Climate-Smart Agriculture (CSA)

TRAINING MANUAL

Users' Manual for Development Practitioners and Extension Workers

Provincial Government
Ministry of Land Management, Agriculture and Co-operative
Gandaki Province, Pokhara, Nepal

LI-BIRD

CDKN
Climate & Development Knowledge Network

ICLEI
Local Governments for Sustainability

CGIAR

RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

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Climate-Smart Agriculture (CSA): Training Manual

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Authors

FOREWORD

Nepal is one of the most vulnerable countries to the negative effects of climate change. It has been actively implementing various programmes related to climate change management since it signed a treaty for the United Nations Framework Convention on Climate Change (UNFCCC). Nepal has prepared a National Adaptation Programme of Action (NAPA) in 2010 and implemented several climate change adaptation projects. Similarly, in 2011, Nepal has developed the National Framework on Local Adaptation Plan of Action (LAPA) in order to integrate the climate change related issues in the local development plan. The Government of Nepal (GoN) has endorsed the climate change policy, 2011. The National Agriculture Policy, 2004, Agriculture Development Strategy (ADS) and 15th Five-year Plan have also tried to address climate change related issues at policy level.

Agriculture sector has been highly affected by climate change induced risks and challenges. Thus, it is utmost important to reduce the impact of climate change by building the agriculture system more resilient through promotion of various climate smart technologies and practices. In this regard, there's an urgent need to develop and disseminate relevant technologies, strengthen the capacities of farmers through providing technical assistance for the adoption of the technologies and implement various programmes to improve the livelihoods of farming communities.

The Gandaki province has varied agro-ecological region hence has huge potential for diverse agriculture and livestock commodities however it is equally vulnerable to climatic induced risks. Considering this, Ministry of Land Management, Agriculture and Cooperative (MoLMAC), Gandaki Province, has been implementing Chief Minister Climate Friendly Model Agriculture Village Programme (CMCFMAVP) since 2018 in order to increase agricultural production and ensure food security in the face of climate change. The CMEFMAVP has established 87 model villages in 85 municipalities. In these villages, various programmes have been implemented in order to promote climate-smart agriculture (CSA) technologies and practices for minimizing the negative impacts of climate change and increasing the adaptive capacity of the farming communities. In this regard, the MoLMAC, Gandaki province and Local Initiatives for Biodiversity, Research and Development (LI-BIRD) has signed a MoU in order to implement climate change related programmes, disseminate various technologies and provide capacity building trainings. In order to make these training programme more effective, MoLMAC and LI-BIRD have jointly published a 'Climate-Smart Agriculture Training Manual'. The training manual is expected to help field level technician to effectively organize a five-days training programme on climate change. The contents covered will help them understand the concept of climate change, its impacts, different climate-smart agriculture technologies and practices and deliver the same. The knowledge generated through this training manual is expected to be useful and applied at farmers' level.

Your suggestions to further improve the publication in the future would be highly appreciated and welcomed.

Lastly, I would like thank the team of MoLMAC, Gandaki Province and LI-BIRD, and those who contributed directly and indirectly to generate this CSA manual.

Sabnam Shivakoti
Secretary
Ministry Of Land Management, Agriculture and Co-operative, Gandaki Province

FOREWORD

Climate change is inevitable, and its impact is most visible in agriculture sector affecting crop production and productivity, leading to increased food and nutrition insecurity. Smallholder farmers are the most vulnerable and affected due to their low adaptive capacity. This 'Climate-Smart Agriculture (CSA) Training Manual' is designed as a reference material and as part of building the capacity of a range of stakeholders involved in agriculture sector for cross-fertilizing CSA knowledge, technologies and practices through the design and delivery of appropriate training courses at multiple levels.

The manual is prepared jointly by Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Ministry of Land Management, Agriculture and Cooperative (MoLMAC), Gandaki Province, and Agribusiness Promotion Support and Training Centre, Pokhara, as one of the outputs under the project 'Supporting Gandaki Provincial Government through Climate Compatible Agriculture Development' with financial and Technical Assistance support from the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), South Asia, and Climate and Development Knowledge Network (CDKN) through Local Governments for Sustainability, South Asia (ICLEI SA). I hope the potential user of this manual, especially the agriculture development practitioners, extension workers, academia and researchers, will find this manual a useful reference source to further their work.

On behalf of LI-BIRD, let me take this opportunity to extend my sincere gratitude to the Ministry of Land Management, Agriculture and Co-operative, Gandaki Province and Agribusiness Promotion Support and Training Centre, Pokhara for their excellent cooperation and collaboration throughout the preparation of this manual. I would also like to thank the reviewers, and most importantly the authors of this manual, who worked hard to produce this useful CSA training manual as a reference document.

I hope this manual will be utilized fully by a variety of users and we expect receiving feedback from the users to further improve the manual.

Balaram Thapa, PhD

Executive Director, LI-BIRD

ABBREVIATIONS

ABPSTC	Agribusiness Promotion Support and Training Center
ADS	Agriculture Development Strategy
AKC	Agriculture Knowledge Centre
CCA	Climate Change Adaptation
CCAFS	Climate Change, Agriculture and Food Security
CCM	Climate Change Mitigation
CDKN	Climate and Development Knowledge Network
CGIAR	Consultative Group on International Agricultural Research
CSA	Climate-Smart Agriculture
FAO	Food and Agriculture Organization
FM	Frequency Modulation
FYM	Farm Yard Manure
GDP	Gross Domestic Product
GESI	Gender Equality and Social Inclusion
GHGs	Greenhouse Gases
GoN	Government of Nepal
ICLEI	Local Governments for Sustainability
I CT	Information and Communications Technologies
IPCC	Intergovernmental Panel for Climate Change
LARP	Local Agriculture Resource Person
LCC	Leaf Color Chart
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MoALD	Ministry of Agriculture and Livestock Development
MoLMAC	Ministry of Land Management, Agriculture and Cooperative
MoPE	Ministry of Population and Environment
MoSTE	Ministry of Science, Technology and Environment
NAPA	National Adaptation Programme of Action
NARC	Nepal Agricultural Research Council
NDC	Nationally Determined Contribution
PPCR	Pilot Programme for Climate Resilience
SAK	Sustainable Agriculture Kit
SRI	System of Rice Intensification
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UPVC	Unplasticized Polyvinyl Chloride

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INTRODUCTION

Agriculture is among the sectors that is highly affected by climate change. In developing countries, out of total economic loss, the agricultural sector alone contributes around 22 percent of the economic impact caused by medium to large-scale natural hazards and disasters (FAO, 2018). Nepal, an agricultural country with huge climatic variability ranks 13th in terms of climate vulnerability despite being an insignificant contributors to greenhouse gas (GHGs) emission (The climate change risk atlas, 2012). Nepal contributes about 0.027% of global GHGs emission (MoPE, 2016) but has to bear the substantive cost. The estimated costs of climate change hazards equate to 1.5-2% of the annual Gross Domestic Product (GDP) (NDC, 2016) manifested in reduced agricultural productivity, biodiversity loss, and degradation of ecosystem services - important foundations for sustainable development where over two-thirds of the agricultural system is rainfed and operated by smallholder farmers. Hence, strengthening adaptive capacity is inevitable to minimize the negative impacts of climate change.

To deal with the ever-growing pressures on the agricultural systems and natural resources, Climate-Smart Agriculture (CSA) has been widely promoted as a strategy for enhancing sustainable farming and the resilience of livelihoods and ecosystems with no or low emission of GHGs. This training manual provides a broader understanding of various aspects of CSA including the concept of CSA, champion CSA technologies and practices appropriate for different agro-ecological zones of Nepal and GESI integration in CSA. CSA can be defined as "agricultural practices that sustainably increases productivity, enhances the resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals".

Since women are highly dependent on agriculture and are affected by various climatic stresses in Nepal, their engagement plays a crucial role in the upliftment of the agriculture sector and building resilience to climate change. This manual also provides insights on gender relationships particularly with regards to agriculture and climate change and also gives a brief description of the women-friendly tools and importance of gender integration in planning CSA policies, programmes and plans.

PURPOSE OF THE MANUAL

Broadly, this training manual aims to benefit the government extension workers across municipal, provincial and federal level who are responsible for designing and implementing climate change and livelihood related programmes and projects. This manual is also equally useful to agricultural experts, researchers, academicians and students. This manual is expected to enrich knowledge and skills on CSA and its various components which eventually helps in building climate-resilient farming systems and communities.

Specifically, this training manual helps the participants to:

- Understand the concept of climate-smart agriculture and its components;
- Become familiar with various CSA technologies, practices and solutions appropriate for diverse geographic locations of Nepal; and
- Learn about how GESI consideration is important in designing, implementing and monitoring CSA interventions in the Nepalese context.

TRAINING MODULES AND SESSIONS

The training courses are divided into five modules. It will be a five-days training including a field excursion.

MODULE 1: Basics of Climate Change and Its Impacts

This module covers basics concepts of climate change, its impacts on natural resources and agriculture, adaptation measures and mitigation strategies.

MODULE 2: Understanding Climate-Smart Agriculture (CSA) and its processes

This module covers the concepts and role of CSA in establishing a resilient farming system. This also includes the assessment of social and climate vulnerability and resilience planning including the identification of CSA technologies and practices.

MODULE 3. CSA Technologies, Practices and Solutions Relevant for Nepal

This module of the training covers various CSA technologies and practices identified for different agro-ecosystems across the mountain, hill and Terai eco-regions. The practices and technologies promoted on CSA will also be briefed.

MODULE 4. Integrating Gender Equality and Social Inclusion Issues in Planning, Implementation and Monitoring of CSA

This module of the training covers the gender equality and social inclusion perspective that needs to be considered in planning, implementation and monitoring of CSA. This module also covers existing policies, acts and strategies related to GESI.

MODULE 5: Learning from the Field and Action Plan Preparation and Closing

In this last module, the participants will travel to CSA demonstration sites where they observe field activities and interact with farmers to leverage their learning and experiences. After the completion of the field visit, the participants will prepare an action plan and present their outcomes and outputs from the field visit.

TRAINING OUTLINE

Various sections has been scheduled under different modules for each day.

Time	Day 1	Day 2	Day 3	Day 4	Day 5
	Module 1	Module 2	Module 3	Module 4	Module 5
8:30 - 10:00	**Session I.** Introduction of Participants and Defining Training Objective	**Session I.** Introduction to climate-smart agriculture (CSA)	**Session I.** Climate-Smart Agriculture (CSA) Technologies and Practices for Different Agro-Ecological Zones (Mountains, Hills and Terai region) of Nepal	**Session I.** Importance of gender and social inclusion and its interconnection in Nepalese agriculture system	**Session I.** Field visit to CSA demonstration sites
10:00-11:30	**Session II.** Introduction to climate change and key terminologies	**Session II.** CSA characterization as per smartness criteria	**Session II.** Crop Based CSA Technologies and Practices Appropriate for Mountains, Hills and Terai Region of Nepal	**Session II.** Assessing CSA tools, technologies and practices	Continue from the previous session
11:30-1:00	**Session III.** Climate risks and their impacts on agriculture and food security	**Session III.** Role of CSA for resilience agriculture	Continue from the previous session	**Session III.** Gender responsive planning, implementation and monitoring of CSA	Continue from the previous session
2:00-3:30	**Session IV.** Adaptation and Mitigation strategies	**Session IV.** Assessing CSA technologies and practices	**Session III.** Poultry and Livestock-based CSA technologies and practices suitable for Mountain, Hill and Terai region of Nepal	**Session IV.** Gender responsive budgeting and coding	**Session II.** Participant's reflection and facilitator's remark and feedback collection
3:30-5:00	Continue from previous session	**Session V.** Climate Risk Assessment and Risk-Based Planning	Continue from the previous session	**Session V.** Women responsive policies, strategies and mechanisms and its importance	**Session III:** Certificate distribution and closing

MODULE 1

Photo: unsplash.com/@markusspiske

BASICS OF CLIMATE CHANGE AND ITS IMPACTS

	Time needed:	1 Day
	Materials needed:	Projector, Marker pen, White board, Brown paper

OVERVIEW

This module discusses commonly used terminologies and phrases in climate and weather sciences. It aims to enrich participants' understanding on climate change, its major causes, consequences and overall impacts. It also highlights how the change in climatic patterns affect agriculture and agroecosystem vis-à-vis on food, nutrition and income security.

This module also orients participants on adaptation and mitigation options linking with climate-induced hazards and disasters. Further, this module highlights different climate change adaptation and mitigation strategies in the Nepalese and global context.

OBJECTIVES

After the completion of this module, the participants will be able to:

- Become familiar with commonly used terminologies in climate science and explain the difference between weather and climate;
- Describe the science of climate change with reference to the greenhouse effect and global warming;
- Identify the main factors causing climate change.

Session I. Introduction of Participants and Defining Training Objective

Introduction of participants

The introduction of participants will be done in pairs. Each member of the pair needs to discuss first their names, address, and personal interest. Then one member of the pair needs to introduce the other member of the pair with all the information.

Training Objective

The facilitator delivers the overall objectives of the training.

Expectation collection

Each participant is provided with meta cards and a marker and asked to write what s/he expects at the end of this training. Limit one expectation per meta card and make sure the letters are clear and big enough for other participants to read from distance. The facilitator collects the meta cards and affixes on the board by grouping them by thematic areas so that every participant can read the expectations of all other participants.

Pre-Training Assessment

To see the effectiveness of the training program, an assessment will be carried out before and after the training using some standard questionnaire.

Session II. Introduction to Climate Change and Key Terminologies

What is climate change and how it occurs?

In a simple term, climate change is a change in climatic parameters including temperature, rainfall, relative humidity and wind patterns over time. As a result of increased concentration of greenhouse gases (GHGs) like carbon dioxide, methane and nitrous oxide in the atmosphere, climate change is happening naturally. It is also induced by human actions or anthropogenic factors. Anthropogenic activities are the main causes of the emission in the atmosphere that results in warming of Earth's surface leading to climate change. Burning of fossil fuels, forest degradation and forest fires, land use change, increasing use of agro-chemicals, transportation, electricity, and release of urban waste are the main causes of carbon emission. In Nepal, agriculture is the main source of greenhouse gas emission that accounts for 50.1% of the total national GHGs emission followed by energy, land use change and forestry, industrial processes and waste sectors (USAID, 2019).

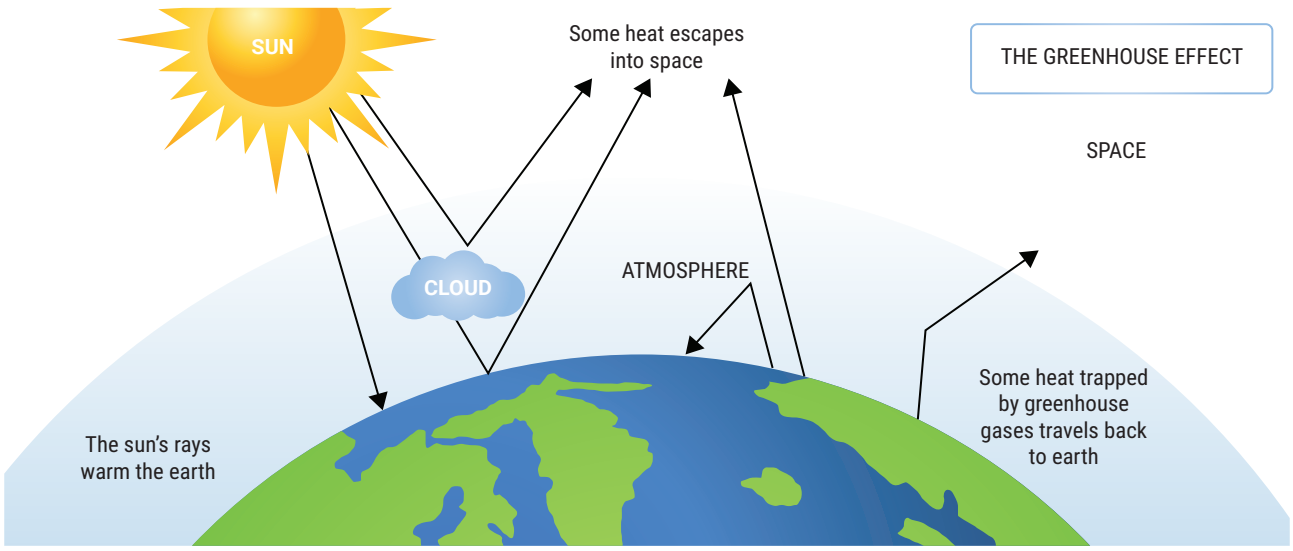


Figure 1. Climate change process

According to Intergovernmental Panel on Climate Change (IPCC), climate change can be referred to as "a change in the state of climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer". It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

The United Nations Framework Convention on Climate Change (UNFCCC) refers climate change as "a change of climate that is attributed directly or indirectly to human activity that alters the composition of global atmosphere and that in addition to natural climate variability observed over comparable time periods".

Some of the main causes of climate change discussed earlier are elaborated below:

- **Burning of fossils fuels:** The burning of fossil fuels such as coal, gas and oil produces carbon dioxide and nitrous oxide which are the major GHGs in the atmosphere.
- **Agricultural practices:** The haphazard use of chemical fertilizers during crop production releases different types of greenhouse gases. Rice cultivation is the main source of methane production through anaerobic fermentation in soil when the field is continuously flooded.
- **Intensive farming/Livestock:** The animals like cattle and sheep produce a large amount of methane during their process of digestion of food (enteric fermentation). Manure management is another key source of GHGs like methane and nitrous oxide.
- **Deforestation:** Trees absorb carbon dioxide from the atmosphere mainly for photosynthesis. When trees are cut down, the carbon stored in the trees is also released into the atmosphere. Carbon dioxide, carbon monoxide, nitrogen oxides and sulfur oxides are released when the trees are cut down.

Key Terminologies

Weather: Weather can be defined as the state of an atmospheric condition at a particular place and time. Weather changes frequently in a very short period. For example, we can say it rained for an hour in Pokhara and then became a sunny day.

Climate: Climate can be defined as the state prevailing over a long period (IPCC, 2007a). Climate is the average weather condition of a particular location for over 30 years.

Global Warming: Literally, global warming refers to the rise in temperature of Earth's atmosphere due to the increase in GHGs emissions.

Greenhouse gases (GHGs): GHGs are those gases that absorb and emit radiant energy within the thermal infrared range. The primary GHGs in the Earths' atmosphere are water vapor, ozone (O_3), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_20).

Greenhouse effect: The greenhouse effect is the process by which radiation from the sun is trapped in the atmosphere thus warming the planet's surface. GHGs cause greenhouse effects that results in global warming.

Vulnerability assessment: Vulnerability can be defined as "the degree to which a system is susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes (IPCC, 2007). This is effective to collect baseline information from an area where a hazard occurs. This comprises of different steps and tools that can be used to assess the vulnerability of a particular site/area. However, vulnerability for farming communities towards any climatic hazard can be assessed in terms of their sensitivity and adaptive capacity.

Exposure: It is a measure of the magnitude and extent of exposure of communities or systems to climate change.

Sensitivity: It is a measure of how a system or community is likely to respond when exposed to climate-induced stress or disasters.

Adaptive capacity: It is a measure of the potential, ability, or opportunities of a community or system to cope with the situation when they are exposed to climate-induced stress or disasters.

Risk: It is the function of hazard, exposure and vulnerability.

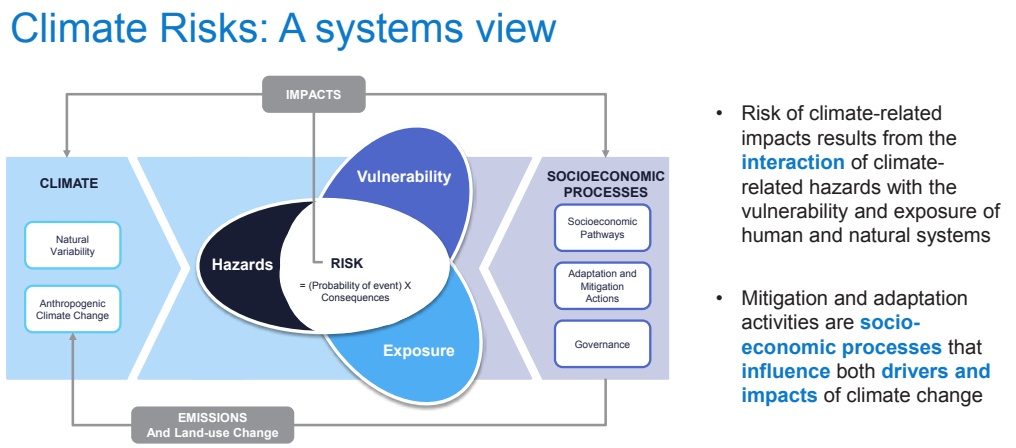


Figure 2. Schematic of the interaction among the physical climate system, exposure and vulnerability producing risk (Illustrative Example). Source: IPCC (2014)

Vulnerability: It is the function of sensitivity and adaptive capacity.

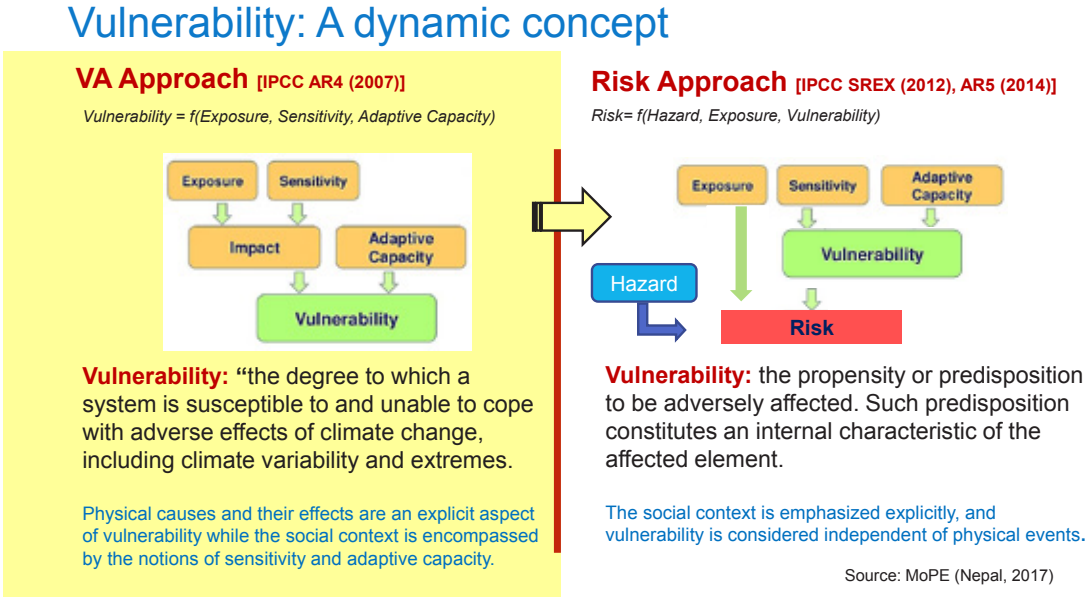


Figure 3. Conceptual framework of vulnerability and risk adopted by AR4 and AR5.

Agroecosystem: It refers to the organisms and environment of an agricultural area within an ecosystem. Agro-ecosystem is a conceptual model of an agricultural system (crop, farm, or whole economy), relating its functions to its inputs and outputs.

Resilience: Resilience is the ability of a system to recover, absorb, withstand and bounce back to the original state after an adverse event from the effect of climate change. The farming communities need to have better planning strategies for effective adaptation and thrive in the face of a changing climate. The IPCC defines resilience as the "capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation." Farming communities need to have better planning strategies for effective adaptation and thrive in the face of a changing climate. The planting of trees increases the resilience of farming communities to flooding from excess or haphazard water flow.

Climate Change Adaptation (CCA): Climate Change Adaptation is defined as a series of activities that respond to climate change-induced disasters due to global warming. According to the IPCC, "climate change adaptation is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment, including infrastructure, agriculture and education, to expected climate and its effects."

Climate Change Mitigation (CCM): Climate Change Mitigation is defined as a series of actions that limit the magnitude of emission of greenhouse gases (GHGs) and increases carbon sinks through reforestation. According to the IPCC (2014), "Mitigation is a public good; climate change is a case of the 'tragedy of the commons'. Effective climate change mitigation will not be achieved if each agent (individual, institution, or country) acts independently in its selfish interest, suggesting the need for collective action. Some adaptation actions, on the other hand, have characteristics of a private good as benefits of actions may accrue more directly to the individuals, regions, or countries that undertake them, at least in the short term. Nevertheless, financing such adaptive activities remains an issue, particularly for poor individuals and countries."

Food security: Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (WFS, 1996).

Dimensions of food security

Food availability: It refers to the proper and adequate supply of quality food in a given area.

Food access: It refers to the social and economic aspects of how people get food. The income of an individual and the prices of food affect the accessibility of a food system.

Food utilization: It refers to the ability of an individual to utilize available food effectively.

Figure 4. Effects of greenhouse gas emission in different sectors
(Source: Climate Concepts, EPA, http://www.epa.gov/climatestudents/basics/concepts.html)

Session III. Climate Risks and Their Impacts on Agriculture and Food Security

Nepal's agriculture is primarily rain-fed managed by smallholders (<1 ha farm size) across the ecologically diverse landscapes which are the ones affected most from the impact of climate change. As a result of climatic events such as the increased intensity of landslides, droughts and floods have been damaging livelihood assets. They have been a regular phenomenon of declining agricultural production and productivity. The erratic weather patterns such as heat stress, longer dry days, and uncertain rainfall have been seriously affecting the agriculture system of Nepal. About 64% of the cultivated land area is fully dependent on monsoon rainfall. It has been observed that the

highest loss of the cultivable land was from the dry spell (38.85%) followed by flood (23.25%), hailstorm (13.86%), rains (6.47%), strong winds (2.47%) and cold waves (2.57%) in Nepal. Frequent droughts are common in the mid hill and high hills regions and floods especially in the Terai region of the country. The farmers who rely on agriculture for their livelihoods are facing climatic risk viz., drought, floods, landslides, and so on and this ultimately results in less production and productivity of the crops and food insecurity in some regions.

The impacts of climate change on the agricultural systems of Nepal are significant. Some of the direct impacts are briefly listed and described below:

- Increasing surface runoff resulting in the decline of soil fertility;
- Loss and degradation of the agricultural field due to landslides, inundation and sand deposition;
- Frequent outbreak of crop pests and diseases;
- Loss of biodiversity especially of local origins;
- Excessive growth of weed and invasive species affecting the persistence of native biodiversity;
- Long term and frequent droughts and short rainy season's results in water scarcity during critical growth period of crops decreasing the crop production;
- Early heatwaves prevailing for an extended period affect crop growth and development thus reducing yield of crops;
- Decline of flora and fauna species;
- Unpredictable weather patterns including rainfall;
- Decreased availability of usable water resulting in water insecurity;
- Shifting of production zones as a result of an upward shifting of the snow line.

Thus, it's important to minimize the negative impacts of climate change through the promotion of climate change adaptation-related interventions.

Session IV. Adaptation and Mitigation Strategies

Adaptation mainly involves reducing the risk and vulnerability to cope with the negative impacts of climate change, and the types of adaptation strategies vary from place to place, depending on the vulnerability of the areas to the climate change-induced disaster. Research studies show that adaptation is of great importance particularly in developing countries where communities are vulnerable to climatic risks. The climate change adaptation and mitigation strategies to cope with the negative impact resulted by climate change particularly in the agriculture sector are depicted in Table 1.

Table 1. Climate change adaptation and mitigation strategies (Examples)

Adaptation strategies	Mitigation strategies
• Increasing crop diversity in the farming systems • Changes in cropping patterns, an adjustment in crop cycle and planting time • Water harvesting and efficient water management • Development and rehabilitation of Irrigation infrastructures • Promotion of climate-resilient technologies such as drought, flood and disease/pest tolerant crop varieties particularly in stress -prone areas; • Promotion of local, indigenous knowledge and practices • Economic empowerment of the communities; • Improving awareness of communities through education and information dissemination and • Improving the institutional capacity and efficiency of the communities/organizations.	• Reduction in chemical fertilizer and pesticide use and promotion of organic and ecological agriculture; • Reducing deforestation and promote reforestation; • Increasing use of renewable energy including solar energy, electrification and reduction in the use of fossil fuel-based vehicle and promotion of electrical energy

Exercise: Listing various climatic hazards in agriculture and its adaptation measures

Steps

- Participants will be divided into groups and requested to complete the exercise within the allocated time of 10 minutes;
- The group will be asked to discuss in their table and identify different kinds of climatic hazards that occur frequently in the agriculture sector;
- Participants will list out the effects caused by climatic hazards and the measures taken to address them;
- In the end, participants will share their group discussion points and the facilitator provides views and suggestions.

Further Reading

Adhikari. L.D., Paudel, B., Awale, P., Rasaili, S., Shrestha, D.K., Bhusal, A. 2016. Climate-Smart Villages in Nepal-Baseline Report. Local Initiatives for Biodiversity, Research, and Development (LI-BIRD) and The Consultative Group for International Agricultural Research's (CGIAR) Research Program on Climate Change, Agriculture, and Food Security (CCAFS), Kaski, Nepal

FAO. 2018. Climate-Smart Agriculture Case Studies.2018. Successful approaches from different regions. Rome. 44 pp. Licence: CC BY-NC-SA 3.0 IGO.

IPCC. 2006. IPCC Guidelines for National Greenhouse Gas Inventories. Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_01_Ch1_Introduction.pdf

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Glossary, pp. 869–883. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linder and C.E. Hanson eds. Cambridge, UK, Cambridge University Press.

MoALD. 2019. Integrating Climate Change Adaptation into Agriculture Sector Planning in Nepal: A Training Manual for Agricultural Officers and Planners. Ministry of Agriculture and Livestock Development, UNDP and FAO

MoALD. 2019. Integrating Climate Change Adaptation into Agriculture Sector Planning of Nepal: A Handbook. Ministry of Agriculture and Livestock Development, UNDP and FAO

MoPE. 2016. Briefing note on UNFCCC COP 22 and Nepal's Key Concerns, Issues and Events. Kathmandu: Ministry of Population and Environment (MoPE).

MoSTE. 2015. National adaptation plan formulation process. Kathmandu, Nepal: Ministry of Science, Technology and Environment (MoSTE), Climate Change Management Division.

Natasha G. 2015. Case Study: Nepal's Agriculture, Climate Change and Food Security: Country Analysis and Programming. Available at http://dx.doi.org/10.12774/eod_hd.july2915.gristn.

Pudasaini. R., L.D. Adhikari, A. Bhusal, and B. Paudel. 2019. Building Capacities for Scaling Up Climate Smart Village in Nepal: A training manual. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Thapa, K., K. Bhatta, B. Bhattarai, K.D. Gurung. 2016. Inside Stories on climate compatible development. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and Climate and Development Knowledge Network (CDKN)

USAID. 2019. Greenhouse gas emissions in Nepal: A factsheet. Available at https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID_Nepal%20GHGs%20Emissions%20Factsheet.pdf

MODULE 2

Artwork: Mahesh Shrestha

UNDERSTANDING CLIMATE-SMART AGRICULTURE AND ITS PROCESSES

	Time needed:	1 Day
	Materials needed:	Projector, Marker, Whiteboard, Brown paper

Overview

This module explains the concept of CSA, its key characteristics and various examples of CSA technologies, practices and planning approaches. The sessions describe CSA and its models by briefly explaining the three pillars viz., adaptation, mitigation and food security. Furthermore, this module also provides an opportunity for participants to share and assess the potential of different CSA technologies and practices promoted and/or adopted in their location.

Objectives

After completion of this module, the participants will be able to:

- Understand and describe CSA and its practices;
- Differentiate between CSA technologies and practices based on their smartness criteria and conventional practices.
- Identify and suggest CSA technologies and practices appropriate for different agro-ecosystem across mountain, hills and Terai, and for their locality in particular.

Session I. Introduction to Climate-Smart Agriculture

CSA has been emerged to address the challenges in the agriculture sector caused by climate-induced disasters and stresses. It is defined as a strategic approach that aims to sustainably improve agricultural productivity and enhance food security, increase farmers' resilience and adaptation to climate change, and reduce and/or remove GHGs emission where possible (FAO, 2013). CSA helps guide actions needed to transform and reorient agricultural systems to effectively support the development and ensure food security in a changing climate.

In Nepal, CSA has come into practice recently, and various government and non-government organizations are promoting CSA technologies and practices. Some of these organizations include the Ministry of Agriculture Development (PPCR Project), International Center for Integrated Mountain Development (ICIMOD), Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) and so on. However, investment in the research and development of CSA related capacity building is not adequate to generate and promote technologies and practices appropriate for different agro-ecological zones ranging from high hill to Terai.

Three Pillars of Climate-Smart Agriculture (CSA)

CSA consists of three pillars which are described below:

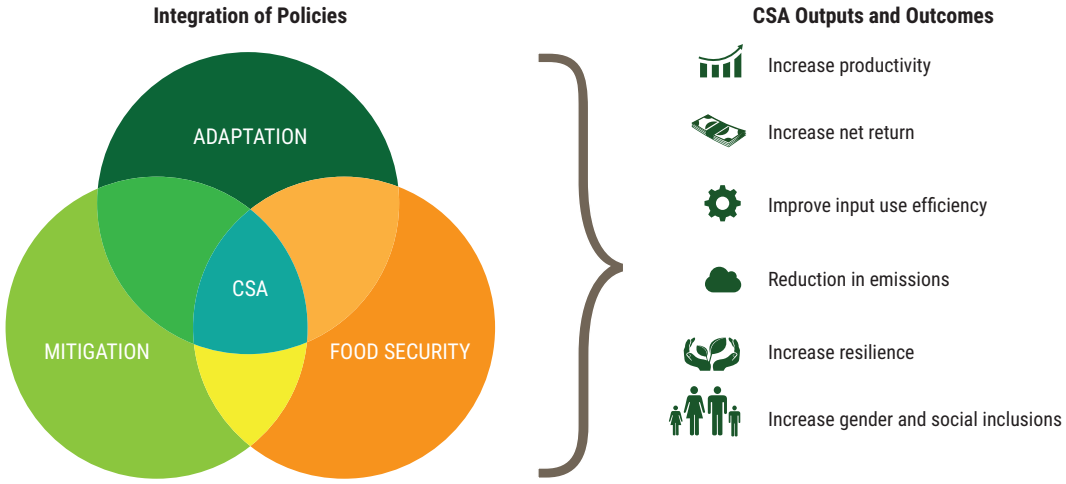


Figure 5. FAO conceptual framework of Climate-Smart Agriculture

Adaptation

Adaptation refers to reducing the vulnerability of climate change-induced disaster by altering the exposure, reducing sensitivity and increasing the adaptive capacity. Examples:

- If a particular site faces drought conditions, then one of the adaptation strategies that one can adopt is the use of drought-tolerant crop varieties. Furthermore, the promotion of different water-efficient technologies including drip irrigation could be other strategies to produce crops under water-limited conditions.
- Similarly, farming communities in flood-prone areas can prepare raised nursery beds to protect seedlings from submergence.

Mitigation

Mitigation refers to the reduction of the emission of greenhouse gases and enhancing carbon sequestration for long term storage of atmospheric carbon dioxide.

Examples:

- Use of zero tillage/minimum tillage technology can reduce GHGs emissions from the volatilization of organic soil carbon.
- Integrated nutrient management can reduce emissions by reducing the excessive use and loss of chemical fertilizers and thus improves nitrogen use efficiency through precision farming systems.
- Use of Leaf colour chart helps calculate the exact amount of nitrogen required by the plants and reduces excessive use of fertilizers.
- Use of cover crops and incorporation of crop residues into the soil can generate higher inputs.
- Use of a solar-based irrigation system can replace the diesel pump-based irrigation system that can significantly reduce GHGs emission.

Productivity

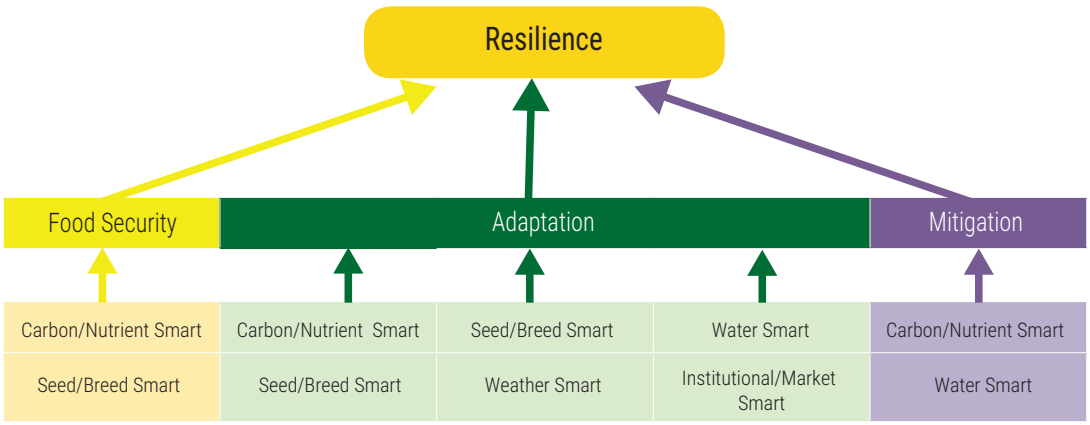
CSA aims to maintain and improve agricultural production and productivity under adverse climatic condition through the promotion of different climate change adaptation-related technologies and practices.

Session II. CSA Characterization as per Smartness Criteria

The CGIAR Research Program on Climate, Change, Agriculture and Food Security (CCAFS) has designed a framework on the climate-smart options and grouped CSA technologies and practices under them. To make the agriculture climate-smart, technologies and practices promoted for adaptation and mitigation are categorized into different smart criteria such as weather and knowledge-smart, water-smart, nutrient/carbon-smart, seed/breed-smart and institution/market-smart (CCAFS, 2016). One CSA technology and practice can also contribute to more than one smartness criteria. For example, the use of drought tolerant variety is a weather-smart technology that can also be considered as water-smart technology. Likewise, a solar-based irrigation system is regarded as a water-smart technology, but this can also be included within carbon-smart technology owing to its role in the reduction of GHGs emission.

Types of Climate Smart Options				
Weather and Knowledge Smart	Water Smart	Seed/breed Smart	Carbon/nutrient Smart	Institutional/market Smart

All these climate-smart options ultimately contribute to the three pillars of CSA as illustrated in the figure below.



(Source: Adopted and modified from Pudasaini et al., 2018)

CSA technologies and practices are site-specific. For instance, some technologies and practices appropriate for the hilly region may not be useful in the Terai region. CSA is aimed at identifying practices that are most adaptable to a localized condition or widely across multiple agro-ecosystems.

Categorization of CSA technologies and practices based on five smart options.

Water-smart: One of the consequences of climate change is the fluctuation of rainfall that results in dry spells and drought. Erratic rainfall and long-term drought result in the reduction of agricultural production and productivity. Hence, water-efficient technologies and practices are the options for such a situation, and it can be considered as water-smart since technologies which utilize water effectively and efficiently are water-smart technologies. This practice helps minimize yield loss due to extreme weather conditions. Examples include rainwater harvesting, drip irrigation, solar-based irrigation, water harvesting/collection tank, drainage management, cover crops method, mulching, flood/drought-tolerant varieties, direct-seeded rice, alternate wetting and drying, sprinkler irrigation etc.

Drip irrigation

System of Rice Intensification

Weather and knowledge-smart: The weather pattern is changing and becoming more unpredictable thus inviting more challenges in farming. Increased variability of rainfall patterns is contributing to the reduced agriculture production particularly in rainfed farming systems. The fluctuation of weather conditions increases risks and uncertainty and hence makes agriculture even less profitable. Accessing and disseminating weather and meteorological information and forecast to farmers play a crucial role to effectively plan agriculture interventions. Furthermore, dissemination of information about the occurrence of pest and disease due to changing climatic condition and its management practices help better prepare and respond in a timely manner. Several weather-smart technologies and agro-advisory services disseminated through mobile, FM, radio, television help save crop damage. An individual can access the information through a different mobile-based application that can be downloaded on android mobile phones. Examples; Hamro Krishi, Hamro Biu, NARC Krishi .

LI-BIRD, through financial and technical support from CCAFS has been implementing a project "Piloting and Scaling Out Climate-Smart Villages in Nepal", appraised benefits of dissemination of weather forecasting through mobile text messages in three days interval to the beneficiaries in Nawalparasi and Dang districts of Nepal with the support from ICT for Agriculture Pvt. Ltd (IFA). From the services received (text messages in mobile), the farmers have been able to harvest the paddy on time, reduce the use of chemical fertilizers in their field, and shifted the date of harvesting and fertilizer use. Similarly, with the financial support from CARE Nepal, LI-BIRD is implementing SAMARTHYA project that has also been promoting agro-met advisory service in Siraha and Udayapur districts of Nepal.

Weather forecast system

Similarly, the Ministry of Agriculture and Livestock Development (MoAD), in partnership with Nepal Agriculture Research Council (NARC), is implementing a Pilot Program for Climate Resilience (PPCR) that generates and disseminates customized information through a website www.namis.gov.np. This website publishes an agriculture bulletin where we can receive information on agriculture policies, weather forecast, insect-pest control measures of various crops, crop

calendar, krishi diary, crop and livestock insurance, etc.

Institutional-smart/Market-smart: The institutional linkages need strengthening for enhanced agriculture production. Examples of institutional/market-smart practices include Inter-sectoral linkage, capacity building programs, financial services, market information, etc. These practices help farmers in accessing resources, information, and market outlets and also address gender-related issues.

Carbon-smart/Nutrient-smart: Elevation in the emission of GHGs to the atmosphere through the burning of various fossil fuels, the use of chemicals and different agricultural interventions result in global warming which eventually contributes to climate change. It is therefore important to adopt technologies and practices that reduce GHGs emissions and increase the carbon sequestration for maintaining good environmental condition. The decline in soil fertility is estimated to reduce 12% of global food production over the next 25 years, which likely can increase world food prices by 30% (UNCCD, 2015).

In Nepal, soil erosion, poor recycling of organic matter and unbalanced fertilization are the main reasons for soil fertility decline. Farmers use chemical fertilizers haphazardly to increase their production. Over and unscientific application of chemical fertilizers deteriorates the soil quality resulting in declining crop production and increasing GHGs emissions. Furthermore, the burning of fossil fuels, agriculture residues, cow dung, a common practice across Terai region of Nepal, and the raising of low productive livestock species in poor management contribute to the GHGs emission.

It is important to reduce GHGs emissions through the implementation of different carbon-smart technologies. Proper soil nutrition management through the use of organic manure, integration of legume in the cropping system, site-specific nutrition management, use of leaf color chart (LCC), Green Seeker and residue retention, farmyard manure management, zero-tillage/minimum tillage are some examples of carbon/nutrient-smart technologies and practices.

Agriculture production collection centre

Photo: Munnuram Tharu, TWUC

Rice cum duck farming

Photo: Yogendra Katuwal, LI-BIRD

Water-logging tolerant variety of rice (Ciherang Sub-1)

Seed-smart/Breed-smart: Quality seeds of locally adapted varieties and improved livestock breeds play a vital role in overall agricultural and livestock production. Examples of seed-smart/breed-smart technologies and practices promoted in Nepal include community seed banks, adoption of drought, flood and disease tolerant crop varieties and cross-bred high yielding livestock breeds. Elevation of temperature and changing the weather condition have also resulted in a higher incidence and occurrence of new insect/pests and disease in agriculture crops. Therefore, pest and disease resistant cultivars are required to address this problem. Furthermore, nutrient efficient crop cultivars also help minimize the excessive use of chemical fertilizer in the soil.

Session III. Role of CSA for Resilience Agriculture

The agricultural resilience can be defined as the ability of the farming communities to absorb and recover from shocks and stresses that occurs in their agricultural production and livelihoods from the effects of climatic hazards. Nepalese agriculture is primarily subsistence in nature and practiced by smallholder farmers. A small fraction of the cultivators has been adopting modern technologies, especially in the high production potential areas. In this context, CSA could be an option to increase the gross agriculture production with optimum utilization of scarce inputs and resources, especially in the low inputs agriculture system. CSA technologies and practices also help reduce the cost of production so could be viable options for smallholders.

CSA technologies accept the use of the practices that are adapted to local conditions. CSA approaches principally build on sustainable agriculture as they promote the judicious management of water, land, and other resources and optimize the benefits from the food systems.

Table 2. Comparison of current agricultural practices and climate-smart agriculture

	Current agricultural practices	Climate-Smart Agriculture
Land	Expand agricultural area through deforestation and converting grasslands to cropland.	Increase land utilization by converting degraded land to cultivable land (e.g. through solar-based irrigation) and reduces land degradation otherwise caused by heavy tilling (by using zero or minimum tillage) or similar ones.
Natural resources	Make the most use out of natural resources - the land, water, forests, and soils used in production - without paying much attention to their sustainability over the long term.	Restore, conserve and use natural resources sustainably.
Varieties	Rely on a few crops and/or a few high yielding improved and hybrid crop varieties and improved breeds.	Use a mix of traditional and modern, locally adapted varieties and breeds to maintain output, increase yields and ensure their stability in the face of climate change.
Inputs	Relentless use of fertilizer, pesticides and herbicides.	• Improve the efficiency of agrochemical use. • Control pests, diseases and weeds using integrated management approaches. • Priority is given to the application of compost manure and green manure. • Rotate crops with legumes to fix nitrogen and reduce the use of chemical fertilizers.
Energy	Use farm machinery that usually relies on fossil fuels – such as tractors and diesel pumps.	Use energy-efficient methods, such as solar-based irrigation and biofuels.
Production and marketing	Specialize in production and marketing to achieve greater efficiency.	Diversify production and marketing to add stability and reduce risk.

(Source: FAO, 2013a)

Session IV. Assessing CSA Technologies and Practices

In CSA, careful assessments of the technologies and practices are of utmost importance. The pool of CSA technologies which are most relevant to different agro-ecosystems i.e., high hill, mid hill and Terai region can be evaluated against four qualifying criteria: i) the technical appropriateness in the local context, ii) economic benefits, iii) farmers acceptance, iv) climate sensitivity and scalability (Paudel et al., 2017). The technologies and practices are identified based on the literature reviews, consultation with the stakeholders and subject experts, field piloting

and screening based on which final selection can be done.

CSA practices can be assessed upon various indicators representing the three pillars CSA. The indicators to assess the CSA technologies and practices can be grouped in four different categories; i) changes in the agronomic practices, ii) increase in the energy/water use efficiency, iii) use of ICT services for the dissemination of information related services, and iv) various methods that can either reduce or transfer the risks associated with farming systems. The reduction in the greenhouse gas emission and the use of clean energy can be counted as indicators to assess the mitigation pillar of CSA. However, GESI being the cross-cutting of CSA can be further assessed based on the indicators such as time-saving and drudgery reduction, access to information and knowledge, capacity building, leadership roles and skills development, increment in the income, asset and nutrition diets. The indicators set can be used to monitor the progress and assess the CSA technologies and practices as suitable technologies play a key role in the different agro-ecological regions.

Exercise: List different CSA technologies and practices and categorize them as per smartness criteria.

- The participants are divided into different groups. 4-5 participants in each group.
- The participants are provided with a list of different CSA practices.
- The participants are asked to group practices and technologies based on the smartness criteria discussed earlier.
- The outputs of the group work will be shared in the plenary for discussion.

Session V. Climate Risk Assessment and Risk-Based Planning

There are climatic and non-climatic risks associated with agricultural production, processing, marketing, and financing. To minimize the risk and maximize the benefits, it is crucial to fully understand all possible risks associated with a particular site and crop commodity right from planning against which actions and interventions are identified and resources allocated to implement them. Here, we will only talk about understanding and assessing climate risks in agriculture. There are various steps for risk-based planning from identifying the hazard to the implementation of suitable measures and evaluating them in the existing context. To better understand the climate risks, it is necessary to understand the following terms:

Vulnerability assessment: This is effective to collect the baseline information from an area where hazards occur. Different steps and tools can be used to assess the vulnerability of a particular site/area. Vulnerability for farming communities towards any climatic hazard can be measured in terms of their sensitivity and adaptive capacity to respond to the hazards they are exposed to.

Understanding and mapping frequently occurring climate hazards and disasters

i) Historical Timeline

In this process, the information on the climate-induced disaster over years i.e. last 20-30 years is collected. The event that has occurred along with the qualitative and quantitative information will be collected.

Procedure:

- Organize Focus Group Discussion with every age group from elderly to young participants as they have experienced with different periods and can easily tell about the past and present situations.
- For time duration, information can be taken in 5 years interval depending upon the situation.

Table 3. Sample of a historical timeline

Climate related major hazards/ disasters	Time interval and the degree of impact					
	2045-2050 BS	2050-2055 BS	2055-2060 BS	2060-2065 BS	2065-2070 BS	2070-2075 BS
Floods	Huge floods in 2046 washed way 50 households and 10 hectares of land					
Drought					Drought reduced the production of paddy field	
Disease pest			Late blight in 2059 affected 5 ha of potato production			
Landslide		Landslide has washed 5 hectares of paddy field				

ii) Ranking of climatic hazards

In this process, the hazards obtained from the historical timeline are categorized and prioritized based on the occurrence in the specific area and community.

Procedure

- List out the hazards that are more frequently occurring in that area.
- List out the climatic hazards in rows and columns in a table.
- Compare both the hazards vertically and horizontally and select the one which has more impact in terms of loss.
- Put the number in the hazards based on their frequency and score them which has the greatest priority.

Table 4. Sample of ranking of climatic hazards

Hazard	Landslide	Drought	Flood	Hailstone	Pest	Fire	Disease	Total
Landslide		Landslide	Flood	Landslide	Landslide	Landslide	Landslide	5
Drought			Flood	Hailstone	Pest	Fire	Disease	0
Flood				Flood	Flood	Flood	Flood	6
Hailstone					Pest	Hailstone	Disease	2
Pest						Pest	Disease	3
Fire							Disease	1
Disease								4

iii) Preparation of Seasonal Calendar

This is another tool to assess the vulnerability of a community. In this tool, the climatic hazards faced by the community are listed out based on the time duration, compare past and present scenarios.

Procedure:

- Prepare a format for the seasonal calendar either in brown paper or chart papers.
- List the climatic hazards in the first row and first column.
- Then discuss the time duration in the past like when the drought used to occur in that specific community and what is the scenario at present.
- If there's changes in the occurrence of the hazards then discuss with the community on what they have been doing to overcome the specific hazard.

Table 5. Sample of a seasonal calendar

Hazard		Baisakh	Jestha	Ashad	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra
Drought	Before												
	Now												
Flood	Before												
	Now												
Army worm	Before												
	Now												
Leaf minor	Before												
	Now												
Hailstone	Before												
	Now												

iv) Preparation of Crop Calendar

This tool is similar to seasonal calendar. In this tool, the changes in the cropping and agricultural operation by the community are listed out based on the time duration, compare past and present scenarios.

Procedure:

- Prepare a format for crop calendar either in brown paper or chart papers.
- List the crops in first column and months in first row.
- Then discuss the time duration in the past when the community used to cultivate and harvest the crops and what is the scenario in the present.

Beside these tools, an individual needs to consider the intensity and behavior of the precipitation and monitoring of the weather measurements such as installation of the weather forecasting system, record keeping of the climatic parameters in the climate diary.

Action Planning

The selection of potential CSA practices can be done through the participation of various stakeholders including farming communities. The farming communities implementing the technologies for years can also help in the climatic risk management and need to be considered during the risk-based planning. However, the new technologies and practices that are advance and that need advanced research and planning can be taken from researchers as they need to be validated with the facts and figures through research. The focus group discussion with the participation of the local communities and stakeholders play an indispensable role in the prioritization of the technologies and practices suitable for a specific agro-ecological region. The consultation is vital in this case.

The technologies can be identified and prioritized through consultation workshops and in a participatory manner with the participants. The importance of the respective technologies is assessed by the experts during the consultation workshop. The team then identifies some technologies and practices for implementation in specific location.

Implementation

The identified technologies can be implemented directly based on different agro-ecological regions. However, those requiring the validation with the generation of the evidence need to be implemented as action research and relevant information needs to be collected for assessing the overall performance and suitability of the technology to effectively address the identified climate risk of the area.

Monitoring

The CSA technologies need to be monitored if they are properly applied and working well or not in a particular area. The indicators can be set against the baseline and data can be generated to assess their performance. Periodic and joint monitoring field visits should be organized in the presence of communities, key stakeholders and agencies working in CSA including government officials.

Further Reading

CCAFS. 2016. Climate-Smart Villages. An AR4D approach to scale up climate-smart agriculture. Copenhagen,Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.cgiar.org

Pudasaini R., L.D. Adhikari, A. Bhusal and B. Paudel.2019. Building Capacities for Scaling Up Climate Smart Village in Nepal: A training manual. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Paudel, B., R.C. Khanal, A. KC, K. Bhatta, P. Chaudhary.2017. Climate-Smart Agriculture in Nepal. Champion technologies and their pathways for scaling up. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

MODULE 3

Photo: Aastha Bhusal, LI-BIRD

Climate-Smart Agriculture (CSA) Technologies, Practices and Solutions Relevant for Nepal

	Time needed	1 Day
	Materials needed	Brown paper, projector, board marker, pen, masking tape
	Method	Presentation, discussion and group work

Overview

This module provides information on various climate-smart technologies and practices relevant to different ecological zones of Nepal with their contribution to the three pillars of CSA. Agriculture is highly sensitive to climate change-induced disasters, but there are many options available to address them. Several CSA technologies and practices have been identified and recommended for crops and livestock sectors in Nepal. However, research is required to develop new relevant CSA technology to address major climatic risks imposed on agriculture. By the end of this session, participants will be able to categorize various climate-smart technologies and practices suitable for their location.

Objectives:

After the completion of this module, the participants will be able to:

- List various CSA technologies and practices suitable for different agro-ecological regions.
- Differentiate how these technologies and practices contributes to the pillars of CSA.

Session I. Climate-Smart Agriculture (CSA) Technologies and Practices for Different Agro-Ecological Zones (Mountains, Hills and Terai Regions) of Nepal

Topographically, Nepal is a country with diverse geography where it is divided into three ecological zones: mountains, hills (high and low hill) and Terai. They cover 15 %, 68 % and 17 % of the total land area of the country, respectively. Even within the same region, there are various agro-ecological zones/niches which have a unique micro-climatic condition. Hence, agricultural technologies and practices suitable for one region may not be suitable for another region. In some cases, some technologies are suitable for all regions. This session highlights the diverse climate change adaptation technologies and practices for different agro-ecological zones and techniques to categorize them based on different smartness criteria which are depicted in Table 7 below.

Table 7. Champion CSA technologies and practices for high hills, mid hills and Terai regions

Champion CSA options	High hills/ Mountain	Hills	Terai	Smartness
Climate-resilient crops varieties	✓	✓	✓	Seed/breed-smart, weather-smart
Climate-resilient home garden	✓	✓	✓	Weather and knowledge-smart
Mixed farming (legume integration)	✓	✓	✓	Nutrient-smart and weather-smart
Community Seed Banks	✓	✓	✓	Seed/breed-smart and knowledge-smart
Small handheld-tools, machine	✓	✓	✓	GESI and labour/energy-smart, carbon-smart
Agriculture and livestock insurance (Particularly index-based)		✓	✓	Weather-smart
ICT-based agro-advisory	✓	✓	✓	Knowledge-smart and Weather-smart
Cattle-shed improvement	✓	✓		Nutrient-smart and carbon-smart
Package of a plastic pond, plastic house, drip irrigation and improved cattle shed	✓	✓		Water-smart, weather-smart and nutrient-smart
Agro-forestry	✓	✓		Carbon-smart and nutrient-smart
Plastic house	✓	✓		Weather-smart and water-smart
Plastic pond		✓		Water-smart
Water harvesting ponds, multiple-use and water recharge pond		✓		Water-smart
Drip irrigation	✓	✓	✓	Water-smart, GESI and labor
Solar-based irrigation			✓	Water-smart and energy-smart
Conservation agriculture (zero tillage, residue retention)			✓	Carbon-smart and water-smart, nutrient-smart
System of rice intensification			✓	Water-smart, carbon-smart
TOTAL	11	13	10	

Note: Adapted from Paudel et al. (2017) with modification

Session II. Crop Based CSA Technologies and Practices Appropriate for Mountains, Hills and Terai Region of Nepal

A. Weather and knowledge-smart technologies and practices

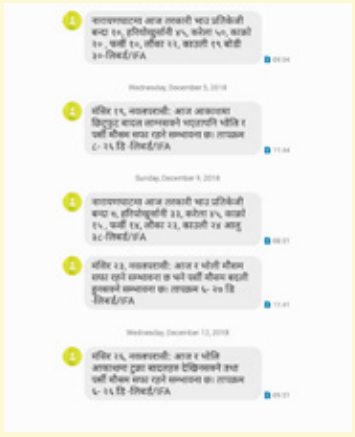
i) Agro-met advisory service

Changes in temperatures and rainfall, climate extremes (e.g. very wet days, long dry spells, very cold nights, extreme heatwave) and climate-induced hazards such as drought, flood and higher incidence of pests and diseases are the major consequences of climate change. However, due to a lack of proper knowledge and prior information on weather conditions and its probable effect in the agriculture sector, farmers are facing challenges to protect their crops and or minimize crop damage. Therefore, agro-met advisory service is one of the important practices that provides knowledge, information and predictions to farmers on weather conditions, agronomic practices, and the possibility of pest and disease infestation. This helps farmer to take appropriate mitigation measures on time (Box 1). Furthermore, this service also disseminates market information of the crops, especially vegetable crops that helps farmers make a better plan for harvesting and marketing. There are several ways for disseminating weather and other information to the farmers such as disseminating information from the NARC bulletin to farmers in person, via radio, FM, television and message on mobile phones. This agro-met advisory service is applicable in all regions of Nepal.

Box 1: Agro-met advisory service promoted by LI-BIRD under Samarthya project

With the aim aim of providing advisory services to smallholder farmers, LI-BIRD has introduced agro-meteorological advisory services as a climate-resilient model under the Samarthya project. This model was designed in a way that local Palika would take the lead and other stakeholders including the agriculture knowledge center (AKC) would also be engaged in the process whereas LI-BIRD facilitates the delivery of the service. In this model, the agro advisory bulletin published on the website of the national agriculture research council (NARC) (http:www.namis.gov.np) is downloaded, sorted and shared amongst the beneficiaries. The information obtained from different ICTs can also be integrated into this advisory service and can deliver to the farmers so that they can be more benefited from the technology. To run the model, the technician from the agriculture section of the municipality and AKC are trained on collecting information from the NARC bulletin and handling different mobile-based applications. In this model, leader farmers considered as a Local Agriculture Resource Person (LARP), are trained on the agricultural practices and handling of the different agriculture-related mobile applications. These LARPs hold a meeting every week in the respective groups and disseminate the information to other members. In case there are new problems observed in the field, they immediately report to agriculture technicians of Palikas and AKC, and LI-BIRD's staff to resolve the problem. Furthermore, the agro-met advisory notice board is also placed at the centre of the village where agro-met advisory bulletin and other information are affixed. There is a provision of feedback mechanism in this model where LARP collects feedbacks of farmers on advisory service from the field and provides them to the agriculture section of Palika for further improvement. The methodology is improvised and made more efficient as per the suggestions of the farmers and local governments.

The agro-met advisory services contributes to CSA pillars in the following ways.



Weather and market information via mobile phone

Adaptation	Mitigation	Food security
• Farmers get information about weather conditions on time so that they can be better prepared to cope with the bad weather. • Farmers also get information about the best agricultural practices so that they can adopt suitable practices during a changing environment.		• Reduction of crop loss by bad weather conditions due to getting weather information on time. • Farmers can increase their crop production by adopting the climate-resilient varieties, technologies and cultural practices as suggested in the bulletin.

ii) Crop and livestock insurance

Climate change impacts on agriculture to a varying degree. The crop loss due to extreme weather events particularly prolonged drought, floods and incidence of pests and diseases has been increased. Likewise, farmers may also lose their livestock due to climate-induced disasters. As a risk reduction measure, crop and livestock insurance has been applied to ensure farmers that they are benefitted when they lose their crops and livestock due to extreme weather conditions and disasters. Government of Nepal has endorsed and launched crop and livestock insurance policy 2069 under the insurance act of 2049. There are about 20 non-life crops and livestock insurance companies registered in Nepal which are involved in serving farmers and agri-entrepreneurs (Table 8).

Box 2: Scheme/provision for Crops and Livestock Insurance in Nepal

(Source: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2427605)

- According to the current insurance policy, 5% and 6% of the total insured amount should be paid as premium while insuring livestock and poultry, respectively.
- The Government of Nepal has subsidized crops and livestock insurance. GoN provides a 75% subsidy in its premium for up to 10,00,000 insurance amount and the remaining 25% should be paid by farmers.
- Under the scheme, the insurance company provides 90% of the total insured amount as compensation cost in case of the death of livestock. In the case of injured and disabled, 50% is provided as compensation cost.
- The total insurance amount of crops is equal to the cost of production including the purchase of seedlings, fertilizers, labor charge required until the crops/horticulture are ready for the harvest.
- In case the insured plant, animal, or fowl has a life span of less than one year, then the premium amount will be calculated based on the production cycle.
- The claim settlement process should be wrapped up within 30 days from the first reporting date (website for more information.

Table 8: Few examples of Insurance companies available in Nepal

S.N.	Name of Insurance companies	S.N.	Name of Insurance companies
1.	Ajod Insurance Company Limited	11.	Oriental Insurance Company Limited
2.	Everest Insurance Company Limited	12.	Prabhu Insurance Company Limited
3.	General Insurance Company Nepal Limited	13.	Premier Insurance Company (Nepal) Limited
4.	IME General Insurance Company	14.	Prudential Insurance Company Limited
5.	Himalayan General Insurance Company Limited	15.	Rastriiya Beema Company Limited
6.	Lumbini General Insurance Company Limited	16.	Sagarmatha Insurance Company Limited
7.	National Insurance Company Limited	17.	Sanima General Insurance Company
8.	Neco Insurance Company Limited	18.	Shikhar Insurance Company Limited
9.	Nepal Insurance Company Limited	19.	Siddhartha Insurance Company Limited
10.	NLG Insurance Company Limited	20.	United Insurance Company (Nepal) Limited

Source: http://nib.gov.np/non-life-insurance/

The agriculture and livestock insurance contributes to CSA pillars in the following ways.

Adaptation	Mitigation	Food security
• Due to crop and livestock insurance, farmers can take the risk to cultivate crops and rear livestock.	• Not applicable	• Farmers get payment from the insurance company when their crops and livestock are lost by bad weather conditions.

iii) Plastic house

Plastic house cultivating high value crops

Fluctuation in precipitation is one of the key impacts of climate change that results in generating long term drought and flood condition that impacts crop yield. Excessive rainfall in unwanted time makes the cultivation of high-value crops difficult. In such places particularly in mid hill and mountains, plastic house can be one of the technologies to address the problem. A plastic house is a greenhouse-like structures where plants, especially high-value crops, are grown under semi-controlled conditioon, creating a favorable environment for the cultivation of crops. As the plastic house protects plants from frost and cold injury, this technology is well known and has the potential for mid hills and high hills of Nepal. Unlike in open field, the disease and pest problems under the plastic house is expected to be relatively low thereby increasing crop yield and quality. When integrated with drip irrigation, the plastic house can be more effective and beneficial in terms of cultivating crops in drought-prone areas. Generally, high-value crops including off-season vegetables such as tomato, cole crops, cucurbits especially cucumber are cultivated under the plastic house. There is a possibility to cultivate crops throughout the year, thus farmers are more benefitted by adopting it.

The plastic house contributes to CSA pillars in the following ways:

Adaptation	Mitigation	Food security
• Farmers can cultivate crops throughout the year.	• Not applicable	• Unlike normal farming practices, farmers can be benefitted more from plastic tunnel due to higher productivity, long season harvesting and possibility of growing high value crops.

iv) Climate-resilient home garden

Climate-resilient home garden

The Home garden is an integrated farming approach where vegetables, fruits, fodders, medicinal plants and other crops are cultivated in a small piece of land around homestead areas maximizing spatial and temporal dimensions primarily to fulfill the daily requirements of the family. Apart from crops, livestock are also integrated into the home garden. LI-BIRD is a pioneer organization for home garden research and development in Nepal which has been integrated by the government of Nepal in their regular programs. Home garden is considered as one of the climate-resilient practices due to its diversity, knowledge intensiveness and use of different climate-smart technologies and practices that are integrated into the home garden production system. As it is managed by family members, home garden is also considered as the domain of women farmers. Besides getting healthy and fresh vegetables for daily use, households can also produce some surplus and have the potential to obtain income. Home garden is suitable for all three agro-ecologial zones, but crop selection might differ among the zones. The size of the home garden may vary depending on the availability of land.

The climate-resilient home garden contributes to CSA pillars in the following ways:

Adaptation	Mitigation	Food security
• Maximize the use of space, time, diversity, knowledge systems and women farmer-friendly CSA technologies and practices. • Crop diversity in home garden secures crop harvest even in climatic disaster.	• Farmers mostly use organic manure and biopesticide in home garden that results in reduction of GHGs emission.	• Farmers are able to produce diverse vegetables in their home garden that secures food and nutrition security. • Farmers save family expenditure and also make some income by selling surplus production from the home garden.

B. Water-smart technologies and practices

i) Solar-based irrigation system:

The Solar-based irrigation system is one of the important CSA technologies that help farming communities to irrigate crop fields even in the dry season. Solar-based irrigation has helped smallholder farmers to switch from traditional rain-fed subsistence agriculture to high-value crops and engage in marketing by organizing them in groups and cooperatives. This is considered as one of the champion CSA technologies suitable for Terai and foothill river basin areas for lifting water.

Box 3. LI-BIRD's experience in promoting solar based irrigation

Through different projects, LI-BIRD has promoted over 28 solar-based irrigation system in seven districts (Udayapur, Siraha, Mahottari, Nawalparasi, Bardiya, Dang and Kailali) of Terai region providing irrigation approximately in 120 ha of land and benefiting over 700 smallholder farmers.

Field demonstrations revealed that solar-based irrigation has increased crop intensity by 200% (four crops/year compared to the baseline two crops), crop yield by 2-3 folds, and income by 222% (NPR 32,292 compare to the baseline NPR 14,485).

Additionally, the capacity of women in solar water user groups has been improved and their workload has been reduced as the water-efficient technologies have been introduced to reduce their burden of irrigation.

Photo: Aastha Bhusal, LI-BIRD

Solar-based irrigation system at Agyauli, Nawalpur

The solar-based irrigation system contributes to CSA pillars in the following ways:

Adaptation	Mitigation	Food security
• Year-round availability of water so that farmers can cultivate rice and vegetable crops on time irrespective of weather.	• There is no GHGs emission in this system and it can significantly reduce the GHGs emission caused by diesel pumps.	• Increase in productivity of crops and vegetables due to assured irrigation facilities. • Increased cropping intensity by growing multiple crops in a year rather than keeping land fallow after the summer crop.

ii) Rainwater harvesting

The Rain water harvesting is one of the suitable practices where naturally occurring rainwater is collected either in large community-managed ponds as in Terai or the smaller ponds or tanks being practiced in the mid and high hill areas. Rainwater harvesting reduces the surface runoff and the collected water can be used for irrigation during the dry season. Furthermore, the collection of water from the roof of the house in the water collection tank during the rainy season is also a common practice especially in the high hills and mid hills of Nepal. The rainwater harvesting system contributes to adaptation, mitigation and production (food security) in the following ways.

Rainwater harvesting

Adaptation	Mitigation	Food security
• Improve water availability for farmers during dry period to cultivate high value (vegetable) crops. • It also reduces the soil erosion. • Construction of bigger ponds for collecting rain water reduces societal responses to climate change like population dislocation, habitat abandonment etc.	• The year-round cultivation of crops helps in carbon sequestering thus reduces the emission of GHGs.	• Increase and secure crop production particularly of vegetable crops. • Farmers can have better income so that they can secure their food.

iii) Drip irrigation

Drip irrigation technology; under plastic house

Drip irrigation is a water-efficient technology and is considered to be one of the important technologies for climate change adaptation. It is composed of plastic pipes fitted with outlets from where water drops at a slow rate from the system. As the drip irrigation system irrigates plants only in the root zone, it increases water use efficiency and also minimizes the weed infestation in the field resulting in cost reduction of intercultural operation. It also reduces soil erosion, particularly in slope land. Further, the risk of disease incidence is low as most of the soil and foliage remains dry. This technology can be applied in mid hills, high hills and Terai and is appropriate for high-value vegetables and fruits and for cultivating crops under the greenhouse or plastic tunnel.

The drip irrigation contributes contributes to three pillars of CSA in the following ways:

Adaptation	Mitigation	Food security
• Efficient use of water and minimum water loss. • Minimum weed infestation in the field.	• Since there is reduction of weeds, the use of weedicides is reduced, which ultimately reduces the emission of greenhouse gases.	• Increase the productivity of high-value crops (vegetables) results in better income so that farmers can secure better food and livelihood.

iv) System of rice intensification (SRI)

Photo: Aastha Bhusal, LI-BIRD

System of Rice Intensification (SRI)

The System of Rice Intensification (SRI) is a farming practice that aims at increasing the yield of rice production. This practice requires less water to cultivate rice where younger seedlings (about 15 days old as opposed to a month old) are transplanted singly in wider spacing (25-40 cm) that makes hand weeding with tools easy. This practice is one of the important adaptation practices for rice cultivation as it requires less water. This practice is more suitable in the Terai region of Nepal. This farming practice contributes to three pillars of CSA which is shown in the following table:

Adaptation	Mitigation	Food security
• Requires 30-40% less water for rice cultivation than conventional method. • Healthy and strong plants with long roots even in minimum water application.	• High carbon storage in plants due to increased biomass. • Reduction in the use of chemical fertilizers. • Reduce the methane gas emission by 22-64% due to reduced water logging and flooding of field.	• Increase the productivity of rice by 14.1% compared to conventional practices. • Reduction of production cost due to reduced irrigation and input use.

C. Carbon/nutrient-smart technologies and practices

i) Zero tillage and minimum tillage

Zero tillage and minimum tillage is a farming practice where the soil is disturbed less during the cultivation of crops. This practice is suitable in the Terai region especially for wheat and other compatible crops. This practice contributes to the cost reduction of the labour, seed and fertilizer and irrigation (as the soil remains moist). While practicing zero tillage in wheat, seeds are sown in line where fertilizers can also be applied together with the help of a machine. As the soil is less disturbed, there is high carbon storage in the soil thereby contributing to the reduction of CO_2 emission. This practice contributes to CSA in the following ways.

Photo: Aastha Bhusal, LI-BIRD

Zero tillage wheat cultivation

Adaptation	Mitigation	Food security
• Timely sowing of the wheat and other crops. • Maintain soil moisture due to less disturbance.	• High storage of carbon in the soil and increase soil organic matter. • Reduce the use of fuels as compared to normal farming for tillage operation.	• Reduce the production cost. • Higher cost: benefit ratio.

ii) Mulching

Mulching is a covering of soil by straw, compost, plant materials or plastic sheets that helps to minimize water loss from evaporation and erosion, enrich the soil with organic matter and inhibit weed growth. Furthermore, this practice also plays a key role in reducing CO_2 emission from the soil. Mulching is well practised in mid hills and might also be suitable in the Terai region. Plastic mulch plays a role in conserving water, soil solarization and inhibit weed growth. In recent days, plastic mulch has been widely used for vegetable production under the greenhouse or plastic house and also in the open field of commercial pocket areas. Mulching contributes to CSA in the following ways.

Photo: Kartiklal Chaudhary, LI-BIRD

Use of plastic for mulching

Adaptation	Mitigation	Food security
• Increase the organic matter in the soil. • Act as soil cover to maintain soil moisture.	• Reduce the exposure of soil so that there is less carbon emission from the soil. • Minimize the use of weedicide.	• Increase the crop yield in dry areas.

iii) Agro-forestry

Agro-forestry system

Agro-forestry is a farming practice or system where agriculture, forestry and livestock interventions are integrated to maximize the land productivity and get benefitted from multiple crop yield. It is a community-based adaptation practice to increase community resilience to climate change and also contributes to mitigation by reducing greenhouse gas (GHGs) emission in response to climate change. Furthermore, this practice plays a positive role in minimizing soil erosion particularly in sloppy areas as it provides dense canopy and there's proper use of soil nutrients due to plants with a different root system hence enhance organic matters in soil, minimize loss by floods and increase water availability (Nuryati et al., 2019). This farming system is appropriate for mid hills and high hill areas, but can also be applied in the Terai region especially for plantation crops. Agro-forestry contributes to CSA pillars in following ways:

Adaptation	Mitigation	Food security
• Proper use and recycling of nutrients in the soil. • Increase organic matter in soil and reduce soil erosion.	• Enhance carbon sequestration through sustainable land use management.	• Integrated farming of diverse crop plants and livestock allow multiple crop harvest and increase overall productivity of the farming system.

Box 4. Examples of agroforestry practices in Nepal (ASHA, 2018)

- Agriculture crops and trees: *Albizia lebbeck*/Siris+Tea; *Ulnus nepalensis*/Utis + large cardamom/tea; *Dalbergia sissoo*/Sisau + coffee; Pakhuri + black peeper, etc.
- Forestry and livestock: Livestock + fodder/forage
- Agriculture, forestry and livestock (Bakaino and/or Epilipil + maize/millets + goat keeping; colocasia/ginger/turmeric + fodder tree + livestock)

iv) Leaf colour chart (LCC)

Leaf Colour Chart (LCC) is one of the CSA technologies which is used to determine the requirements of nitrogen fertilizer to cereal crops, especially for rice, wheat and maize, based on the greenness of the plant leaf. LCC is a decision support tool to estimate the appropriate amount of nitrogen fertilizers to use especially in cereal crops. LCC comprises six green strips, with colour ranging from yellow-green to dark green as per the amount of nitrogen content (amino acids) in leaves. This technology is suitable in all regions (Terai, hills and mountains) where cereal crops are cultivated. This is considered as a women-friendly tool as they can easily handle this with simple instructions.

Use of leaf colour chart in wheat

Photo: Aastha Bhusal, LI-BIRD

The use of LCC contributes to CSA pillars in the following ways.

Adaptation	Mitigation	Food security
• Reduce the incidence of disease and pests due to excess application of nitrogen fertilizer in crops and climate change.	• Reduce the emission of nitrous oxide gas due to optimum use of nitrogen fertilizer.	• Reduction of production cost. • Increase crop productivity by proper use of fertilizer and minimizing the crop loss from lodging due to excess nitrogen fertilizer application.

D. Seed/breed-smart technologies and practices

i) Climate-resilient crops and crop varieties

Climate-resilient crops and crop varieties play an important role in climate change adaptation where crops can be cultivated under adverse climatic conditions. Drought is one of the key climate change problems. The fluctuation of rainfall patterns leads to long-term drought during the summer season and flood during the rainy season. Hence, drought and flood-tolerant crops and varieties are required to cope with this situation. Nowadays, there are drought and flood-tolerant rice varieties/cultivars available in Nepal (Box 5). Cultivation of those cultivars in drought and flood-prone areas can help minimize crop loss during extreme climatic conditions. Some recently recommended improved climate-resilient maize and wheat cultivars in Nepal are shown in Box 5. Besides these major cereals, other local crops such as amaranth, proso millet, foxtail millet, finger millet, barley, buckwheat, etc., are climate-resilient crops. These crops can be cultivated in drought-prone areas and can obtain a good yield. The use of climate-resilient crops and varieties is one of the practical strategies to reduce climate change impacts and is suitable in all three agro-ecological zones of Nepal. Climate-resilient crop and crop varieties contribute to CSA pillars in the following ways.

Box 5: Few climate-resilient crops and crop varieties available in Nepal

Rice: Drought tolerant cultivars; Sukha - 1, 2, 3, 4, 5 and 6; Flood tolerant; Bahuguni - 1 and 2

Maize: Heat tolerant cultivars; Rampur Hybrid – 8 and Rampur Hybrid - 10;
Other maize cultivars; Ganesh - 1 and 2, Gulmi – 2, Manakamana - 1, 3, 4, 5 and 6, etc.

Wheat: Annapurna - 1, 2, 3 and 4; Dhaulagiri etc.

Other crops: Finger millets, buckwheat, proso millet

Adaptation	Mitigation	Food security
• Climate resilient crop varieties are better adapted under drought and flood conditions. • Pest and disease resistant cultivars can overcome the incidence of pests and diseases due to climate change.	• Cultivation of crops during dry period can contribute, as an add-on, to carbon sequestering. • Cultivation of disease tolerant crops reduces the use of pesticides.	• Cultivation of climate resilient crop varieties maintains yield even under stress condition and contributes to improve food and nutrition security.

ii) Community seed bank

A Community Seed Bank (CSB) is an approach to conserving plant genetic resources, increasing access of farming communities to local germplasms, and production and distribution of quality seeds at the community level. CSBs can be a viable means to generate agro-biodiversity-based income for farming communities through the production and marketing of high-quality seeds (Joshi et al., 2018). CSBs conserve and promote the local and farmer-preferred improved varieties for food security and improves the livelihoods of smallholder farming communities in marginal and risk-prone areas. Nowadays, CSB has been a farmer's institution where the seeds produced by farmers are collected, stored and sold to seed companies and other farmers. CSBs have a key role in the context of climate change. Conservation and promotion of seeds of local and improved varieties are key to providing seeds during crop loss due to drought, flood, disease and pests. CSBs have also been producing and distributing improved seeds of drought and flood-tolerant rice varieties (Shukha series and Bahuguni) which is playing an important role in climate change adaptation. CSBs can be established in all three agro-ecological zones of Nepal. CSBs contribute to CSA pillars in the following ways.

Adaptation	Mitigation	Food security
• CSB can supply seeds even in extreme climatic condition and disasters. • CSB can produce and distribute diverse crop variety seeds of local and climate resilient improved varieties.	• Not applicable	• Improved seeds provided from CSB increase crops yield. • Locally adapted seed provided by CSB during crisis situation can minimize the crop loss and contribute to food security.

Box 6: Status of community seed bank in Nepal

- The CSB in Nepal was first established in 1994 at Dalchowki, Lalitpur, in support of USC Canada Nepal. Now there are over ten organizations, including the Government of Nepal, LI-BIRD, Bioversity International, Oxfarm and Action Aid, that are actively engaged in promoting CSBs in Nepal. Currently, there are over 46 CSBs in Nepal, off which, 40 are well functioning (Joshi et al., 2018).
- LI-BIRD has supported to establish 22 CSBs in 19 districts of the country. Through the CSBs, 1620 local crop varieties of 75 crops have been promoted.
- CSBs have been vital for supplying rice seeds during COVID-19 pandemic situation. Approximately 163.4 tons of rice seeds have been provided by 16 CSBs across the country.

Photo:Pitambar Shrestha, LI-BIRD

Community Seed Bank, Agyauli, Nawalpur

Exercise: List different CSA technologies and practices suitable for different agro-ecological sites

- Participants are divided into groups as per geographical region and one group leader is selected in each group;
- They will be asked to list out different CSA technologies and practices that are useful for their regions;
- They categorize the list of technologies and practices as per their geographical location.
- The team leader presents the group work and the facilitator provide inputs.

Further Reading

ASHA. 2018. Climate change adaptation toolbox. Adaptation for Smallholder in Hilly Areas. Ministry of Environment and Forestry (MoEF) and International Fund for Agricultural Development (IFAD).

Basnet, S., A. Bhusal, L. Khatri and R. Guragain. 2020. Animal shed and farm yard manure improvement: Climate-Smart Agriculture Technology Brief. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and Ministry of Land Management, Agriculture and Cooperative (MoLMAC), Gandaki Province, Pokhara, Nepal

Bhusal, A., N.P. Pathak, S. GC and L. Khatri. 2020. Plastic House with Drip Irrigation. Climate-Smart Agriculture Technology Brief. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and Ministry of Land Management, Agriculture and Cooperative (MoLMAC), Gandaki Province, Pokhara, Nepal

GC, S., A. Bhusal, L. Khatri and Shrestha, P. 2020. Information communication and technology (ICT) for Climate Friendly Agriculture. Climate-Smart Agriculture Technology Brief. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and Ministry of Land Management, Agriculture and Cooperative (MoLMAC), Gandaki Province, Pokhara, Nepal

Ghimire, R. 2014. Crops and Livestock Insurance Practices in Nepal. Journal of Business and Social Sciences, Vol.1, No 1 December, 2013. Available at: http://dx.doi.org/10.2139/ssrn.2427605.

Joshi, B.K., Shrestha, P., Gauchan, D. and Vernooy, R. eds. 2018. Community Seed Banks in Nepal. 2nd National Workshop Proceedings, 3-5 May 2018, Kathmandu Nepal; NAGRC, LI-BIRD and Bioversity International; Kathmandu, Nepal.

Nuryati, R., Atmaja, U., Sulistyowati, L., Setiawan, I. and Noor, T.I. 2018. Climate change adaptation and mitigation through integrated polyculture plantation application. The 2nd ASEAN Agriculture University Network (AAUN) Forum and the 1st International Conference on Sustainable Agriculture and Food Management: The Roles of Asian Agriculture Universities. 85th Anniversary, Maejo University "The Wisdom of Agriculture", Thailand.

Paudel, B., Khanal, R.C., K.C., A., Bhatta, K. and Chaudhary, P. 2017. Climate-smart agriculture in Nepal: Champion technologies and their pathways for scaling up. Policy Brief, Local Initiative for Biodiversity, Research and Development.

Pudasaini, R., Adhikari, L.D., Bhusal, A., Paudel, B. and Khatri-Chhetri, A. 2019. Building capacities for scaling-up climate-smart village in Nepal: A training manual. Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Sharma, U. 2018. Champion climate-smart agriculture practices (in Nepali). Local Initiatives for Biodiversity, Research and Development (LI-BRD), Gairapatan, Pokhara.

Session III. Poultry and Livestock-based CSA technologies and practices suitable for Mountain, Hill and Terai region of Nepal

Livestock shares about 27% of the total agricultural GDP contribution in Nepal. In the livestock sector, milk and milk products share 63 %, meat 32 % and eggs 5 % of livestock gross domestic product (MoALD, 2017). Climate change has negative impacts on water availability, forage production, quality of the rangeland and pasture, agricultural output, causing malnutrition and deteriorating the health of animals. Climate change is expected to further increase the vulnerability of livestock systems and reinforce existing factors that are affecting livestock production systems, such as rapid population and economic growth, rising demand for food and food products and conflict over scarce resources. Nevertheless, several climate-smart livestock and poultry technologies and practices are recommended by the Nepal Agricultural Research Council (NARC). By the end of this session, participants will know and will be able to categorize various livestock and poultry-based climate-smart technologies and practices suitable for their location.

A. Poultry based climate-smart technologies in Nepal

i. Climate-smart housing for poultry

Climate smart housing for poultry

Climate-smart housing with the provision of proper drinking and feeding facilities is required for commercial poultry farming to cope with very hot and cold climatic conditions. Climate-smart housing not only minimizes the risk of the bad climatic condition but also reduces labor requirements. Regarding the orientation of the poultry shed, south-east facing is recommended for tropical climate and northwest for alpine climate as it prevents from excessive hot and cold conditions in hotter and cold regions. For poultry farming, a cemented floor with dry rice husk bedding material is necessary to protect birds from cold and moist conditions whereas un-plasticized Polyvinyl Chloride (UPVC) is appropriate for roofing since that protects poultry from very hot and cold weather. Furthermore, automated cooling and heating system is also required to protect poultry from high and low temperatures. The regular flow of fresh air under the shed through exhaust fan, cut of roofing and strictly following measures helps to minimize the incidence of disease and parasite to the poultry.

ii. Stress tolerant high-yielding breeds of poultry

Development of the breeds as per changing climate is the key to minimizing poultry loss from climate change-induced disasters. Adaptive capacity of poultry to the increasing water and temperature stress already poor and it is increasingly getting low. As poultry requires short to the medium duration for production, there is always a high risk of failure due to climatic stress. Hence, the development of stress-tolerant breeds or improvement of locally available breeds that are adapted to the local condition may be the best option for poultry production in the Nepalese condition. Until now, cub-400 and cub-500, hubbird, Lohman Indian, riverside breeds of broiler, and Hyline brown, Lowman brown, hisex, bibcock, keystone, ISA brown breeds of layers and dual propose breed like newhampsire, black australorp and giriraj are recommended breeds which are reared mainly in Terai , Midhills and Hilly regions of Nepal. But, these breeds are not suitable for high hills and mountains, so there is scope to develop very hot and cold resistance breeds of poultry. Nevertheless, local breeds such as sakini, ghantikhuile, pwankhulte are well adapted to the local environmental condition. Therefore, local or indigenous poultry farming could be one of the climate-smart practices in the poultry sector. For the climate-smart production, Gandaki Province has promoted local and dual purpose breed of poultry in the farming communities through Chief Minister Environment-Friendly Model Agriculture Village Programme.

iii. Feeding management for poultry

Commercial poultry farming is dependent on concentrate feeding technique and it accounts for 60 to 70 percent of the total production cost (Uprety, 2013). With the increased price of concentrate feed, poultry farming is being costly. The scientific formulation of feed is necessary so that all nutrients, including essential amino acids and probiotics that improve bird's digestion in adverse climatic conditions, are well incorporated. The amount and time of feeding concentrate ration is also critical to protect poultry from adverse climatic conditions and to increase meat/egg production. To cope with the situation, more feed containing high protein is required during cold season and less is required during warm and hot climatic conditions. Besides concentrate feeding, incorporation of some low fiber green leafy grass and larva of insect in poultry feed is also necessary (Uprety, 2013). Improved breeds can produce more meat/egg with the supplementation of 20% green grasses and larva of insect. For layers and broilers, 100% of required feeds are provided through concentrate feeding, local breed can be reared by providing 50% concentrate feed and remaining 50% through scavenging (Uprety, 2013).

B. Livestock based CSA Technologies In Nepal

Climate smart livestock management should focus on the development and implementation of technologies that help achieve triple-win goal of productivity increment, climate change adaptation and resilience building, and climate change mitigation through reduced GHGs emission. Increased livestock productivity improves the food security. Adaptation strategies can improve the resilience of livestock productivity to climate change and the mitigation measures could significantly reduce the impact of livestock on climate change. Some of the smart techniques for livestock sector that contribute to triple win goal are discussed below.

i) Breed improvement

Low producing ruminants, especially the indigenous (local or the less producing) breeds, use a large share of their feed intake for maintenance and the subsequent GHGs emissions are spread over a relatively small level of output resulting in a higher level of emission per unit of product. But methane emission per unit of product is lesser in more productive animals. In the contrary, it is a known fact that basal/metabolic heat production increases with enhanced milk yield (Spiers et al., 2004) and lean tissue accretion (Brown-Brandl et al., 2004). So, keeping high producing animals for higher productivity also means keeping more susceptible animals to thermal stress. In addition, the indigenous (local or the less producing) breeds are better adapted to climate risks.

Thus, improving the production potential of local breeds, which are better equipped to handle climate risks, ultimately results in a lower level of emission per unit of the product without compromising the adaptation ability. Breed improvement of the local breeds could be achieved either through genetic selection in which the best ones are selected based on desired traits for breeding or through crossbreeding with high producing breeds. Improvement of breed ultimately leads to the production of the same amount of products with fewer animals, hence reducing the overall GHGs emission.

ii) Feed Management

Better feed management can improve nutrient uptake and digestibility thus reducing GHGs emission. Additionally, it also increases animal productivity and thus results in lower emissions per unit of product. Improved feed management can be achieved through:

Urea Molasses Mineral Block (UMMB)

Urea Molasses Mineral Block can reduce the GHGs emission up to 20-27% as it provides energy, protein and minerals and increases the digestibility of feedstuff. UMMB can be prepared by mixing, molding and drying the prepared blocks using 10 parts of urea, 32 parts of molasses (more than 80°Bx), 36 parts of rice bran, 6 parts of the mineral mixture, 5 parts of common salt, 6 parts of cement and 5 parts of di-calcium phosphate. Up to 500 to 800 grams of UMMB blocks could be provided to cattle and buffaloes, 60 to 125 grams to sheep and goats, and 400 to 600 grams to yak in a daily basis (Makkar et al., 2007).

Crop Residues Treatment

Crop residues represent the major portion of ruminants' diet especially in the winter season and they are of low digestibility, deficient in Protein thus limiting productivity and increasing methane emission. Crop residues could be treated with 4% urea which could reduce up to 44% emission as urea treatment leads to better digestibility of crop residues. The Urea solution is sprinkled over chopped crop residues and then treated residues are stacked and covered which could be fed after 3 weeks of treatment.

Silage feeding

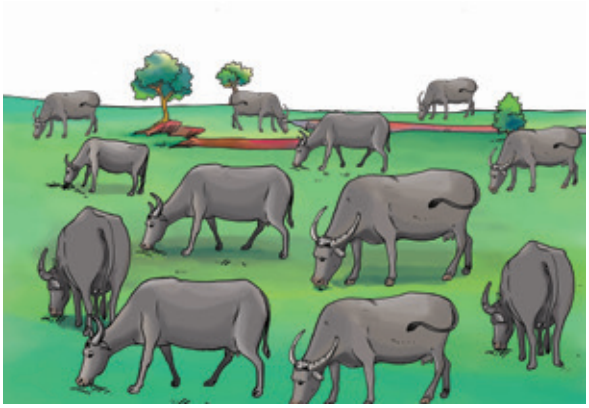
Ensuing a shortage of feed resources and its quality, especially during the time of seasonal feed scarcity, is very essential to maintain productivity and metabolic activity. Silage making is an effective method of forage preservation. Silage could be prepared from maize, sorghum, napier etc. Crops are harvested around at 50% flowering stage, chopped, wilted to reduce the moisture content to 65-70% and put in a silo pit maintaining anaerobic condition for around 2 months. Silage can be fed at 5kg per animal at beginning for adjustment and then can be fed like green fodder later. This means that silage could be used as substituent of green grass in the lean period but it is better to feed green grasses during period of availability.

Precision feeding

Depending upon the production cycle of animals, nutrient requirement differs. Precision feeding refers to matching the dietary requirement with the dietary supply of the nutrients. Accurate estimation of the nutrient requirement of an animal and supply of the same amount through accurate feed analysis not only helps maximize production but also to minimize feed waste and GHGs emission per capita animal. The nutrient requirement of a lactating animal at the stage of peak production is different from that of the dry period. Thus, providing the right amount of nutrient to the right animal at right time helps maintain a healthy rumen and maximize microbial protein synthesis which indirectly maximizes feed efficiency and decreases methane emission.

iii) Pasture management

Higher quality feed in pasture means higher feed efficiency and more nutrient absorbed by animal and less GHGs emission. In addition, forages with extensive roots system help in carbon sequestration in soil thus increasing water holding capacity of soil, enhance grassland biodiversity and protect against erosion. Pasture can be managed well through sustainable grazing management practices like reduction in grazing pressure on overstocked sites, sowing of improved pastures and rotational grazing. Promoting adapted pasture species will also be vital in reducing vulnerability of grazing lands to climate change.



Pasture management

Agricultural system accounts for nearly 70% global N_2O emission and is generated by soil biological process: nitrification (oxidation of NH_3+ to NO_2- and NO_3-) and denitrification (reduction of NO_3- to N_2). The substrate NO_3-, produced by nitrification, is required to occur denitrification. Thus, controlling nitrification is the effective approach to reduce N_2O emission. Some plants have natural ability to produce and release nitrification inhibitors from roots to suppress nitrifying activity. The perennial grasses like *Brachiaria decumbens* (Signal grass), *Brachiaria brizantha* (bread grass) and *Brachiaria mutica* (Para grass) and annual forage *Sorghum bicolor* (Sorghum or great millet) have already been introduced in mid hills and Terai region of Nepal. These species have a biological nitrification inhibition property.

iv) Biogas establishment

Gas emission and leaching of nutrients, organic matter and odor from manure have undesirable effects on the environment. Efficient treatment of manure can reduce the emission of GHGs and raise agricultural productivity. In Nepal, animal dung-based small bio-gas plants (of 2 cu m, 4 cu m, 6 cu m and 8 cu m) are constructed at the household level. The biogas technology, in one hand generates energy from manure, and on the other hand mitigates GHGs emission via substituting the firewood, kerosene and different chemical fertilizers.

Biogas

v) Control of animal diseases related to climate change (Vector-borne diseases)

The effect of climate change is indirectly linked to the severity and distribution of pathogens and their vectors. The emergence and re-emergence of vector-borne diseases also attest to climate change and human/ animal health interface. Moreover, 75% of emerging animal diseases are zoonotic. Therefore, it is more important to ensure surveillance, early diagnosis, treatment and control of such diseases.

Treatment against animal diseases

vi) Wallow and bath

The increased temperature and frequency of heatwaves are the direct effects of climate change. The extreme heat stress affects the growth, milk production, reproductive performance, meat production and disease occurrences in animals. However, the practice of allowing the buffalo and pigs for wallowing and bathing the cattle helps reduce the impacts of heat stress in summer and extremely hot weather. The buffaloes and pigs have relatively very less sweat glands in their body. Hence, they depend on wallowing, a learnt behavior, to maintain their body temperature during hot and humid conditions. Wallowing allows them to dissipate heat and protect from insects too.

Wallow and bath of Buffalo
Photo by Rani Sahu from Pexels

vii) Shed improvement and manure management

Most of the Nepalese farmers keep livestock in conventional ways with poor animal hygiene and health. Cattle shed improvement plays a crucial role in keeping the good health of animals and producing quality organic manure. The efficient handling and treatment of manure can also reduce emissions. Frequent removal of manure from the shed and storage in a covered manure pit and collection of urine for fertigation prevent escapes of GHGs particularly methane and nitrous oxide. The practice of regular emptying the floor or underneath channels/gutter and transporting the manure/slurry to the storage facility have the potential to reduce methane and nitrous oxide emission by 55% and 41% respectively (Sanjeev et al., 2018). Furthermore, improved cattle shed also contributes to keeping the environment clean and healthy. This practice is well practiced in mid hills and high hills, but it can also be practiced in the Terai region. Cattle shed improvement is a widely promoted practice by the government and development organizations and has been found effective in mid hill areas.

Improved cattleshed

Farmyard manure management

Photo: Aastha Bhusal, LI-BIRD

Exercise: List different poultry and livestock based CSA practices suitable in different agro-ecological sites

- Participants are divided into groups as per geographical region and one group leader will be selected;
- They will be asked to list out the different poultry and livestock based CSA practices;
- The practices listed will be divided based on the suitability of the different geographical locations.
- The team leader presents the group work and the facilitator provides inputs and suggestions to the team.

Further Reading

Beauchemin, K. A., Kreuzer, M., O'mara, F., and McAllister, T. A. 2008. Nutritional management for enteric methane abatement: a review. Australian Journal of Experimental Agriculture, 48(2), 21-27.

Brown-Brandl, T. M., Nienaber, J. A., Xin, H., and Gates, R. S. 2004. A literature review of swine heat production. Transactions of the ASAE, 47(1), 259.

Grossi, G., Goglio, P., Vitali, A., and Williams, A. G. 2019. Livestock and climate change: impact of livestock on climate and mitigation strategies. Animal Frontiers, 9(1), 69-76.

Makkar, H. P., Sánchez, M., and Speedy, A. W. (Eds.). 2007. Feed supplementation blocks: urea-molasses multinutrient blocks: simple and effective feed supplement technology for ruminant agriculture (No. 164). Food and Agriculture Org.

MoALD. 2017. Statistical Information on Nepalese Agriculture. Ministry of Agriculture and Livestock Development, Singhadurbar, Kathmandu.

Pokhrel, P.K., S.P. Neupane, S. Sapkota and R. Kandel. 2012. Indigenous Livestock Breeds of Nepal. Animal Breeding Division. Nepal Agricultural Research Council, Khumaltar, Lalitpur.

Sajeev, M., Purath, E., Winiwarter, W., and Amon, B. 2018. Greenhouse gas and ammonia emissions from different stages of liquid manure management chains: abatement options and emission interactions. Journal of environmental quality, 47(1), 30-41.

Spiers, D.E., Spain, J.N., Sampson, J.D., and Rhoads, R.P. 2004. Use of physiological parameters to predict milk yield and feed intake in heat-stressed dairy cows. Journal of Thermal Biology, 29(7-8), 759-764.

Uprety, C. and S. Uprety. 2013. Hand book of Livestock, Poultry and Fish Nutrition in Nepal.

MODULE 4

Photo: Hem GC, LI-BIRD

INTEGRATING GENDER AND SOCIAL INCLUSION IN PLANNING, IMPLEMENTATION AND MONITORING OF CLIMATE-SMART AGRICULTURE

	Time needed:	1 Day
	Materials needed:	Meta card, projector, brown paper, marker

Overview

Women make an important role in the agricultural sector as they are more involved in farming besides household chores. In developing countries, 43 of the agricultural labor force are women with considerable variation across regions and within countries (FAO, 2011). It is utmost that the information, services, resources, technologies etc. are provided to the women farmers so as to increase the efficiency of the workload and bring about transformational changes in agricultural sector.

This module introduces participants on how climate change is affecting women and provides an overview of the interconnectedness of women with agriculture and climate change. It also introduces participants to the major national policies related to climate change and agriculture, gender-responsive budgeting and makes participants familiar with women-friendly tools to reduce women's drudgery in agriculture.

Objectives

At the end of this module, participants will be able to

- define the relationship between women, agriculture and climate change;
- internalize why gender integration is an important component of CSA;
- learn about women-friendly CSA practices;
- understand policy provisions for gender in agriculture and climate change.

Session I. Importance of Gender and Social Inclusion and its interconnection in Nepalese agriculture systems

Women, agriculture and climate change in Nepal

The impact of climate change is different in all sectors of Nepal. However, Nepalese agriculture is more affected due to its high exposure to nature and dependency on weather conditions. Besides, climate change impacts on agriculture is more important to women because of the increased role of women in Nepalese agriculture due to ongoing socio-economic and demographic changes in rural areas because of the outmigration of men. Central Bureau of Statistics data in 2011 shows that more women (76.7%) are involved in agriculture than men (54.6%). As the statistics show, despite women's large role in agriculture in Nepal, there remains a wide gender gap in access to and control over resources that affect overall agricultural productivity and disempowers women farmers in Nepal.

Besides, the unequal gender roles defined by the society in Nepal further makes women more exposed and sensitive to climate change and reduce their ability to respond to its impact. Unless these gender dynamics and differential impacts are understood and gender needs and priorities are integrated into relevant policies and programmes, climate change adaptation in agriculture and other sectors becomes less effective. Hence, women-responsive, climate-smart and transformative agricultural systems, technologies, practices and approaches are essential to improve food and nutrition security by improving and sustaining agricultural productivity and livelihoods and contributing to broader development outcomes by addressing the interconnected challenges of gender inequality and building resilience to climate change.

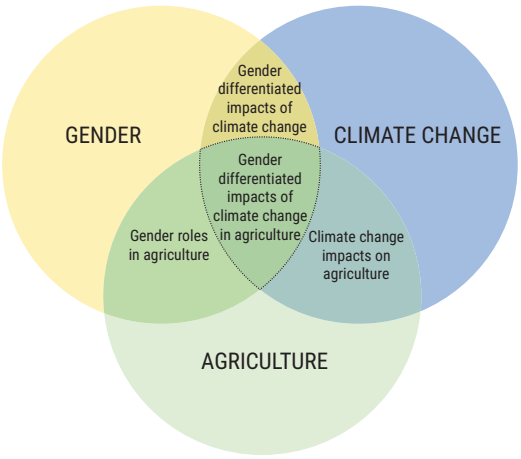


Figure 6. Gender, Agriculture and Climate Change Nexus. Source: Poudyal et al., 2019

Climate change and women work burden

Climate vulnerability affects women the most not only because of their direct exposure to nature but also because migration that has drastically affected the household composition and feminized agriculture, especially in the rural areas. Women's vulnerability is more because of their direct relationship with day-to-day farming activities and poor ability to respond to risks. The effect of climate change is seen in the form of the prolonged drought period, which has resulted in increased weeds, and since weeding is primarily the job of women their workload has increased due to the impact of climate change (Bhatta, 2015). The adverse effect of climate change on women is also related to the frequency and intensity of rainfall. The drying up of water sources, erratic rainfall or drought, increase in pest, disease and weeds have multiple effects on women's adaptive capacity. An increase in male migration directly affects the agricultural workload and the day-to-day lives of women. Factors like overburdening, poverty, lack of education, skills and income also constrain women's access to information and exploration of diversifying livelihoods options within agriculture and off-farm sectors.

Women of rural villages have work burden

Case I:

Agriculture now needs more attention than earlier because of climate change. It requires more field observation and a more frequent spray of pesticides for the control of pests and insects. Women need to work hard to manage water for irrigation and more frequent weeding is needed in the field. Earlier, irrigation and application of pesticide and insecticide were seen as key tasks performed by men. As men are out of home now, women have taken the responsibility to manage these tasks, which is an 'add-on' to their already exhausting workload. Women now are indiscriminately responsible for both their 'own' work and the traditional 'male jobs' in agriculture such as irrigation, ploughing, pest control causing time poverty.

'Earlier, there used to be rainfall in the time of sowing of maize, nursery establishment of rice, panicle initiation of rice. These are the critical water-requiring period of crops. These days, it does not rain'-Women at Kuleni Rajhar group, Nawalparasi

Case II:

Rural women are responsible to manage water for domestic use in Nepal. The decrease in volume or dried spring water may increase the women's work burden in fetching water for domestic use.

A study carried out in the Melemachi watershed revealed 85% of the fetching activity is carried out by women. Local people have experienced a decrease in seasonal spring by 10% in the last 10 years. While the water volume of 44% of perennial spring has decreased by up to 50%. This decrease in the easy availability of water for women increases their involvement in water fetching time and limits their participation in productive work.

Source: Shrestha et al., 2019 (retrieved on 25 Feb 2020 (https://journals.sagepub.com/doi/full/10.1177/2158244018823078#)

Session II. Assessing CSA tools, technologies and practices

Any kind of tools and technologies that help women to reduce their work burden and save time will encourage women to engage in farming and contribute to increased agricultural productivity. Several low-cost innovations are available to reduce women's drudgery and increase farm productivity and women resilient to climate change.

All CSA practices may not be gender-friendly, and even innovative technologies identified by the research may not be adopted by farmers. Therefore, need assessment to search and select the right tools and technologies is the key initial step for the implementation of CSA. Women responsible tools and practices suitable in a particular context are easily adopted by the community. LI-BIRD used two criteria on how the selected CSA technologies and practices will contribute/improve or do no harm in the conditions and positions of the women and poor farmers.

Table 9: The pool of technologies/tools and practices are further selected under the criteria on how these practices contribute to improve or do no harm in the conditions and positions of women. Further indicators on each of the criteria are developed for context and location-specific gender- friendly CSA.

Criteria I: Condition of women	Criteria II: Position of women
Time-saving and drudgery	Leadership skill and role
Access to knowledge	Influencing decision- making
Income	Recognition
Nutrition	
Health	

Here are few examples of women friendly time saving tools to reduce the women work load

	**Jab planter:** Jab planter is a seed showing tool. This machine can reduce people and livestock requirements for land preparation and seed showing. It is a light-weight and single women can easily handle it for showing in line.
	**Corn sheller:** Hand corn sheller is a simple tool to separate maize seed from the cob. It is portable, inexpensive, easy to operate and available in the market. This machine is time-saving and reduces injuries and blisters for women farmers.
	**Millet thresher:** Traditionally millet threshing is time consuming and labor intensive. Millet thresher is time saving.
	**Farm rake:** Women are mostly responsible for cleaning animal shed, removing and cutting weeds. Farm rake is one of the tools for women to cut or remove weeds. This tool is equally useful in collecting cow/buffalo dung in animal shed leaving women's hand clean and unwounded.
	**Yam in sac:** Usually men are responsible to dig yams. The practice of cultivating yam in sacks at the base of the terrace wall is time as well as labor saving.

Exercise: Calculate the efficiency of corn sheller

- The participants are divided into different groups each comprising of 4-6 members.
- One group provided with 5 cobs and one corn sheller
- Tell them to shell the corn and record the time.
- Another group provided with 5 corn and tell them to shell by their hand and record the time.
- The calculation between two cases can be done and let participants know about how efficient the tool is.
- Further discuss in plenary: What are the climate-smart agriculture tools that will help to contribute to increase the resilience of women, poor, disadvantage and marginalized community (See table above for examples of women-friendly tools and practices)

Session III. Gender responsive planning, implementation and monitoring of CSA

The increase in women's workload has rendered multiple effects on women's health, income, safety, nutrition, violence against women, and ultimately in women's social, economic and political empowerment. The climate challenges have exacerbated their existing marginalization and limited them from accessing knowledge of adaptation, technologies, climate finance and infrastructure. To integrate gender in CSA, basic information on the status of gender inequality in the particular project sites and communities should be considered against which interventions are planned, implemented and monitored.

Considerations while planning CSA

- Gender analysis and mapping of roles: It is important to understand the engagement of men and women in farming activities and also analyze the differential impact of climate change in the local context. This analysis will give a background of the vulnerability status of women based on which CSA interventions can be identified/developed.
- Identification of CSA actions and interventions that improve the condition and position of women: Identification of women responsive technologies, practices suitable at the local context will help to improve the condition of the women.
- Identification of targeted communication materials and specific training and capacity building needs.

Considerations while implementing CSA

- Production of simple but effective communication means to reach women as males and females have different capacities to understand the information. Even the capacity of women to understand and read knowledge products are not homogenous in Nepal. Hence, attention should be paid while generating knowledge products targeting women in different parts of Nepal.
- Consider how the identified interventions benefit women and men equally also make sure the identified interventions for CSA do no harm to women.
- Women and men may not access information from the same place or same way. Hence, it is important to make sure suitable time, locations and right resource person is selected for training to benefit men and women equally.
- Eliminate any kind of discrimination between men and women while implementing the CSA intervention. Consider that women equally participate in the planning, design, testing and implementation of CSA interventions.

Considerations while monitoring and evaluating CSV

- Monitoring and evaluation for the effectiveness of CSA tools for women: After the selection and promotion of CSA tools and technologies, it is necessary to carefully monitor the effectiveness of the technologies and practices before we go for large-scale promotion.
- To assure if climate-smart agriculture technologies and interventions implemented are gender-responsive, the following additional criteria and indicators can be used in CSA M and E framework.

Criteria	Indicators	Positive	Neutral	Negative
Condition of women	Time saving and drudgery reduction			
	Access to knowledge			
	Income			
	Assets			
	Nutrition			
	Health			
Position of the women	Leadership skill and role			
	Influencing decision-making			
	Recognition			

Session IV. Gender responsive budgeting and coding

- Gender responsive budgeting and coding is the key factor to translate the policy into actions. From the year FY 2013-2014, the government of Nepal is using climate change code to track its investment as a response to climate change. In addition to climate change, GoN also uses gender-responsive budgeting with separate budget codes. This budgeting category includes direct responsive, indirect responsive and neutral based on the level of targeted investment to reach out and benefit women as detailed out below:
  - » Direct Responsive: if 50 percent or more budget directly reaches and benefits women
  - » Indirect Responsive: if 20-50 percent of the budget directly reaches and benefits women
  - » Neutral: if less than 20 Percent of the budget directly reaches and benefits women

Table 10. Indicators to assess the percentage

Indicators	Score
Women Participation in the formulation and implementation of Program	20
Women Capacity Development	20
Women's share in benefit	30
Support in employment and income-generating to women	20
Quality reform in time consumption and minimization in of workload to women	10

Source: Ministry of Finance, Gender Responsive Budget Guideline

Session V. Women responsive policies, strategies and mechanisms and its importance

The availability of women responsive CSA tools and technologies only is not enough for the integration of gender in CSA. Supportive policy provisions are equally essential to help women use and benefit from climate-smart technologies. Harmonization among various policy frameworks and programme is equally essential to increase women's role in agriculture and make agriculture climate smart. There are several policies and strategies for gender, agriculture and climate change in Nepal. The section below highlights some key policies and strategies with their specific provisions in agriculture and climate change targeting women.

National Agriculture Policy (2004)

The National Agriculture Policy (NAP) aims to transform current subsistence-oriented farming systems into a commercial and competitive farming system. In terms of gender, the policy recognizes that women play a significant role in agricultural production and their participation is necessary for any agricultural development interventions. This policy also recognizes that women farmers have specific needs and therefore need-specific support but lacks the empowerment perspective.

Key provisions of the NAP

- Achieve 50% of women's participation in all agricultural production-related interventions, institutions and organizations.
- Mobile training camps to help women participate in training.
- Ensure the flow of disaggregated data and information related to the involvement of women.

Gender Mainstreaming Strategy (2006)

The government has developed a Gender Mainstreaming Strategy for the agriculture sector with an objective to reduce gender inequity and address systemic patterns of disadvantage in the agriculture sector. The strategy has

a specific focus to operationalize commitments made by National Agriculture Policy towards increasing women's participation in agriculture intervention to 50%, capacity building through mobile training and establishing the disaggregated database.

Strategies and interventions proposed by Gender Mainstreaming Strategy (2006)

- Increase the participation of women and their access to input and services for high-value production and Agri- enterprises;
- Support for irrigation scheme demanded from women farmers' groups;
- Development of women technicians for better reach to women farmers;
- Formation and mobilization of women farmers' groups to deliver input and services;
- Gender disaggregated database and monitoring;
- Gender Focal Desk and involvement in planning, monitoring, capacity building;
- Research and coordination with other actors on women-specific matters;
- Support for women's agro enterprise (high-value crop).

Though the strategy has proposed specific interventions to reach, benefit and empower women farmers, it is silent on the impact of climate change on women and need for specific interventions in the context of climate change. The gender mainstreaming strategy, therefore, needs to be updated to make it more responsive to the changing context of climate change and the needs and priorities of women farmers. On the other hand, there is little evidence that these strategic interventions are translated into respective guidelines, plans and backed up by the resources. For implementation, the strategic measures outlined in the strategy need to be well integrated into other sectoral plans and budget secured accordingly.

Nepal Agricultural Extension Strategy (2007)

The Government of Nepal has introduced Nepal Agricultural Extension Strategy in 2007 as an integral element to reach and expand coverage of agriculture technology adoption and access to service among farmers. The strategy emphasizes efficient and effective services to agricultural producers through the decentralization of extension services. Although women are an integral part of agriculture, the strategy does not have enough provisions to reach and benefit women farmers.

National Seed Vision (2013-2025)

Protection, conservation and development of climate-resilient varieties are some of the important strategies of CSA. Women are primary users of seeds and are mainly responsible for the production, harvesting, processing, storage and use of seeds in farming communities. Increasingly, women are also taking lead in the marketing of seeds. Therefore, National Seed Vision (2013-2025) has significance for women farmers.

The seed vision recognizes the impact of climate change on the seed sector and a need for developing climate-resilient varieties (flood, drought and pest/ insect resistant) for adaptation. The vision also acknowledges the important role women play in agriculture generally and in the maintenance and use

The vision recommends the following measures to reach and benefit women.

- Encouraging the participation of women and disadvantaged groups in producers' groups and labours' organizations.
- Minimizing entry barriers for women and disadvantaged groups in seed value chains.
- Improving the income of women and disadvantaged groups from seed value chains.

of seed particularly. It proposes for specific interventions to build the capacity of women and other marginalized for equal access to information, skills, services and seed use. It envisages that 50% of additional employment generated from seed production and value chain will be absorbed by rural women and the poorest.

National Agrobiodiversity policy (revised 2014)

Agro-biodiversity policy (first developed in 2006, revised in 2014) guides the overall interventions of the government towards identification, protection, conservation, development and sustainable use of plant genetic resources. Women are primary users of biodiversity and loss of biodiversity affects women immediately. Being primary users, women also possess important knowledge and skills related to biodiversity conservation, protection and sustainable use. Except provisioning of one woman farmers' representative at the national level steering committee, the policy is silent on the role of women in agro-biodiversity conservation and management. The policy is also silent on whether and how women farmers will be reached, benefited and empowered in the process of identification, protection, conservation, promotion and sustainable use of agro-biodiversity. It does not have any specific provisions on how to empower women farmers to participate in agrobiodiversity conservation and promotion measures.

Agriculture Development Strategy (ADS) (2015-2035)

The ADS is an important policy document of the GoN providing the direction of Nepalese agriculture for the next two decades. In terms of gender integration, the ADS has some important provisions and targets related to women farmers especially aimed to reach, benefit and empower in the long run. The strategy has a specific output:

"Establish a comprehensive set of mechanisms at the policy, planning, and implementation levels to assure gender equity, social inclusion, and geographical inclusion in the ADS through capacity building of relevant institutions at the central and local level." (ADS, 2015, page 63).

Specific provisions outlined in ADS to reach, benefit and empower women farmers:

- Awareness-raising about women's rights to land and its significance on agriculture production.
- Increase women's land ownership (single or joint) from 10% (in 2010) to 50% by 2035.
- Specific provisions to promote women organizations and co-operatives to achieve economies of scale in technology dissemination, marketing, finance and logistics.
- Encourage women for agro-entrepreneurship through innovation and agro-entrepreneurship programme.
- Create job opportunities for women through the value chain.
- Training on financial management for farmers, cooperatives, agri-entrepreneurs, rural women and rural youth to enhance agricultural enterprise creditworthiness.

Further Reading

Bhusal A., L. Khatri, S. Neupane, N. Yadav, A. Khatri-Chettri and Y. Malla. 2019. Communicating Climate-Smart Agriuclture to the Stakeholdes: Impact of LI-BIRD/CCAFS Travelloing Seminars in Climate-Smart Villages of Nepal: Assessment Report. LI-BIRD/CCAFS

FAO. 2019. Country gender assessment of agriculture and the rural sector in Nepal retrieved from https://reliefweb.int/report/nepal/country-gender-assessment-agriculture-and-rural-sector-nepal

LI-BIRD. 2019. Scaling up Climate-Smart Technologies and Approaches Using Travelling Seminar as a Method and Tool in Nepal

LI-BIRD. 2020. Women responsive agricultural systems: Approaches and Practices appropriate for smallholder farmers in Nepal: A study report retrieved from file:///C:/Users/User/Downloads/Documentation%20on%20Women%20Responsive%20Agriculture-Assessment%20Report.pdf Travelling Seminars in Climate-Smart Villages of Nepal

Sherpa, L. and Thapa, B. 2019. Travelling Seminar: action for strengthening elected women's leadership in Local Government for Scaling up Climate Smart Village Approach in Nepal

Please refer : (Image) https://www.youtube.com/watch?v=yMFx4AJ7DcA

www.libird.org: Sustainable Agriculture Kits (SAKs) Reduce Drudgery and Increase Farm Income

MODULE 5

Photo: Hem GC, LI-BIRD

LEARNING FROM THE FIELD AND ACTION PLAN PREPARATION AND CLOSING

	Time needed:	1 Day
	Materials needed:	Meta card, projector, brown paper, marker

Overview

In this practical session, the participants are divided into different mixed groups based on the number of participants and provided orientation and information about the farming communities and tasks they are expected to perform in groups. A field visit will be conducted for groups in a community where CSA practices have been implemented. Each group interacts with the farmers and their institutions and raise their queries on the approach and specific interventions. The participants can also provide on the site suggestions to the individual farmers and farmers' group for the betterment of the technology they are adopting in their sites.

After the field visit, the participants are asked to identify the climate vulnerability of the communities and suggest appropriate CSA technologies and practices to better address the problems considering the agroecology, technical feasibility and farmer's affordability. Each group is asked to prepare a CSA action plan to suggest farming communities in the visited site for implementation.

Objectives

At the end of this module, participants will be able to:

- Develop action plan to reduce climatic risk of a specific area.

Session I: Field visit to the CSA demonstration site

Procedure

- The participants are divided into mixed groups each comprising of 5-6 members and a group leader is selected.
- The group will receive information about the visiting communities and the tasks to be performed prior to field visit.
- The participants visit the CSA demonstration sites.
- Each group is asked to identify climate vulnerability and make their separate CSA action plans based on the field observation and community interaction.
- Each groups will also identify potential CSA technologies and practices and different stakeholders with roles for its implementation;
- The facilitators will provide needed support for the group exercise; and
- The group leader from each group is asked to make the presentation and feedback and suggestions are provided by facilitator.

Session II. Participant's reflection and facilitator's remark and feedback collection

After the completion of the regular sessions, the facilitator hands over the session to the organizer for reflection, evaluation and closing. The organizer will request participants to give their honest feedback on the training outcome, session delivery, venue and logistics so that it can be considered as a learning to improve future training programmes. Similarly, available facilitators will be requested to provide their observations and suggestions to the participants and organizers.

Participatory evaluation

The evaluation of the training can be done through an assessment of the level of technical information received and understood by the participants. The organizer, with the support of facilitators, can prepare a questionnaire in advance which will be used for both pre and post-training assessment of the participants.

Session III. Certificate distribution and closing

At the end of the session, certificates are distributed to the participants.The closing of the programme is done by the organizer by thanking all the participants for their active participation and making the training programme successful.

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