



BANKERS INSTITUTE OF RURAL DEVELOPMENT, LUCKNOW
(Designated Nodal Training Institution at Central Level by GoI under the
Central Sector Scheme on Formation & Promotion of 10000 FPOs)

**FPOs are
growth
engine of Indian
Agriculture**

Trainer's Note **Hi-Tech Agriculture**

under
**Central Sector Scheme on Formation &
Promotion of 10000 FPOs**



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PROGRAM OUTLINE

Program objective	To equip the Farmers Producers Organisations (FPOs) to understand, appreciate, imbibe, and adopt Hi-Tech Agriculture systems and practices under the Central Sector Scheme on Formation & Promotion of 10000 Farmers' Producer Organisations (FPOs)
Duration	4 days
Course content	1. Hi tech agriculture techniques and relevance in Indian context 2. Systems of crop intensification 3. Efficient water management techniques, fertigation and its potential in different crops 4. Concepts of Protected cultivation and its advantages (Green house, Poly house, Shade net) 5. Cultivation concept of High Density & Ultra High-Density plantations and its applicability in different crops 6. Precision farming concepts, methods & components, benefits and scope of precision farming 7. Concepts and importance of Integrated Farming Systems (Agroforestry, agro horticulture, Aquaponics) 8. Commercial aspects of model hi-tech agro projects, examples of bankable models 9. New generation farming techniques - Hydroponics, Aeroponics, Aquaponics, vertical farming 10. Hi-tech applications in allied sectors (dairy, poultry, beekeeping, piggy, etc.) 11. Digital agriculture, advantages, and applications of IOT in agriculture-concepts, role of Big Data and AI in farming and productivity and faster yields 12. Initiatives of hi-tech agri-startups and collaborations with FPOs
Target Participants	BODs & Officials of FPOs

TRAINING PLAN

The facilitator need not cover all the topics in the list below in great detail. Alternatively, multiple topics can be covered during the same session by splitting up the study between sub-groups. The Field visit and debriefing would be more useful for participants.

N	SESSION TITLE	DAY	TIME (HOUR)
1	Formal Inauguration, Introduction	1	1.5
2	High Tech Farming - an Introduction	1	1.5
3	System of Crop Intensification (SCI)	1	1.5
4	Climate-Smart Agriculture (CSA)	1	1.5
5	Integrated Farming Systems	2	1.5
6	Integrated Pest Management and Integrated Nutrient Management	2	1.5
7	Managing Water Efficiently	2	1.5
8	Protected Cultivation	2	1.5

N	SESSION TITLE	DAY	TIME (HOUR)
9	Soil-Less Farming	2	1.5
10	High-Density and Ultra High-Density Plantations	2	1.5
11	Internet of Things (IoT) for Agriculture	4	1
12	Precision Farming	4	1
13	Collaborations between Agri-Startups and FPOs	4	1
14	Action Planning for how to introduce Hi-tech Agriculture in FPOs, Feedback, Valedictory Ceremony	4	1.5
	Field Visits and Debriefing sessions to be incorporated preferably on day 3 – and those technologies that will be covered during the field visit can be covered in brief in the classroom.	3	1 day

SESSION 1: HI-TECH FARMING – AN INTRODUCTION

CONCEPTS, NEED, ADVANTAGES, POTENTIAL, AND TECHNIQUES

SYNOPSIS

In the introductory session, the participants will understand the concept of hi-tech agriculture. There are several advantages and potentials of hi-tech agriculture for small and marginal farmers in India. It can use one or more hi-tech agriculture techniques: soil-less agriculture, protected cultivation under greenhouse, hydroponics, aeroponics, vertical farming, tissue culture-based units, nanotechnology-based farm practice. Participants will also identify the high-value crops and their potential to maximize profit. There are several government institutions and schemes to support hi-tech agriculture.

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

At the end of the session, the participants will understand the promise and potential of hi-tech agriculture. They will also develop a familiarity with seven high-tech agricultural practices. They can analyze the potential of such practices in farming activities in their FPOs.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction		15 min	Presentation slides
2	Introduction to different methods of hi-tech agriculture	Video presentation Group discussions	35 min	Chart Videos (offline)
3	Identifying high-value crops	Group discussions	35 min	Chart

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language, especially to locate videos in local language. Encourage the participants to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator will provide an overview of the session. Then the facilitator will introduce the concept of hi-tech agriculture to the participants, its advantages, and potential areas of application.
Task 2: Introduction to seven methods of hi-tech agriculture	In this task, the class will explore different types of hi-tech agriculture: soil-less agriculture, protected cultivation under greenhouse, hydroponics, aeroponics, vertical farming, tissue culture-based units, nanotechnology-based farm practice. The class will understand the methods and their practical applications using video case studies.
Task 3: Identifying	In this activity, the facilitator will first present the high-value crops (HVCs) list

TASKS	ACTIVITIES
high-value crops	that the farmers might consider using one or more hi-tech agriculture methods. In the previous activity, the class has explored seven different methods. The class will form 3 or 4 groups. Based on the HVCs, the group will first identify the HVCs in their areas. In a chart, they will create a table to list those HVCs. For each HVCs, the group will also mention the most relevant hi-tech agriculture method they deemed fit. At the end of 10 minutes, the facilitator will call each group to present their HVC selection and method to the class (20 minutes). The class will discuss their findings and learnings.
Task 4: Summing up	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. Are you familiar with any of the hi-tech agriculture techniques? Share what you know with your peers.
2. Do you see any potential for hi-tech farming practices in your area? Illustrate with one example.
3. What are the disadvantages of hi-tech farming?
4. How can your FPO benefit from hi-tech farming?

BACKGROUND READING

1. IARI. *Technological Options for Enhanced Productivity and Profit*. New Delhi: Indian Agricultural Research Institute, 2014.
<https://www.zotero.org/groups/4505676/fpo/items/WDC22MBV/library>.
2. TNIE Videos. *This 23-Year-Old Andhra Farmpreneur Sows Seeds of Soil Less Farming*. Video, 2021. <https://www.zotero.org/groups/4505676/fpo/items/63J8FEQN/library>.
3. The Hindu. *All about Hydroponics*. Video. Accessed November 15, 2021.
<https://www.zotero.org/groups/4505676/fpo/items/42AXS6QI/library>.
4. MANAGE India. *Protected Cultivation*. Video, n.d.
<https://www.zotero.org/groups/4505676/fpo/items/YGVRR3I9/library>.

SESSION 2: SYSTEMS OF CROP INTENSIFICATION

CROP INTENSIFICATION MODELS/METHODS – SRI, SWI, SSI, SCI

SYNOPSIS

This session introduces systems of crop intensification (SCI). It has explained the methods on System for Rice Intensification (SRI), System for Wheat Intensification (SWI), and System for Sugarcane Intensification (SSI).

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing the session, the participants will know the different methods of crop intensification. They will also have in-depth knowledge of crop intensification techniques in one or more crops – rice, wheat, and sugarcane.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation slides
2	Methods of SCI for crops	Presentation Video	80 min	Presentation Video

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials. If the facilitator knows the crops grown by the participating FPOs – specific crop intensification materials can be prepared.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. In the introduction, the facilitator explains the SCI concept.
Task 2: Methods of SCI for crops	The facilitator will select crops that are relevant for the participants. The class will use the presentation to understand the techniques of crop intensification. It will also use videos to learn the processes. The key principles behind crop intensification will be stressed upon.
Task 3: Summing up	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. What are the advantages of crop intensification?
2. What are the cost implications of crop intensification?
3. What are the resources required for crop intensification?

4. How much increase in output can be expected for crop intensification?

BACKGROUND READING

1. TNAU Agritech Portal. n.d. "System of Rice Intensification (SRI)." TNAU Agritech Portal. <https://agritech.tnau.ac.in/sri.html>.
2. "The System of Crop Intensification: Reports from the Field on Improving Agricultural Production, Food Security, and Resilience to Climate Change for Multiple Crops." 2014. *Agriculture & Food Security Volume*, no. 4. <https://doi.org/10.1186>.
3. National Bank for Agriculture and Rural Development. 2016. "The System of Crop Intensification: Agroecological Innovations for Improving Agricultural Production, Food Security, and Resilience to Climate Change." 2. NABARD Knowledge Series. Mumbai: National Bank for Agriculture and Rural Development. <https://www.zotero.org/groups/4505676/fpo/items/5Q4LUHNA/library>.

SESSION 3: CLIMATE SMART AGRICULTURE (CSA)

VULNERABILITIES AND ADAPTATION STRATEGIES

SYNOPSIS

In this session, participants will learn about the concepts, approach, and significance of climate smart agriculture (CSA).

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing the session, the participants will be able to define what climate smart agriculture means, recall the objectives of CSA, list its key characteristics, and describe some examples of CSA with the positive impact.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	5 min	Presentation slides
2	Introduction to Climate Smart Agriculture (CSA)	Presentation and discussion	20 min	Presentation slides
3	Characteristics of Climate Smart Agriculture (CSA)	Presentation and discussion	35 min	Presentation slides
4	Climate Smart Agriculture (CSA) – Technologies and Practices	Presentation and discussion	25 min	Presentation slides
5	Discussion	Discussion	5 min	Whiteboard

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session Introduction	The facilitator sets the session objectives and structure for the participants. In the introduction, the facilitator asks participants what are the recurring challenges that they attribute to climate change. Following the responses from the participants, the facilitator asks if agriculture can adapt to climate change.
Task 2: Introduction to Climate Smart Agriculture (CSA)	Using a presentation, the facilitator introduces the concept of CSA: • Which organisation developed the concept? • What are the objectives of CSA? • What are the focus areas of CSA? • What does the approach involve?

TASKS	ACTIVITIES
	• What impact is it designed to have? • What benefits will it yield?
Task 3: Characteristics of Climate Smart Agriculture (CSA)	Using a presentation, the facilitator introduces the key characteristics of CSA: • What are the characteristics? • What are the components of a CSA plan?
Task 4: Climate Smart Agriculture (CSA) – Technologies and Practices	Using a presentation, the facilitator discusses some well-documented examples of successful CSA: • The projects, such as Climate Smart Village • The key pillars in the project • The technologies and practices used under each pillar • The interventions and the benefits
Task 5: Summing up	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. What risks does climate change pose to farmers?
2. What risks does climate change pose to society?
3. Can farmers do something to cope with climate change?
4. Can the way we do agriculture adapt to climate change?
5. Are any of the available government schemes relevant to my FPO?

BACKGROUND READING

1. Bell P, Namoi N, Lamanna C, Corner-Dollof C, Girvetz E, Thierfelder C, Rosenstock TS. 2018. A Practical Guide to Climate-Smart Agricultural Technologies in Africa. CCAFS Working Paper no. 224. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.cgiar.org
<https://ccafs.cgiar.org/resources/publications/practical-guide-climate-smart-agriculture-technologies-africa>
2. Jat, ML, HS Jat, T Agarwal, D Bijarniya, SK Kakraliya, KM Choudhary, KC Kalvaniya, et al. 2020. A Compendium of Key Climate Smart Agriculture Practices in Intensive Cereal Based Systems of South Asia. New Delhi: International Maize and Wheat Improvement Center.
<https://www.zotero.org/groups/4505676/fpo/items/5JDLZ66V/library>.
3. This section has drawn heavily from <https://csa.guide/> - <https://csa.guide/csa/what-is-climate-smart-agriculture>
4. FAO. 2013a. Climate-Smart Agriculture: Sourcebook. Rome, Italy: Food and Agriculture Organization of the United Nations. <http://www.fao.org/3/a-i3325e.pdf>
5. Deepika, Suchiradipta, B., and Saravanan, R. 2018. Climate Smart Agriculture towards Triple Win: Adaptation, Mitigation and Food Security. MANAGE Discussion Paper 5, MANAGE-Centre for Agricultural Extension Innovations, Reforms and Agripreneurship (CAEIRA), National Institute of Agricultural Extension Management, Hyderabad, India
6. <https://www.manage.gov.in/publications/discussion%20papers/MANAGE-Discussion%20Paper-5.pdf>

SESSION 4: INTEGRATED FARMING SYSTEMS

CONCEPT, IMPORTANCE, AGROFORESTRY, AGRO-HORTICULTURE

SYNOPSIS

In this session, participants will learn about the concept and importance of Integrated Farming System (IFS) and also agroforestry and agro-horticulture.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing the session, the participants will be able to define what an integrated farming system is, list and explain the components of an IFS, recall some models of IFS, and also recall the successful IFS models.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation slides
2	Integrated farming	Brief Presentation – with group discussions	10 min	Presentation slides, Videos
3	Components of IFS		15 min	
4	Different models of IFS		30 min	
5	Successful IFS		15 min	
6	Discussion	Discussion	10 min	Whiteboard

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. What system do corporate farms prefer and why? What do large farmers prefer and why? What would work better for small and marginal farmers?
Task 2: Integrated Farming	The facilitator makes a brief presentation that introduces the IFS concept to the participants: • What are the core design principles of an IFS? • What are the goals of an IFS? • What enterprises are typically part of an IFS? • How do these enterprises come together to create benefits?
Task 3: Components of IFS	The facilitator makes a presentation that introduces the components of IFS to the participants:

	• What are the typical components of an IFS?
Task 4: Some IFS Models	The facilitator makes a presentation that gives an overview of some IFS models: • What was the initial condition? • What was the net income before the IFS was established? • What were the components of the customised IFS? • What was the net income after the IFS was established?
Task 5: Successful IFS – Examples	The facilitator, with the use of carefully selected videos, introduces more examples of success IFS.
Task 6: Discussion	The facilitator spends a few minutes to wrap up the discussion on IFS

QUESTIONS FOR DISCUSSIONS

1. Why do modern farming systems prefer monocultures? What are the benefits and harmful effects of such systems?
2. Why are integrated farming systems important in the current time?
3. What is a more suitable farming system for smallholders?
4. Do you know farmers who have implemented IFS successfully? In what way has it improved their livelihood and life?

BACKGROUND READING

1. TNAU Agritech Portal, n.d. "Integrated Farming System" TNAU Agritech Portal.
https://agritech.tnau.ac.in/agriculture/agri_majorareas_ifs.html
2. MYRADA KVK (2008) Integrated Farm Development: Effective Utilisation of Farm, Home and Human Waste - A Users' Guide.
https://www.indiawaterportal.org/sites/default/files/iwp2/integrated_farm_development_users_guide_english.pdf
3. Panwar, A.S. & Ravisankar, Natesan & Singh, Raghuveer & Prusty, A K & Shamim, Mohammad & Ansari, Meraj & Noopur, Kohima. (2021). Potential integrated farming system modules for diverse ecosystems of India. *Indian Journal of Agronomy* 66 (5th IAC Special issue). 15-32.

SESSION 5: INTEGRATED PEST MANAGEMENT AND INTEGRATED NUTRIENT MANAGEMENT

SYNOPSIS

In this session, participants will learn about the concept and importance of Integrated Pest and Nutrient Management – with an objective of reducing cultivation costs through rational use of agri-chemicals and improve the safety of food.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

At the end of the session participants will be able to:

- Describe the concept and principles of IPM and INM
- Describe some of the methods under IPM, INM
- Discuss application of IPM, INM in the FPO

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Introduction to IPM	What is IPM? why is IPM critical for sustainable farming among FPO members?	10	Presentation slides Charts and markers
2	Practices and technologies of IPM	Principles of IPM Examples of IPM practices and technologies practiced in India and what each practice addresses	15	
3	Introduction to INM	What is INM? why is INM critical for sustainable farming among FPO members?	10	
4	Practices and technologies of INM	Principles of INM Examples of INM practices and technologies practiced in India and what each practice addresses	15	
5	Potential to implement IPM and INM in FPOs	Personal experiences with IPM and INM among participants, discussion on potential to implement IFS in FPO; Support available from line departments and Central Sector Schemes	20	
6	Plenary discussion on implementing IPM, INM in FPOs	How can we implement IPM, INM in our FPOs?	15	

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. Brainstorm with the question “how safe are the chemicals we use in agriculture – towards human, animal and ecological health?” “what are the possible benefits of learning to use agri-chemicals in a more rational way?” Introduce the concepts of Integrated Pest and Nutrient Management using a presentation.
Task 2: Integrated Pest Management	The facilitator makes a presentation that introduces the IPM concept to the participants: • What are the core design principles of an IPM? • What are the goals of an IPM? • What are some common technologies used in IPM and what problems they address? Discuss how an FPO can support member farmers to adopt IPM
Task 3: Integrated Plant Nutrition Management	The facilitator makes a presentation that introduces the INM concept to the participants: • What are the core design principles of an INM? • What are the goals of an INM? • What are some common technologies/systems used in INM and what problems they address? • Discuss how an FPO can support member farmers to adopt INM
Task 4: Experience sharing	• Enable short presentations or experience sharing by participants about their experiences with IPM and INM among their member farmers • Discuss the costs and benefits of these methods. • Potential to implement IPM and INM in FPOs – some best practices and government schemes available
Task 5: Summing up	The facilitator spends a few minutes to wrap up the discussion on IFS

BACKGROUND READING

1. For an overview of IPM: <https://www.fao.org/pest-and-pesticide-management/ipm/integrated-pest-management/en/>
2. For crop-wise IPM practices in many Indian languages: <https://ncipm.icar.gov.in/technical-bulletins.aspx>
3. For detailed reference notes on IPM: <https://diragri.assam.gov.in/portlet-innerpage/integrated-pest-management-ipm> and
4. https://diragri.assam.gov.in/sites/default/files/swf_utility_folder/departments/diragri_medhassu_in_oid_4/portlet/level_2/Crop%20protection%20under%20IPM.pdf

SESSION 6: MANAGING WATER EFFICIENTLY

UNDERSTANDING WATER USE EFFICIENCY & JUDICIOUS USE OF WATER, DRIP IRRIGATION, FERTIGATION, SPRINKLER IRRIGATION, ECONOMICS OF MICRO-IRRIGATION TECHNIQUES

SYNOPSIS

This session provides a macro-overview of the micro-irrigation techniques and their relevance. A project in Sunderbans in West Bengal has used solar-powered drip irrigation for farming.

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

At the end of the session, the participants will be aware of the importance of micro-irrigation techniques. The participants can understand the broad select criteria to use for selecting between two micro-irrigation techniques -

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation
2	Methods of irrigation	Slides Video demonstration	35 min	Presentation Video Chart and marker
3	Overview of fertigation	Slides Video demonstration	45 min	Presentation Chart Marker

TEACHING METHODS AND NOTES

The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator provides an overview of the session and its schedule.
Task 2: Methods of irrigation	The facilitator presents different irrigation methods. For modern techniques such as micro-irrigation, the facilitator can use videos to show how these techniques work.
Task 3: Overview of fertigation	The facilitator will present fertigation techniques and their adoption. Videos on fertigation techniques for different crops can provide the participants some experiences.

QUESTIONS FOR DISCUSSIONS

1. Why do you think the micro-irrigation methods help increase crop productivity?
2. Why are certain crops more suitable for drip irrigation while others for sprinkler irrigation?
3. Do you find micro-irrigation relevant for your FPO? If so, why?
4. What are the critical considerations for implementing micro-irrigation?

BACKGROUND READING

1. Chand, S, P Kishore, S Kumar, and S.K Srivastava. "Potential, Adoption, and Impact of Micro Irrigation in Indian Agriculture." Policy Paper. New Delhi: ICAR-National Institute of Agricultural Economics and Policy Research, September 2020.
<https://www.zotero.org/groups/4505676/fpo/items/DKKLRVHI/library>.
2. Department of Agriculture, Cooperation & Farmer Welfare, Ministry of Agriculture & Farmers Welfare. 2017. "Operational Guidelines of Per Drop More Crop (Micro Irrigation) Component of PMKSY." Department of Agriculture, Cooperation & Farmer Welfare, Ministry of Agriculture & Farmers Welfare. <https://www.zotero.org/groups/4505676/fpo/items/KY3GHFJ3/library>.
3. ICAR. n.d. "Solar Powered Drip Irrigation Transforms Agriculture in Remote Village of Sundarbans in West Bengal." n.d.
<https://www.zotero.org/groups/4505676/fpo/items/NAEYPWRB/library>.

SESSION 7: PROTECTED CULTIVATION

GREENHOUSE, POLY HOUSE, SHADE NET - CONCEPT AND MODELS AND THEIR COMMERCIAL ASPECTS

SYNOPSIS

This session introduces the concept of protected cultivation and its methods - greenhouse, poly house, and shade net for protected cultivation. There are five factors that the FPOs need to consider in adopting a protected cultivation technique. The session also helps the participant understand the theoretical and practical aspects of a greenhouse, poly house, and shade net.

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing the session, the participants will clarify protected cultivation and usage of a greenhouse, poly house, and shade net. The session provides a theoretical understanding of how greenhouse, poly house, and shade net would work. Then, the participants will explore the technology and economics of those methods.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation
2	Understanding protective cultivation	Presentation with demo model	45 min	Presentation Charts and markers Miniature models of greenhouse, poly house, and shade net
3	Implementing protective cultivation	Presentation	35 min	Presentation Pre-printed sheets

TEACHING METHODS AND NOTES

The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. The introduction also helps the participants understand the topic and the advantages of using protective cultivation.
Task 2: Understanding protective cultivation	In this activity, the class will understand the science behind the greenhouse, poly house, and shade net. For this, the facilitator can use a presentation and charts to explain the concept. Following the explanation, the facilitator shall use the miniature models for a greenhouse, poly house, and shade nets to demonstrate how they help manage micro-climatic conditions.

Task 3: Implementing protective cultivation	The class will understand the implementation requirements for different protective cultivation methods. A presentation will help the class to relate the method to the crops in the FPOs. Sample pre-printed cost sheets will also help the participants get a clear picture of the investments and returns for their FPOs. Discuss how the FPO can enable member farmers to implement some forms of protected cultivation.
Task 4: Summing up	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. Have you seen any protective cultivation? Share your observations with the class.
2. What are the advantages and disadvantages of a greenhouse?
3. Provide an example of the crop and climatic conditions that would require protective cultivation?
4. Which type of protective cultivation would you prefer and why?
5. What are some government schemes that you can make use of?

BACKGROUND READING

1. ICAR-National Innovations in Climate Resilient Agriculture. n.d. "Low-Cost Polyhouse for off-Season Vegetable Cultivation." ICAR-National Innovations in Climate Resilient Agriculture. <https://www.zotero.org/groups/4505676/fpo/items/GNKFJJ6H/library>.
2. IARI. 2014. *Technological Options for Enhanced Productivity and Profit*. New Delhi: Indian Agricultural Research Institute. <https://www.zotero.org/groups/4505676/fpo/items/WDC22MBV/library>.
3. ICAR-ICAR Research Complex for NEH Region. n.d. "Round the Year Vegetable Production in Low Cost Polyhouse." ICAR-ICAR Research Complex for NEH Region. <https://www.zotero.org/groups/4505676/fpo/items/ISC3WHBT/library>.

SESSION 8: SOIL-LESS FARMING

CONCEPTS AND COMPONENTS OF HYDROPONICS, AQUAPONICS, AEROPONICS, VERTICAL FARMING

SYNOPSIS

In this session, participants will learn about a mix of modern farming techniques. Specifically, they will learn about the concepts and components of hydroponics, aquaponics, aeroponics, and vertical farming.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

At the end of the session the participants will be able to:

- Explain the concepts behind soil-less farming and where it can be applied
- Describe the functioning of three basic Soil-Less Farming Methods
- Discuss the potential for Soil-Less Farming in their FPO

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation slides
2	The need for Modern Farming Systems, introduction and video	Discussion; Presentation	15 min	Laptop, Projector, and Speakers
3	Hydroponics	Presentation; Video	15 min	Presentation slides; Laptop, Projector, and Speakers
4	Aeroponics & Aquaponics	Presentation; Video	20 min	Presentation slides; Laptop, Projector, and Speakers
5	Vertical Farming	Presentation; Video	20 min	Presentation slides; Laptop, Projector, and Speakers
6	Discussion and Wrap-up	Discussion	10 min	Whiteboard

TEACHING METHODS AND NOTES

Before organising the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. What are conventional farming systems? What do we mean when we say

	'modern farming systems'?
Task 2: Modern Farming Systems	The facilitator initiates a discussion, makes a presentation, and plays a video on the need for modern farming systems.
Task 3: Hydroponics	The facilitator initiates a discussion and makes a presentation (using a good video as supporting content) on hydroponics: • The method • The benefits • The limitations The facilitator presents and discusses the examples given in the reading material.
Task 4: Aeroponics and Aquaponics	The facilitator initiates a discussion and makes a presentation (using a good video as supporting content) on aeroponics and aquaponics: • The method • The benefits • The limitations The facilitator presents and discusses the examples given in the reading material.
Task 5: Vertical Farming	The facilitator initiates a discussion and makes a presentation (using a good video as supporting content) on vertical farming: • The method • The benefits • The limitations The facilitator presents and discusses the examples given in the reading material.
Task 5: Summing up	Seek feedback from participants and wrap up.

QUESTIONS FOR DISCUSSIONS

1. Have you heard of soil-less farming? Can you share your experiences with soil less farming or what you have heard about these methods?
2. Why would any farmer go for soil-less farming?
3. How can the FPO support member farmers in attempting soil-less farming and for what crops?

BACKGROUND READING

1. Nikcole Thompson, n.d., "The Future of Food: Hydroponics, Aquaponics and Aeroponics Agriculture", Green Living Mag
<https://greenlivingmag.com/the-future-of-food-hydroponics-aquaponics-and-aeroponics-agriculture/>

SESSION 9: HIGH-DENSITY AND ULTRA-HIGH-DENSITY PLANTATIONS

TECHNIQUES AND BENEFITS

SYNOPSIS

This session provides an overview of high-density plantation (HDP) and ultra-high-density plantation (UHDP) practices. It has provided a list of horticultural activities where FPOs might find suitable practices to get higher returns. It has included an example of a package of practices and an example statement of investment and returns in HDP and UHDP. This session can also be combined with discussions on Systems Crop Intensification (horticulture).

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing this session, the participants will know about HDP and UHDP. They will also be identify most suitable candidate for consideration for HDP or UHDP implementation. The session will equip the participants to understand reviewing a business proposal for adopting such methods in their FPOs.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Handouts Agenda
2	Package of practices	Presentation and discussion	45 min	Presentation
3	Overview of investment and returns	Presentation by facilitator and discussion	35 min	Presentation slides Cost sheets

TEACHING METHODS AND NOTES

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. The introduction also helps the participants understand the advantages of using high-density plantations (HDP) and ultra-high-density plantations (UHDP).
Task 2: Package of practices	The facilitator will choose any crop that the participating FPOs are cultivating in their areas for discussion in the class. The class will relate to a discussion that focuses on the package of practice on a select fruit. The presentation will provide the details for both HDP and UHDP practices.
Task 3: Overview of investment and returns	Using cost sheets, the facilitator will explain the investments required for HDP and UHDP. The class will discuss a possible selection of a method suitable for their FPOs.

QUESTIONS FOR DISCUSSIONS

1. Can you describe traditional fruit cultivation and harvest? What is easy and what is difficult in traditional fruit tree cultivation?
2. What are the possible use cases of HDP and UHDP in your FPO?
3. What are the technologies required to implement HDP and UHDP?
4. What are the disadvantages of HDP?
5. What are the advantages of HDP?

BACKGROUND READING

1. Singh, Gorakh. 2008. *High Density and Meadow Orchard of Guava*. Lucknow: Central Institute for Subtropical Horticulture.
<https://www.zotero.org/groups/4505676/fpo/items/SUSGRH23/library>.
2. Bose, Hiren Kumar. 2021. "New Trend In Mango Farming Helps Maha Farmer Reap Profits Worth Rs 6 Lakhs per Acre." *The Better India*, April 9, 2021.
<https://www.thebetterindia.com/252647/mango-farm-ultra-high-density-planting-uhdp-kesar-alphonso-profits-farmer-success-story/>.
3. Kumar, Adyant, Shyam Singh, and Payal Jaiswal. 2017. "Ultra-HighDensity Plantation of Mango – New Technology for Increasing the Income of the Farmers." *Indian Farmer* 4 (5): 368–75.
4. Choudhary, Sanvar & Sarkar, Tanmoy & Magar, Vaishnavi. (2020). High Density Planting System in Fruit Crops. 1. AgriCos e-Newsletter I Volume : 01 Issue : 04 August 2020 Article No: 57. 167-169.

SESSION 10: INTERNET OF THINGS FOR AGRICULTURE

IOT APPLICATIONS IN AGRICULTURE – ROLE IN PRE- AND POST-HARVEST OPERATIONS

SYNOPSIS

In this session, participants will learn about the role of Internet of Things (IoT) in pre-harvest operations and post-harvest operations.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After the session, participants will have greater clarity about the ways in which IoT will play a role in agriculture.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	5 min	Presentation slides
2	IOT in agriculture	Presentation	15 min	Presentation slides/video
3	Farm management through IOT	Presentation	20 min	Presentation slides/video
4	IOT models	Presentation	20 min	Presentation slides/video
5	IOT & FPO	Presentation	20 min	Presentation slides
6	Discussion and feedback	Whiteboard	10 min	Whiteboard

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants.
Task 2: IoT in Agriculture	The facilitator makes a presentation that covers the topic of digital agriculture and then introduces the concept of IoT in agriculture: • What is IoT in agriculture? • How does it benefit the farmer?
Task 3: Farm Management through IoT	The facilitator makes a presentation that introduces the concept of end-to-end farm management through IoT: • Decision Making

	• Risk Management • Efficiency in Resource Utilisation • Quality Control • Business Management • Monitoring of Climatic Conditions
Task 4: IoT Models	The facilitator then makes a presentation of some early examples of IoT in agriculture, which is a very new idea still.
Task 5: IoT and FPOs	The facilitator then leads a discussion on how FPOs should perceive IoT and how they can leverage IoT for its members. The facilitator then discusses some examples of FPOs using IoT.

QUESTIONS FOR DISCUSSIONS

1. Do you know individual farmers who use internet technology/digital technology extensively in their agriculture? What technology do they use? How does it benefit them?
2. Where do you think farmers from your FPO will benefit from introducing IOT in their farming operations?

BACKGROUND READING

1. India AI, March 18, 2021, "How IoT can transform agriculture in India", India AI
<http://indiaai.gov.in/article/how-iot-can-transform-agriculture-in-india>
2. The Hindu Business Line: <https://www.thehindubusinessline.com>

Suggested Reading for Facilitators:

3. CROPIN. Internet of Things in Agriculture: What Is IoT and How Is It Implemented in Agriculture?
<https://www.cropin.com/iot-internet-of-things-applications-agriculture/>
4. CROPIN. How is Precision Agriculture Different from Smart Farming?
<https://www.cropin.com/blogs/how-is-precision-agriculture-different-from-smart-farming>

SESSION 11: PRECISION FARMING

CONCEPTS, BENEFITS AND ITS APPLICATION IN IMPROVING FARM EFFICIENCY

SYNOPSIS

In this session, the participants will understand the concept, advantages, and applications of precision farming. It will also help the participants understand how precision farming manages inputs to get better outputs.

TARGET GROUPS

BODs & Officials of FPOs, CBBOs

LEARNING OBJECTIVES

At the end of the session, the participants will develop knowledge of precision farming. They will be familiar with the technologies used in precision farming.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	5 min	Presentation
2	Scope of precision farming	Presentation	45 min	Presentation
3	Requirements for precision farming	Presentation	40 min	Presentation Videos Photos

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. The class will discuss the advantages and applications of precision farming.
Task 2: Scope of precision farming	This presentation talks about how precision agriculture would impact farming. It provides a list of precision farming methods for use in crops.
Task 3: Requirements for precision farming	This activity uses a presentation by the facilitator to provide the requirements for precision farming for a select crop. The class can use photos and videos to demonstrate how the precision farming techniques are applied.
Task 4: Summing up	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. What are the advantages of precision farming?
2. Will you consider using precision farming techniques in any of the crops for your FPO? Explain.

3. What are the technology requirements for using precision farming?
4. What kind of assistance would you need to develop a precision farming project?

BACKGROUND READING

1. Mungarwal, Amit Kumar, and SK Mehta. 2019. "Why Farmers Today Need to Take up Precision Farming." Blog. *Down to Earth Blogs* (blog). May 21, 2019.
<https://www.downtoearth.org.in/blog/agriculture/why-farmers-today-need-to-take-up-precision-farming-64659>.
2. Kumar, Manoj, Preeti Singh, and Santosh Kumar. 2020. "Precision Agriculture in Potato Cultivation." In *Potato: Science and Technology for Sub-Tropics*, 155–68. New Delhi: New India Publishing Agency.

SESSION 12: COLLABORATIONS BETWEEN AGRI-STARTUPS AND FPOS

SYNOPSIS

In this session, participants will learn about agri startups, a distinct set of stakeholders in the ecosystem, and become aware of ways in which FPOs can collaborate with agri startups.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After the session, participants will be able to understand better and assess how the category of agri startups can be potential growth partners for the FPOs they are promoting.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Presentation	10 min	Presentation slides
2	Agri start ups	Discussion; Presentation	10 min	Whiteboard; Presentation slides
3	Integration of startups in agri value chains	Discussion; Presentation	25 min	Whiteboard; Presentation slides
4	Agri startup Business models	Presentation	30 min	Presentation slides
5	Discussion and Feedback	Discussion	15 min	Whiteboard

TEACHING METHODS AND NOTES

****This session can also be a guest lecture by an agri-startup representative.**

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants. To set the context, the facilitator can highlight some challenges that form the rationale for the promotion and nurturing of FPOs.
Task 2: Agri Startups	The facilitator initiates a discussion and makes a presentation that introduces the concept of agri startups: - What is the nature of startups across sectors? - What are the startups in the space of AgTech?

	• What challenges are the AgTech startups trying to solve?
Task 3: Integration of Agri Startups in Value Chains	The facilitator initiates a discussion and makes a presentation that locates the agri startups in the value chain model: • What are the typical value chain challenges, across different value chains, that need solving? • In the context of these challenges, where do the startups fit in and how do they solve the problems?
Task 4: Agri Startup Business Models	The facilitator initiates a discussion and makes a presentation on the ways FPOs can partner with AgTech startups: • Where can technology play a role in FPO operations and member operations? • What benefits can it enable? • How can technology solutions empower FPOs at different steps, from production to market? • What are some examples of collaboration between FPOs and AgTech startups that are registering success?
Task 5: Discussion and Feedback	Seek feedback from participants and sum up the session.

QUESTIONS FOR DISCUSSIONS

1. Have you had any AgTech startup approach you with their solutions?
2. Have you seen a demo of any AgTech solution?
 - a. What is the potential benefit?
 - b. What are the barriers in using the technology solution and realising the benefits?
 - c. How can the FPO help farmers overcome these barriers?

BACKGROUND READING

1. MANAGE-Centre for Agricultural Extension Innovations, Reforms, and Agripreneurship (CAEIRA), 2019, "Agritech Startups: The Ray of Hope in Indian Agriculture", MANAGE, <https://www.manage.gov.in/publications/discussion%20papers/MANAGE-Discussion%20Paper-10.pdf>
2. Agritech startups have great potential in India, November 9, 2021, Ashok Gulati, Kavery Ganguly, The Indian Express <https://indianexpress.com/article/opinion/columns/agritech-startups-great-potential-india-7611902/>

SESSION: FIELD VISIT TO A HI-TECH PROJECT

SYNOPSIS

In this session, participants will make a field visit to a hi-tech agriculture project site and learn more about some of the concepts discussed in the earlier sessions.

Preferably, the field visit should be held on Day 3 of the program and followed by a debriefing.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After the session, participants will have greater clarity and understanding of some concepts and models of hi-tech agriculture – through observation and interactions with the hi-tech farmers.

TEACHING METHODOLOGY

N	AREAS	DESCRIPTION	TIME	MATERIALS
1	Session introduction	Discussion	10 min	No material required
2	Visit to models (with break for tea in between, as per convenience)	Activity	230 min	Notepad and pen, for participants
3	Debriefing	Discussion	30 min	Notepad and pen, for participants

TEACHING METHODS AND NOTES

Before organizing the training session, the facilitator shall ensure all the materials used in training are available in the local language. The participants need to attend the session after going through the reading materials.

TASKS	ACTIVITIES
Task 1: Session introduction	The facilitator sets the session objectives and structure for the participants.
Task 2: Visit to Models in Hitech Agriculture	The facilitator moves with the participants from one model to another. The participants are given an opportunity to see, discuss, and ask questions of the host to understand each model better.
Task 3: Debriefing	At the end, the facilitator asks the participants to take up each model and discuss in the group what they saw and what they learned and how they can apply some of these technologies in their FPO.

QUESTIONS FOR DISCUSSIONS

1. What are the models of hitech agriculture you have learned about so far, in the classroom?
2. What models of hitech agriculture did you see in the field?
3. Which model is suitable for the farmers in your cluster?
4. What support would you need to help pilot or implement these methods in your farms/FPO?

BACKGROUND READING

Material provided for earlier sessions.

VALEDICTORY: ACTION PLAN, FEEDBACK AND VALEDICTION

SYNOPSIS

In this session, participants would prepare an action plan for better implementation of hi-tech agricultural practices by FPOs, offer feedback on the training, and then the session would end with a valediction.

TARGET GROUPS

BoDs and Officials of FPOs, CBBOs

LEARNING OBJECTIVES

After completing the session, the participants would have a draft hi-tech agriculture implementation Action Plan to take back to their institution.

TEACHING METHODOLOGY

#	AREAS	DESCRIPTION	TIME (Minutes)	MATERIALS
1	Session introduction	Presentation	10	Presentation slides
2	Preparation of Action Plan for hi-tech agriculture	Activity	40	Paper and pen
3	Feedback	Interaction	20	Whiteboard
4	Valediction	Valediction	20	Certificates

TEACHING METHODS AND NOTES

Depending on the time available – a more detailed action planning can be conducted for one entire session.

TASKS	ACTIVITIES
Task 1: Session introduction	Set the session objectives and structure for the participants. Introduce the Action Planning Activity; you may give the participants the indicative contents/format of an action plan for better incorporation of hi-tech agriculture in FPOs.
Task 2: Preparation of Action Plan for Financing the FPOs	Ask the participants from the same FPOs to form groups and spend 25 minutes to develop an action plan for incorporation of hi-tech agriculture that they can submit as an internal presentation. After the groups work on the task asks every group to contribute one point each on how to improve FPO's incorporation of hi-tech agriculture (without repetition of points). In this way, many unique ideas and suggestions can be gathered.
Task 3: Feedback	After completing the action plan activity, circulate a well-designed feedback form for each participant to fill (15 minutes) Open the plenary for oral feedback ensuring that every participant has spoken. (15 minutes)

TASKS	ACTIVITIES
Task 4: Valediction	Distribute certificates of participation to participants. Ensure the official group photo has been taken. Conclude the programme with a valediction for the participants.

QUESTIONS FOR DISCUSSIONS

1. What are the essential elements of an action plan?
2. What were the most useful sessions?
3. Which sessions need improvement?
4. What learning will you take back with you?

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