sector is also capable of addressing critical issues of food security, food inflation and providing wholesome, nutritious food to the masses. This sector is also highly labour intensive per unit of capital deployed. The supply chain management of food industry is shown in Figure D4.1.

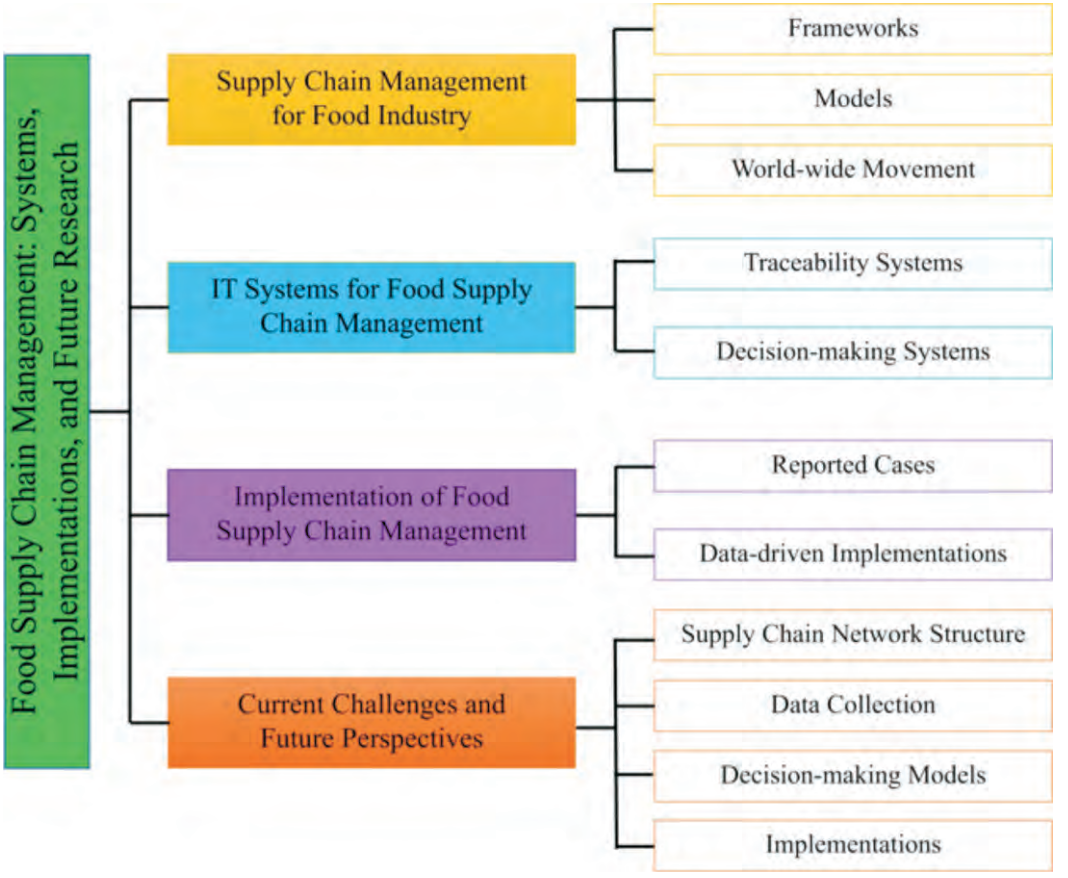


Figure D4.1. Supply chain management of food industry (Source: Zhong, et al. 2017)

Strategies for management

Strategies	Description
Cluster approach	Promoting cluster approach for intervention in the sector in view of the progressive reduction of farm size and preponderance of tiny processing units as well as the inability of individual entrepreneurs to sustain viable infrastructure facility at different stages in value chain
Financial support	Financial support and fiscal incentives for creation of common supply chain infrastructure viz. cold chain, dry storage, packaging, logistics, back and front end infrastructure, expansion of processing capacities etc. to reduce cost of investment, enhance viability and ensure higher conformity to regulatory standards;
Strengthening market linkages	Promoting processing clusters and creating strong backward and forward linkages from farm gate to retails outlet through various measures including setting up of Mega Food Parks/ Processing Clusters with appropriate fiscal and financial incentives
Infrastructure	Creating adequate infrastructure for food testing and training manpower for food safety, and promoting adoption of best practices in the industry in food production, processing, packaging, storage and transportation;
Research	Support creation and provision of services like R&D, testing, quality improvement, marketing and enhancing competitiveness of the sector through promotion of innovations

Government schemes

Strategies	Description
Pradhan Mantri Kisan Sampada Yojna (PMKSY)	PMKSY is a comprehensive package resulting in creation of modern infrastructure with efficient supply chain management from farm gate to retail outlet. Not only it provides a big boost to the growth of food processing sector in the country but also helps in providing better returns to farmers and is a big step towards doubling of farmers' income, creating huge employment opportunities especially in the rural areas, reducing wastage of agricultural produce, increasing the level of processing and enhancing the export of the processed foods
Mega food parks, 2008	Mega Food Parks Scheme, being implemented since 2008, aims to create a modern food processing infrastructure for the processing units based on a cluster approach and on a hub and spoke model in a demand driven manner. The scheme intends to facilitate establishment of an integrated value chain, with food processing at the core and supported by requisite forward and backward linkages.

Strategies	Description
Integrated cold chain and value addition infrastructure, 2008	Scheme provides for promoting integrated and complete cold chain facilities without any break from the farm gate to the consumer to reduce losses by improving efficiency in collection of farmer produce, storage, transportation and minimal processing. Both horticultural and non-horticultural produce are eligible for support under this scheme.
Creation/Expansion of food processing and preservation capacities	Promotion of processing / preservation of agro food products and modernization /capacity enhancement of food processing units with a view to increasing the level of processing, thereby, reduction of wastage and value addition.
Creation of infrastructure for agro processing clusters	The scheme aims at development of modern infrastructure to encourage entrepreneurs to set up food processing units based on cluster approach.
Creation of backward and forward linkages	To create an effective backward & forward linkage for perishable agri-horti produce through setting up of primary processing centers / collection centers at farm gate, distribution hub and retail outlets at the front end. The Scheme is applicable to both perishable horticulture and non-horticulture produce such as: fruits, vegetables, dairy products and fisheries etc.
Food safety and quality assurance infrastructure	To ensure that food is wholesome, hygienic and healthy, there is a need to have infrastructure for testing of food products, enforce Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) at the production level as well as in the entire supply chain of logistics, storage, packaging processes and marketing channel till food products reaches the table of consumers.
Scheme of Operation Greens	Enhancing value realization of Tomato, Onion and Potato (TOP) farmers by targeted interventions to strengthen TOP production clusters and their FPOs, and linking/connecting them with the market.
Technology up gradation scheme	Ministry has been implementing the Scheme of Technology Up gradation/Establishment/Modernization of Food Processing Industries since 9th Five Year Plan (1997-2002).

Learning Objectives	Methodology
• To understand value chain of agriculture sector from production to marketing. • To learn post-harvest management techniques. • To know various schemes of government related to post-harvest management.	• One session • Lecture/Power point presentations • Case study (analysis and Q&A based on the case study) • Experience sharing • Discussion
Guidance	**Recommended readings**
• This session is related to concept of post harvest management of agricultural produce; hence expert of the subject should be invited having sound knowledge of resilient and sustainable agriculture systems. • Case examples in the discussions /case study analysis would be value addition to the learning process	• Zhong, R., Xu, X., and Wang, L. (2017). Food supply chain management: systems, implementation and future research. Industrial Management & Data Systems, 117 (9): pp 2085-2114. DOI 10.1108/IMDS-09-2016-0391. • MOFPI, (2019). Annual report, 2018-19. https://mofpi.nic.in/sites/default/files/selection.pdf.pdf

Module

Mainstreaming Climate Change Adaptation and Disaster Risk Reduction

Background

The word 'adaptation' has been widely and variedly defined and used primarily in ecology, physiology/medical science and now a broader perspective in the sense of 'adaptation to climate-change' as an explanation of ecological adaptation by humankind. Following are few definitions or concepts of 'adaptation'.

The components of adaptation, therefore, refer to following:

(a) Reducing the risk of occurrence of a hazard event by: →	(i) hazard prevention	(ii) mitigation or	(iii) control
(b) Reducing exposure to hazardous event: →	(i) avoidance/migration	(ii) resilience	(iii) impact control
(c) Capacity to contain: →	(i) prevent damages	(ii) prevent losses	(iii) early normalcy

Thus, the term "adaptation" refers to the ability of different species with different genetic make-ups to cope with a specific range of circumstances such as climate, food supply, habitat, defense and movement. Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides (Olmos, 2001). Adaptive capacity is known as the potential or capability of a system to adapt to (to alter to better suit) climatic stimuli whereas the 'Adaptability' is understood as the ability, competency or capacity of a system to adapt to (to alter to better suit) climatic stimuli.

ADAPTATION

- Something, such as a device or mechanism, that is changed or changes so as to become suitable to a new or special application or situation.
- A composition that has been recast into a new form: The play is an adaptation of a short novel.
- The responsive adjustment of a sense organ, such as the eye, to varying conditions, such as light intensity (Physiology).
- Change in behavior of a person or group in response to new or modified surroundings.
- Change in an organism so that it is better able to survive or reproduce, thereby contributing to its fitness. (Source: PHC)

DRR denotes both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience (Lavell et al., 2012).

DRR concepts and practices relate to the paradigm shift in approach from 'response and relief centric' to 'prevention and preparedness (mitigation) centric' approach as shown in Figure E1. However, now the focus is taking a new shift away from concentrating on 'disaster event' and 'minimizing effect of disasters' towards more on 'addressing hazards, reducing vulnerability and ensuring sustainability along environment centric approach' This change is offering better opportunities for CCA and DRR convergence, and is now referred to as 2nd paradigm shift in disaster management.

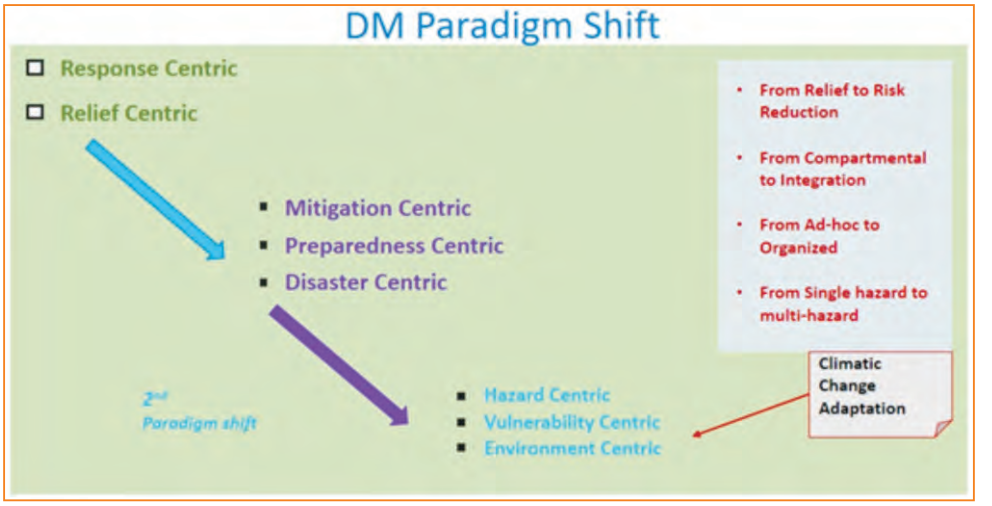


Figure E1. Integration of CCA and DRR leading to a 2nd Paradigm shift in disaster management (modified after, Gupta and Nair, 2010)

CCA and DRR link

The link between climate variability and natural disasters are well established and if not addressed at present can undermine the very objectives of Sustainable Development Goals (SDGs), Paris Climate Agreement as well as Sendai Framework for Disaster Risk Reduction (SFDRR). There are several tools and methods through which DRR and CCA measures have been integrated to reduce the risk of natural disasters. They are legal and policy framework, developmental plans and schemes, environmental and natural resources laws, policy planning instruments like strategic environment assessment, environment impact assessment, life cycle assessment, environmental auditing etc.

An approach to mainstream CCA measures into the ongoing developmental programme may be delineated as following:

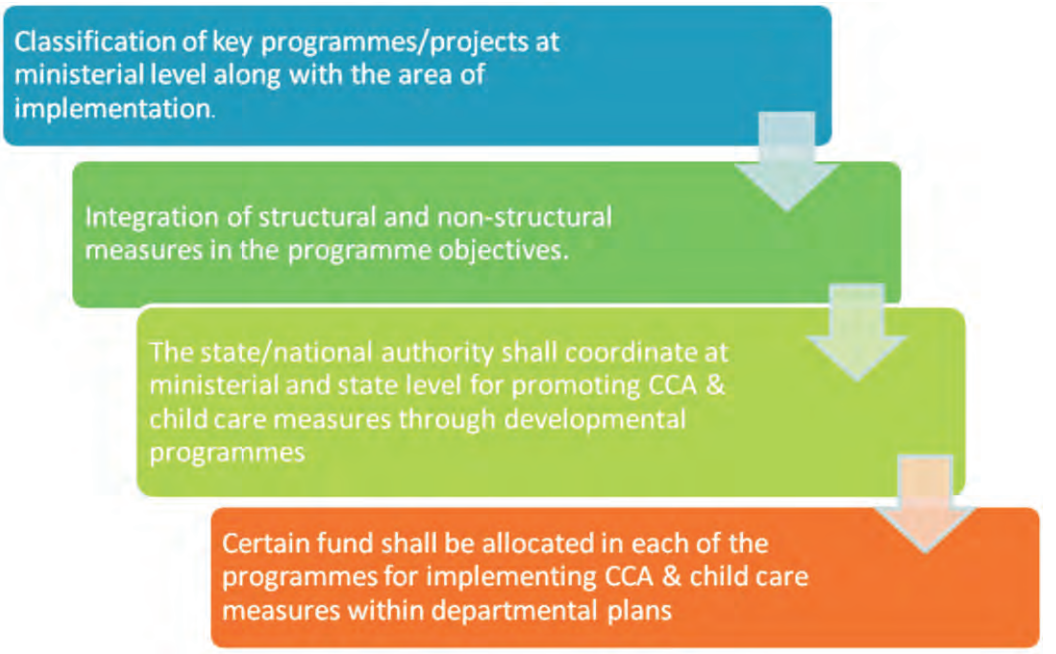
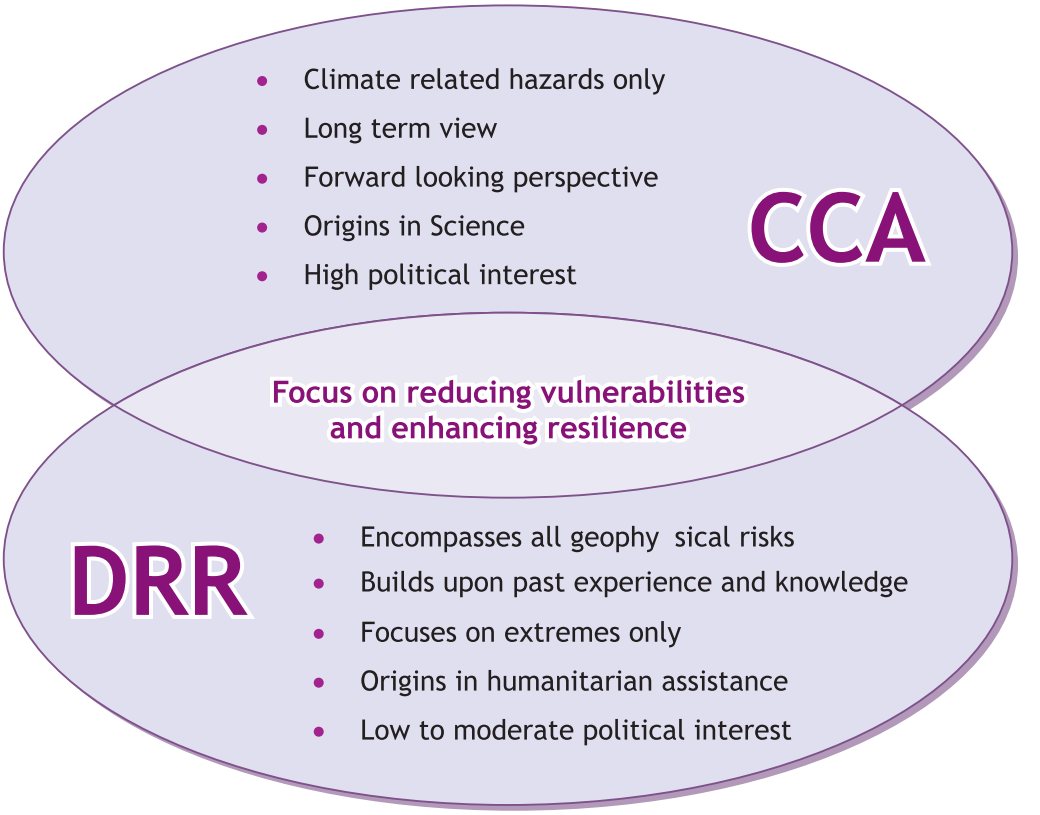


Figure E2. Mechanism for integrating CCA into developmental plans and schemes

Mainstreaming Disaster Risk Reduction concerns in development planning can guide the allocation of resources towards the protection of life and assets, restoration of productive systems and livelihoods, regaining market access, rebuilding social and human capital and physical and psychological health. The process of mainstreaming needs to have appropriate tools and methodologies along with political commitment, public understanding, scientific knowledge and expertise. National and state level development schemes play a crucial role for the socio-economic development of the

community. These schemes target huge population every year with large amount of funds for their implementation. Thus, there is tremendous potential for reducing vulnerability and risks through integration of DRR in national and state schemes through structured framework and operational measures.



Context

This is the fifth and last module of the training manual which focuses on integration of climate change adaptation and disaster risk reduction in agriculture sector. It discusses community perspectives of vulnerabilities and risks and capacity to adapt to climate change. The module also highlights various government schemes and programs for integration. The module is developed as an orientation or sensitization course for authorities or officials of agriculture sector at local level and those dealing with developmental, disaster management, environment and climate action related professional/officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc. towards integration of disaster management and resilience into the agriculture developmental processes.

There are three learning units delineated under this module:

- LU E1: Community action
- LU E2: Government programmes and schemes
- LU E3: Developmental plan and inter sectoral coordination/convergence

Delivery Chanel:



Duration:

About three hours including the inauguration session.



Training objectives

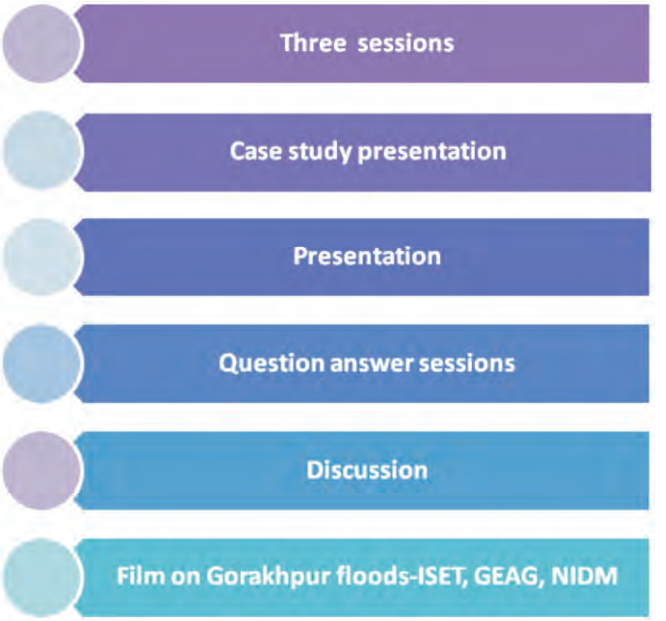


Guidance:



- This module will provide insight on how CCA can be integrated into both growth strategies and disaster risk reduction efforts.
- It includes several hands-on examples, the majority of which are also detailed in the session handout.
- Handouts containing brief of policies and plans can be given to participants

Methodology:



Trainers' Hint

The course coordinator shall conduct an ice breaking exercise to allow trainees to introduce themselves. This session may be included within the inaugural/ introductory session so that the luminary experts of inaugural session are also apprised with the background and profile of the participants. The trainees shall be asked to introduce themselves mentioning their name, designation, qualification and area of interest/work, organization, state/district, previous exposure on disaster and its management etc. Introduction round can also be done separately and relatively comprehensive. Even if a small and formal introduction round during the inaugural session, a more informal and detailed introduction of participants can be organized with the ice breaking session, for around 30 minutes that would help the participants to know each other. It will also initiate some level of group participation

process to continue during the entire training course. In case of 'no formal inaugural function', the programme director and coordinators/trainers shall explain to the participants about the programme objectives and contents, limitations, the process of participatory learning and some general ground rules of the course, if any.



Material required:

Course Brochure, Programme Schedule, Pen, Notepad, Bag, Laptop, Flip charts, Markers, Microhpones, Projector, etc.

LU-E1

E1 Community Action

Background

In order to effectively reduce vulnerability, holistic response to changing climate is must to build resilience communities to withstand the range of shocks and stresses that they are exposed to.

The framework to understand community vulnerability and capacity to respond to climate change and adaptation is four inter-related strategies is given below and is also shown in Table E1.1 (Based on Climate Vulnerability and Capacity Analysis Handbook of CARE (2009)):

- Promotion of climate-resilient livelihood policies, as well as income diversification and capacity building for planning and risk management;
- Disaster risk mitigation measures are designed to lessen the effect of disasters on vulnerable households and individuals;
- Capacity development for local civil society and governmental institutions so that they can provide better support to communities, households and individuals in their adaptation efforts; and
- Advocacy and social mobilisation to solve the root causes of vulnerability, such as inadequate governance, a lack of resource regulation, or insufficient access to basic services.

Table E1.1. Framework for Community Based Adaptation

	Climate Resilient Livelihoods	Disaster Risk Reduction	Capacity Development	Addressing underlying causes of vulnerability
National Level	• Government is monitoring, analyzing and disseminating current and future climate information related to livelihoods • Climate change is integrated into relevant sectoral policies • Climate change is integrated into	• Government is monitoring, analyzing and disseminating disaster risk information • Government is engaged in planning and implementing disaster risk management (including prevention, preparedness,	• Government has capacity to monitor, analyze and disseminate information on current and future climate risks • Government has mandate to integrate climate change into policies • National policies are rolled out at	• Government Recognizes specific vulnerability of women and other marginalized groups to climate change • Policy and implementation is focused on reducing these vulnerabilities • Civil society is involved in

	Climate Resilient Livelihoods	Disaster Risk Reduction	Capacity Development	Addressing underlying causes of vulnerability
National Level	poverty reduction strategy and/ or other development policies	response and recovery) • Functional early warning systems in plac • Government has capacity to respond to disasters	regional and local levels • Resources are allocated for implementation of adaptation related policies	planning and implementation of adaptation activities
Local Government/ NGO level	• Local institutions have access to climate information Local plans or policies support climate resilient livelihoods • Local government and NGO extension workers understand climate risks and are promoting adaptation strategies	• Local institutions have access to disaster risk information • Local disaster risk management plans being implemented • Functional early warning systems in place • Local government has capacity to respond to disasters	• Local institutions have capacity to monitor, analyze and disseminate information on current and future climate risks • Local institutions have capacity and resources to plan and implement adaptation activities	• Local planning processes are participatory • Women and other marginalized groups have a voice in local planning processes • Local policies provide access to and control over critical livelihoods resources
Household/ Individual level	• People are generating and using climate information for planning • Households are employing climate resilient agricultural practices • Households have diversified livelihoods, including nonagricultural strategies • People are managing risk by planning for and investing in the future	• Households have protected reserves of food and agricultural inputs • Households have secure shelter • Key assets are protected • People have access to early warnings for climate hazards • People have mobility to escape danger in the event of climate hazards	• Social and economic safety nets are available to households • Financial services are available to households • People have knowledge and skills to employ adaptation strategies • People have access to seasonal forecasts and other climate information	• Men and women are working together to address challenges • Households have control over critical Livelihoods resources • Women and other marginalized groups have equal access to information, skills and services Women and other marginalized groups have equal rights and access to critical livelihoods resources

Source: Compiled from Climate Vulnerability and Capacity Analysis Handbook (2009). CARE.

Impacts of unplanned urbanization coupled with extremes of climate change are not the same for all peri-urban residents. Due to their proclivity to live in peri-urban areas, high reliance on ecosystem services, and the economic impacts of land use change, the poor and marginalised parts of society, such as small farmers, the working class, and women, are disproportionately affected by peri-urban ecosystem loss The peri-urban areas, which are characterised by illegal settlements and slums, are often populated by low-income families. Furthermore, peri-urban areas are underserved by urban facilities, lack of public services, and have poorer sanitary and hygiene standards. In order to effectively reduce vulnerability of marginalized section of the society, holistic and inclusive response to changing climate, favorable institutional mechanisms, market connectivity, and developing package of practices for better agricultural activities etc. in peri-urban region is must to build resilience communities to withstand the range of shocks and stresses that they are exposed to.

Learning Objectives	Methodology
• To understand community vulnerabilities and risks and capacity to respond to climate change and disasters • To learn different approaches for community based adaptation • To understand the role of traditional knowledge/Indigenous knowledge in mitigating disasters.	• One session • Lecture/Power point presentations • Question-answer sessions • Case studies • Discussion
Guidance	**Recommended readings**
• This session is intended to give role of communities in disaster prevention and mitigation strategies in agriculture. The different components of agriculture like fisheries and allied activities should be discussed in brief. • This module should be taken up involving discussion mode so that trainees can come out with their own ideas and experiences in understanding different mitigation strategies in agriculture. • Lecture and Presentation should use pictorials and easy examples as possible to set the context for next Learning Units in this module.	• UNISDR. (2008). Gender Perspectives: Integrating Disaster Risk Reduction into Climate Change Adaptation. Accessed on http://www.un.org/waterforlifedecade/pdf/2008_isdr_gender_perspectives_disaster_risk_reduction_cc_eng.pdf

LU-E2

E2 Government Programs and Schemes

Background

Mainstreaming Disaster Risk Reduction concerns in development planning can guide the allocation of resources towards the protection of life and assets, restoration of productive systems and livelihoods, regaining market access, rebuilding social and human capital and physical and psychological health. Development plans therefore take on a critical role in disaster risk management. The process of mainstreaming DRR into development planning needs to have appropriate tools and methodologies along with political commitment, public understanding, scientific knowledge and expertise. National and state level development schemes play a crucial role for the socio-economic development of the community. These schemes target huge population every year with large amount of funds for their implementation. Thus, there is tremendous potential for reducing vulnerability & risks through integration of DRR in national and state schemes through structured framework and operational measures. Some key measures at policy level and delivery mechanism that can be incorporated in these national and state schemes are tabulated below in Table E2.1.

Table E2.1. Ministry of Agriculture and Famer's Welfare initiatives relevant for DRR across the three global frameworks

Sendai Framework target	Sustainable Development Goals	COP 21-Paris agreement on Climate Change	Ministries initiatives relevant to DRR
Substantially reduce global disaster mortality by 2030 (2020-2030 compared to 2005-2015)	SDG 1, 2, 11, 13	• Changes in the pattern of extreme events require enhanced disaster resilience and adaptation • Addressing GACC risks is crucial for eliminating poverty and reducing economic losses from disasters	Agri Clinics and Agri Business Centres (ACABC) Scheme Sub Mission on Agriculture Mechanization (Two component - One Central Sector and other Centrally Sponsored) Pradhan Mantri Krishi Sinchai Yojana Mission for Integrated Development of Horticulture
Substantially reduce the number of disaster affected people by 2030 (2020-2030 compared to 2005-2015)	SDG 1, 11, 13	Stresses the need for accelerated action to build resilience through risk-sensitive planning and implementation of DRR	

Sendai Framework target	Sustainable Development Goals	COP 21-Paris agreement on Climate Change	Ministries initiatives relevant to DRR
Substantially reduce direct disaster economic loss	SDG 1, 11	The Paris Agreement aims to hold global average temperature increase to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C,recognizing that this would significantly reduce the risks and impacts of climate change	Support to States for Extension Reforms ATMA Scheme (two components - one for Farmers and other for Functionaries) Sub-Mission on Seeds and Planting Material Crop Insurance Schemes National Mission on Oilseeds & Oil Palm (NMOOP) Integrated Scheme on Agriculture Cooperation National Food Security Mission (NFSM) Krishi Unnati Yojana (KUY)- MOVCDNER NMSA-Rainfed Area Development Interest Subsidy for Short term Credit to farmers e-NAM
Significantly reduce vital infrastructure harm and disruption of basic services (health, education, etc.)	SDG 1, 4, 9, 11,	Global adaptation goals for enhancing adaptive capacity, strengthening resilience and reducing vulnerability to ensure adequate adaptation response in the context of the global temperature goal	
Substantially increase disaster risk reduction strategies	SDG 1, 3, 6, 11, 13,	Addressing GACC risks that are crucial for reducing economic losses from disasters along with a well-integrated approach to adaptation, sustainable development, environmental management and disaster risk reduction	
Substantially increase international cooperation to complement national actions	Close international cooperation to achieve SDGs	Firm commitments by countries to the global response to GACC based on INDCs and international cooperation for achieving the COP21 goals	
Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments	SDG 3, 13	Emphasis on improving early warning systems, risk assessment and management	

Learning Objectives	Methodology
• To identify existing policies and schemes with government addressing climate and disasters risk reduction. • To understand social vulnerability and its inclusion into developmental plans and policies • To understand national perspective for mainstreaming-DM Act, DM policy, NDMP, India's commitment towards international agreements.	• One session • Lecture/Power point presentations • Question-answer sessions • Discussion
Guidance	**Recommended readings**
• This session is intended to give background on how CCA can be mainstreamed into both development policies and DRR actions. • It provides many hands on examples, most which are also presented in detail in the session handout. • Handouts containing brief of policies and plans	Gupta, A. K., Nair, S. S., Wajih, S. A., Chopde, S., Gupta, G. and Aggrawal, G. (2014 a). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114. Gupta, A. K., Nair, S. S., Singh, S., Chaturvedi, A., Arora, R., Saluja, S., Mundra, N., and Mewes, H. (2014 b). Strengthening Climate Resilience through Disaster Risk Reduction: Approach in Andhra Pradesh and Tamil Nadu in India - Experience and Lessons. Special Technical Paper, GIZ - IGEP and NIDM, New Delhi, P 36.

LU-E3

E3 Developmental Plan and Inter- Sectoral Coordination/Convergence

Background

For all-round development and economic viability of agriculture, farmers are given support, encouragement as well as incentives. Also, there are other several schemes and policies for which government compensates to farmers who are affected by natural disasters.

For floods and droughts, both the central and state government undertake various relief and rehabilitation measures to minimize the damage covering farmers, animals, agriculture labour etc. to provide shelters, food, fodder and drinking water supplies, animal health camps, cleaning of debris, There is also compensation from the Prime Minister's National Relief Fund to family members of those killed in natural disasters whenever they occur.

For plant protection, the Integrated Pest Management Scheme (IPM) is one of the most significant schemes run by the government. This scheme is fully run by the government and there is also another scheme to monitor and control the pest population. The National Institute of Plant Health Management (NIPHM) in Hyderabad imparts training in plant protection.

For crop against any natural disaster like floods, droughts, pests and diseases attacks, etc., Pradhan Mantri Fasal Bhima Yojana (PMFBY) provides financial support.

Associated Policies/Schemes

Some of the other agriculture associated policies are given below:

i) Crop Related

- Atma Nirbhar Bharat
- Pradhan Mantri Kishan Samman Nidhi
- National Mission on Sustainable Agriculture with 8 Missions
- National Food Security Mission
- Pradhan Mantri Matsya Sampada Yojana
- National Livestock Mission
- Animal Husbandry Infrastructure Development Fund
- Rashtriya Gokul Mission
- National Animal Disease Control Programme
- Livestock Health and Disease Control Programme

- Kisan Credit Cards (KCC) to Livestock Farmers
- Krishi Unnati Yojna
- Dairy Processing & Infrastructure Development Fund
- Rashtriya Krishi Vikas Yojana
- Pradhan Mantri Krishi Sinchai Yojana
- Ground Water Irrigation Scheme
- Pradhan Mantri Kisan Sampada Yojana
- Pradhan Mantri Annadata Aay Sanrakshan Abhiyan
- Scheme for Conservation, Development and Sustainable Management of Medicinal Plants.
- Jute Development Schemes
- Agriculture Marketing Infrastructure
- Scheme of Seeds
- National Agroforestry Policy
- National Certification System for Tissue Culture Raised Plants
- Biotech-KISAN Scheme
- Agricultural Mechanization for in-situ Management of Crop Residues
- Protection of Plant Varieties and Rights of Farmers
- Model Agriculture Land Leasing Act 2016

ii) Rural Employment Related

- Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA)
- Prime Minister's Employment Generation Programme (PMEGP)
- Agri Clinics and Agri Business Centres Scheme
- Rajiv Gandhi Udyami Mitra Yojana (RUGMY)
- Scheme of Fund for Regeneration of Traditional Industries (SFURTI)
- Rural Industry Service Centre (RISC)
- Coir Udyami Yojna

Source:

To develop the resilience of food crops Government of India launched National Mission on Sustainable Agriculture (NMSA) under the National Action Plan on Climate Change (NAPCC) in the year 2008. The aim of the Mission is to evolve and implement strategies to make Indian agriculture resilient to climate change. The program interventions in NMSA are Rainfed Area Development (RAD), Soil Health Cards, Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development for North Eastern Region (MOVCDNER), National Rainfed Area Authority (NRAA), Soil

Land Use Survey of India (SLUSI), National Bamboo Mission (NBM) and Sub-Mission on Agroforestry (SMAF). All this schemes helps to promote natural resource based integrated and climate resilient sustainable farming systems that ensure maintenance and increase of soil fertility, natural resource conservation, on-farm nutrient recycling and minimize dependence of farmers on external inputs.

Table E3.1. Strategic actions of sectoral coordination and convergence

Priority	Tasks
1. Strengthen governance system (institutional and technical capacities) for disaster risk reduction and climate change adaptation in agriculture and enhance coordination mechanisms	1.1. Strengthen institutional capacity and mechanisms for effective coordination 1.2. Mainstream disaster risk reduction into agriculture policies, strategies and plans
2. Promote and enhance early warning systems for pro-active disaster risk reduction and climate change adaptation	2.1 Establish and improve agriculture specific early warning systems 2.2. Improve in coordination with other relevant stakeholders, existing risks and vulnerability assessment methodologies from agriculture perspectives
3. Enhance knowledge management and innovation in support of disaster risk reduction and climate change adaptation in agriculture	3.1. Enhance DRR related database to better inform planning and decision making 3.2. Enhance knowledge base and promote innovation for DRR and CCA 3.3. Awareness raising and communication for DRR and CCA
4. Reduce vulnerabilities to disasters by improving technical options and implementing Community-Based Disaster Risk Reduction and Climate Change Adaptation measures in agriculture	4.1 Risk and vulnerability assessment at subdistrict level 4.2. Promote integrated farming systems and crop diversification to build resilience of agriculture community to disaster impacts 4.3. Reduce land degradation and erosion through sustainable land management and related intervention 4.4. Promote sustainable water management and conservation practices 4.5. Promote risk sharing and risk transfer mechanism 4.6. Reduce adverse impacts of chemical fertilizers and pesticides in agriculture 4.7. Establishing Village level institutions for enhancing adaptive capacity of farmers

Priority	Tasks
5. Strengthen effective preparedness and response capacities and the integration of disaster risk reduction and climate change adaptation into agriculture interventions	5.1. Enhance the capacity of departments to conduct regular contingency and their consideration in ongoing planning and activities 5.2. Enhance preparedness measures to improve effectiveness of emergency response actions

Learning Objectives	Methodology
• To learn integration into existing development plans through Inter sectoral coordination/convergence • To strengthen institutional and technical capacities for disaster risk reduction and climate change adaptation in agriculture and enhance coordination mechanisms.	• One session • Power point presentations • Discussion • Question answer session
Guidance	**Recommended readings**
• This session is intended to give background on how CCA can be mainstreamed into both development policies and DRR actions. • It provides many hands on examples, most which are also presented in detail in the session handout. • Handouts containing brief of policies and plans	Gupta, A. K., Nair, S. S., Wajih, S. A., Chopde, S., Gupta, G. and Aggrawal, G. (2014 a). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114. Gupta, A. K., Nair, S. S., Singh, S., Chaturvedi, A., Arora, R., Saluja, S., Mundra, N., and Mewes, H. (2014 b). Strengthening Climate Resilience through Disaster Risk Reduction: Approach in Andhra Pradesh and Tamil Nadu in India - Experience and Lessons. Special Technical Paper, GIZ - IGEP and NIDM, New Delhi, P 36.

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National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)

Plot No.15, Pocket 3, Block-B, Sector-29, Rohini, Delhi-110042
Email: ed.nidm@nic.in | Website: www.nidm.gov.in

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