

# GEAVET TRAINING PROGRAMME FOR CSA

## GEAVET TRAINING PROGRAMME FOR CLIMATE-SMART AGRICULTURE (CSA):

## KENYA

### UNIT 2.3 - SEASONAL FORECASTING FOR FOOD PROCESSING

#### ENGLISH VERSION

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Open Educational Resources



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## **PART I – LEARNING MATERIAL**

### **1. Introduction**

Seasonal forecasting refers to predicting climate conditions, such as rainfall, temperature, drought, or flood risk, for the next few months, allowing farmers and processors to anticipate weather-related challenges before they occur. Because it enables better use of resources, reduces waste, and supports climate-smart decision-making, seasonal forecasting is an important tool for building more sustainable and resilient food systems. This unit introduces students to the importance of seasonal forecasting in agriculture and food processing, showing how climate information can inform planning, reduce losses, and strengthen value chains. Students will learn what seasonal forecasts are, why they matter for sustainable food systems, and how they are produced by regional and international organisations in both Europe and Africa. The unit also develops practical skills, including how to read seasonal forecasting maps, identify appropriate actions when forecasts indicate challenging conditions, and explore solar dryers as a low-cost, climate-resilient technology for food preservation.

### **2. Knowledge**

#### **2.1. Definition & Importance of Seasonal Forecasting in Food Processing**

Seasonal forecasting means predicting climate conditions, such as rainfall, temperature, or drought, for the next few months (usually 1–6 months). These predictions help farmers and food processors understand what kinds of weather risks might be coming (ECMWF, n.d.).

In agriculture and food value chains, seasonal forecasts act like an early warning system. They can indicate if there may be too little rain, too much rain, very high temperatures, or other conditions that might lower crop yields, change when crops are ready to harvest, or increase the chance of food losses. When farmers or processing companies have this information, they can plan ahead. For example, they can adjust harvest dates, prepare extra storage space, change processing amounts, or even explore different crops or income options to reduce risk (WMO, 2020).

In Europe, forecasting systems combine satellite observations, climate models, and machine-learning methods to produce detailed agricultural climate outlooks. One major provider is the European Centre for Medium-Range Weather Forecasts (ECMWF), which creates seasonal forecasts up to about 13 months in advance (WMO, 2020).

In Africa, several regional organizations also produce seasonal forecasts that support farmers and food processors. For example:

- The **IGAD Climate Prediction and Applications Centre (ICPAC)** provides seasonal climate outlooks for East Africa through the Greater Horn of Africa Climate Outlook Forum (GHACOF). <https://www.icpac.net/>
- The **Southern African Development Community (SADC)** runs the **Southern Africa Regional Climate Outlook Forum (SARCOF)**, which issues rainfall and temperature forecasts for the region. <https://www.sadc.int/services-and-centres/climate-services-centre>
- The **AGRHYMET Regional Centre** in West Africa provides agro-climatic monitoring and seasonal forecasts to support farming and food security. <https://ccr1-agrhymet.cilss.int/en/>

These systems help African countries prepare for droughts, heavy rainfall events, and other climate-related risks that affect crops and food supply chains.

## **2.2. Role in Sustainable Food-Processing and Value-Chains**

Seasonal forecasting plays an important role in strengthening food processing and agricultural value chains because it helps reduce risks and improve planning. By predicting conditions such as drought, heavy rainfall, or heat stress months in advance, these forecasts help reduce weather-related losses, for example, when crop failure limits the amount of raw material available for processors (WMO, 2020). When drought is expected, farmer cooperatives can optimise their resources by reducing the processing of water-intensive crops or shifting temporarily to stored raw materials. Forecasts also add value, as processors can better plan collection, drying, storage, and processing activities to maintain product quality and take advantage of favourable market conditions. Finally, when seasonal forecasting is connected to early-warning systems, it contributes to long-term sustainability and resilience by helping farmers and processors prepare for increasing climate variability and climate change (ECMWF, n.d.).

## **2.3. Challenges & Possible Solutions**

Seasonal forecasting offers many benefits for agriculture and food processing, but several challenges can limit how effectively this information is used in practice. The table below highlights common obstacles faced by farmers, along with practical solutions that can help improve the accessibility and usefulness of seasonal climate information.

### **Table 8. Linking Challenges and Solutions**

Challenge	Solution
Forecast skill may be low in some regions	Use local calibration, combined with local observations, emphasise probability rather than certainty.
Lack of awareness/skills among cooperatives/farmers	Training, capacity-building, extension services, demo projects.
Data/infrastructure constraints (internet, sensors)	Use mobile SMS alerts, low-cost monitoring stations, and partner with national meteorological services.
Communication gap between forecasts and actionable advice	Tailor forecasts to user needs (e.g., processing planning), co-design with stakeholders.
Integrating forecasting with processing operations	Embed forecasting into business plans, develop SOPs triggered by forecast alerts.

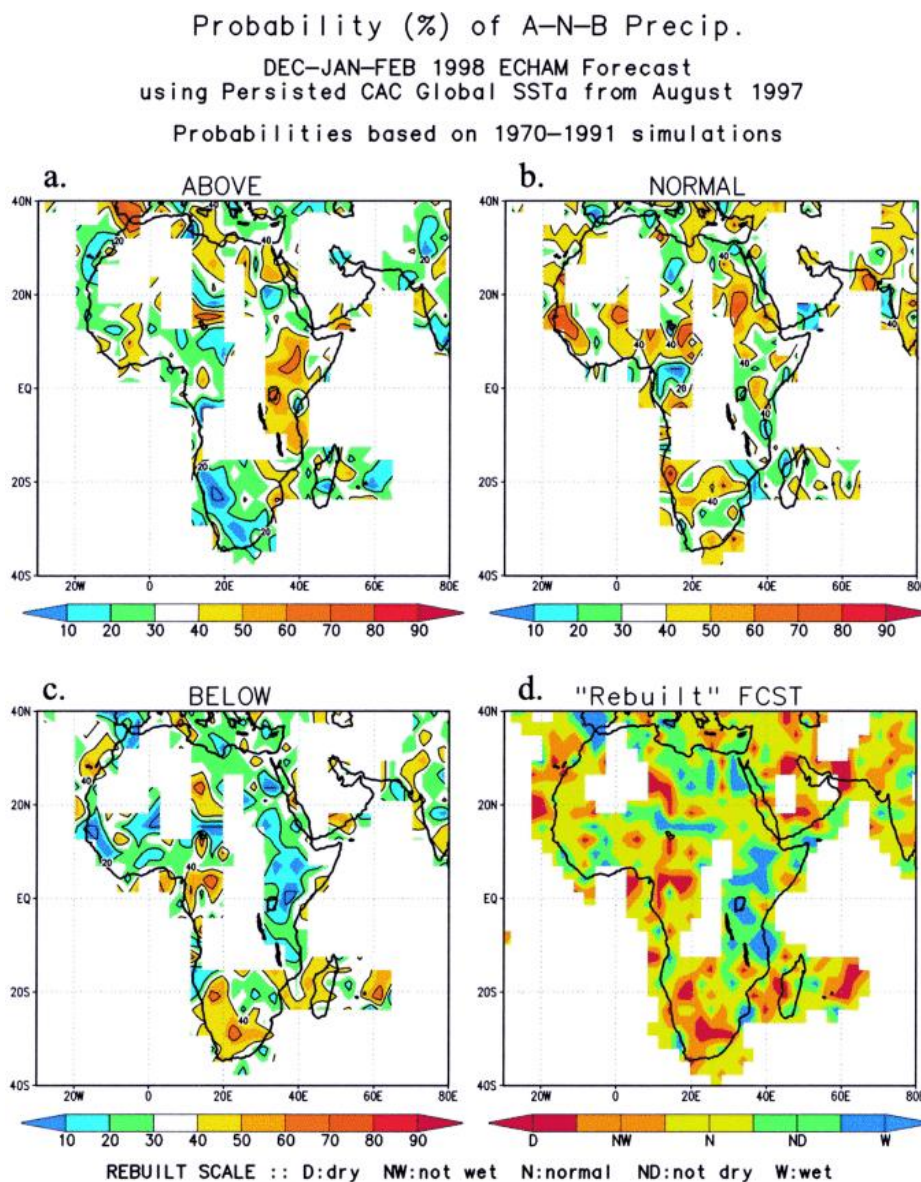
### 3. Skills

#### 3.1. Reading Probability Maps in a Seasonal Forecast

Seasonal forecast reports often include probability maps that show how likely it is that rainfall or temperature will be *above normal*, *near normal*, or *below normal* during the coming months. These maps do not provide exact values but instead indicate which category is most likely based on the long-term climate record. Many forecasting centres, such as ECMWF in Europe or ICPAC in East Africa, use this three-category (tercile) system, where the season is divided into above-normal, near-normal, and below-normal conditions, each of which would normally have about a 33% chance of occurring. When a forecast map highlights one category, it simply means that this category has a higher probability than the others.

Colors on the map usually show how strong or weak this probability is. Darker colors indicate higher confidence, such as a 50–70% chance of above-normal rainfall, meaning the models suggest wetter-than-usual conditions are more likely than the typical one-in-three odds. Lighter shading reflects weaker confidence (for example, around 35–40%), which only slightly tilts the chances toward one category. “Above normal rainfall” means that total rainfall over the

season is likely to be higher than average, not that rain will occur every day. Likewise, "below normal" generally signals a higher risk of seasonal drought and lower soil moisture.



**Image 5. Precipitation Levels Example** (Mason & Goddard, 1999)

Understanding these probability maps is valuable for farmers because it supports early planning and risk reduction. A below-normal rainfall signal may encourage cooperatives to prepare for reduced crop inflow or to rely more on stored raw materials. An above-normal rainfall or temperature forecast might alert processors to potential harvest delays, increased spoilage risks, or the need for expanded drying and storage capacity. Even when a map shows "near normal," it should not be interpreted as risk-free, but rather as a season without strong model agreement toward drier or wetter conditions. By interpreting

these maps correctly, organisations can make informed decisions that improve climate resilience and reduce weather-related disruptions in the value chain.

### 3.2. Reading Drought and Flood Severity Layers in a Seasonal Forecast

Drought and flood maps in seasonal forecasting help users understand how serious upcoming dry or wet conditions may be and where they are most likely to occur. **Drought severity levels** (often labeled as mild, moderate, severe, or extreme) are based on indicators such as rainfall deficits, soil moisture, vegetation stress, and temperature anomalies; lighter colors typically show developing dryness, while darker shades indicate more severe impacts on crops and water supply. **Flood-probability layers**, on the other hand, combine expected rainfall, soil saturation, and river conditions to show areas at low, medium, or high risk of flooding, usually represented by increasingly intense shading. A high drought or flood category does not guarantee that the event will occur, but it signals elevated risk compared to normal conditions. When interpreted correctly, these maps help farmers prepare in advance, for example, by protecting infrastructure, adjusting land and water use, securing storage, or shifting production plans, thereby reducing losses and strengthening climate resilience.

### 3.3. Recommended Actions Based on Seasonal Forecast Signals

**Table 9. What to do in each scenario**

Forecast Signal	Recommended Actions for Farmers
High drought probability / Below-normal precipitation	<ul style="list-style-type: none"> <li>● Conserve water and improve irrigation efficiency.</li> <li>● Switch to less water-intensive crops.</li> <li>● Adjust planting dates.</li> <li>● Rely more on stored raw materials.</li> <li>● Prepare for reduced processing volumes.</li> <li>● Use solar dryers to reduce dependence on fuel-based drying during dry periods.</li> </ul>
Above-normal precipitation / High flood probability	<ul style="list-style-type: none"> <li>● Strengthen drainage and erosion-control systems.</li> </ul>

	<ul style="list-style-type: none"> <li>● Protect storage facilities from moisture damage.</li> <li>● Plan earlier harvests to avoid field losses.</li> <li>● Ensure transport routes remain usable during heavy rainfall.</li> </ul>
Above-normal temperatures	<ul style="list-style-type: none"> <li>● Increase cooling or drying capacity.</li> <li>● Monitor crops closely for heat stress.</li> <li>● Adjust processing schedules to prevent spoilage.</li> <li>● Improve ventilation in processing units.</li> </ul>
Below-normal temperatures	<ul style="list-style-type: none"> <li>● Allow more time for drying processes.</li> <li>● Plan for higher energy needs for heating and drying.</li> <li>● Adjust harvest timing if crop development slows.</li> </ul>

If there is interest in more explanations about seasonal forecasts and how to read them, the following four-part series on Youtube can be an interesting resource: [Seasonal Forecasts Explained Part 1: The underpinning science](#)

### 3.4. Solar Dryers

A solar dryer is a simple device that uses the heat of the sun to remove moisture from agricultural products like fruits, vegetables, grains, or herbs, helping to preserve them and extend their shelf life without using electricity or fossil fuels. Solar dryers work by capturing sunlight in an enclosed chamber or box with transparent surfaces or black materials that absorb heat. Warm air inside the dryer rises and moves over the produce, carrying moisture away and allowing it to evaporate more quickly than in open-air sun drying. Some designs use natural airflow (passive solar drying), while others use vents or small fans to improve ventilation and speed up the process (Energypedia, 2022; FAO, 1995). Solar drying is useful because it reduces post-harvest losses, improves the quality and market value of dried products, lowers energy costs, and protects food from dust, pests, and unexpected rainfall - problems that often occur with traditional sun drying (Energypedia, 2022).

The following video by Sawa World demonstrates how a sun dryer can be built step-by-step: <https://www.youtube.com/watch?v=ckN5aMwXVg8>

#### **4. Case Study: How Rwanda Supports Smallholder Farmers by Using Seasonal Forecasting**

**Description of the Action:** As the study by Birachi et al. (2020) establishes, agriculture in Rwanda depends heavily on rainfall, and farmers often face challenges such as droughts, floods, and unpredictable planting seasons. To address these issues, the Rwanda Climate Services for Agriculture (RCSA) project set out to help farmers use seasonal climate forecasts to improve decision-making. The project upgraded Rwanda’s climate data system using the ENACTS approach, which blends weather station and satellite data to produce more accurate and locally relevant forecasts. These new forecasts were then translated into simple, practical messages and delivered through channels farmers already trusted—extension workers, radio programs, SMS alerts, farmer group meetings, and community “listener clubs.” Extension officers were also trained using the Participatory Integrated Climate Services for Agriculture (PICSA) method, enabling them to guide farmers in using seasonal forecasts to choose crops, adjust planting dates, and manage soils and water more effectively.

**The Results:** The project’s impact was significant. More than 111,000 farmers directly received forecast-based advisories, and nationwide radio programs reached around 70% of Rwanda’s population (Birachi et al., 2020). Most farmers reported actively using the seasonal forecasts—for example, three out of four used them to choose crops or planting dates. Those who participated in PICSA training achieved 24% higher crop production value and 30% higher income than similar farmers who did not use climate information (Birachi et al., 2020). When PICSA training was combined with radio listener clubs, the improvements were even greater. Overall, farmers were better able to match their activities to expected rainfall patterns, reduce weather-related losses, and strengthen their food security.

**Key Take-Aways for Kenyan Learners:** The Rwanda experience shows that seasonal forecasting becomes truly effective when it is made simple, accessible, and directly linked to farm decisions. For Kenyan learners, the key lesson is that climate information is useful only when it reaches farmers at the right time and in a form they can easily apply. Like Rwanda, Kenya has strong extension networks, radio use, and mobile communication, meaning similar approaches can help Kenyan farmers decide when to plant, which crops or varieties to choose, how much to irrigate, and how to prepare for droughts or heavy rains. The case also highlights the importance of combining forecasts with tools like PICSA, local discussions, and early-warning systems. By adopting these methods, Kenyan cooperatives, farmers, and processors

can improve planning, reduce climate-related losses, and build a more resilient food system.

## 5. References/Sources

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## PART 2 – CURRICULUM

### Learning Objectives:

KNOWLEDGE	SKILLS	ATTITUDES
<p><i>Students will know:</i></p> <ul style="list-style-type: none"> <li>• How a seasonal forecast (e.g., "dry season ahead") can predict food availability.</li> <li>• The basics of simple food processing (drying, storage) to reduce losses.</li> <li>• How early warning messages are linked to food security</li> </ul>	<p><i>Student will be able to:</i></p> <ul style="list-style-type: none"> <li>• Plan a food processing schedule (e.g., when to dry mangoes) based on a seasonal forecast.</li> <li>• Operate a simple solar dryer for food preservation.</li> <li>• Identify the right storage methods for different processed foods.</li> </ul>	<p><i>Student will develop the following mindset:</i></p> <ul style="list-style-type: none"> <li>• Innovation: Seeing food processing as a way to add value and reduce waste.</li> <li>• Risk Management: Using forecasts to protect their food and income from climate shocks.</li> </ul>
<p><b>TRANSVERSAL SKILLS INTEGRATED:</b></p> <ul style="list-style-type: none"> <li>• <b>Entrepreneurship:</b> Viewing processed food as a product to be stored and sold later for a higher price.</li> <li>• <b>Problem Solving:</b> Figuring out how to process excess harvest before it spoils due to weather.</li> </ul>		
<p><b>DIGITAL SKILLS INTEGRATED:</b></p> <ul style="list-style-type: none"> <li>• <b>Digital Communication:</b> Using WhatsApp groups with other farmers to share forecasts and processing tips.</li> <li>• <b>ICT For Agriculture:</b> Using mobile apps to find market prices for processed goods.</li> </ul>		
<p><b>GREEN SKILLS INTEGRATED:</b></p> <ul style="list-style-type: none"> <li>• <b>Circular economy &amp; organic waste management:</b> Using crop surpluses and "ugly" fruits for processing instead of throwing them away.</li> <li>• <b>Renewable energy integration:</b> Using solar dryers instead of burning wood or using electricity.</li> </ul>		

### Implementation plan of pedagogical activities - Scheme of work

Duration: 3.5 hours				
Target: TVET students, farmers, agro-processors				
No. of Activity	Duration	Training Methods / Activity	What the trainers do	What the participants do
1.	50 min	Interactive presentation as a general introduction to seasonal forecasting;  Group discussion about scenario: "The Coming Drought"	<ul style="list-style-type: none"> <li>• Give a short presentation about the general use of seasonal forecasting and its impacts on sustainability.</li> <li>• Present a scenario: "The forecast says the next season will be dry. You have a surplus of tomatoes. What do you do?"</li> </ul>	<ul style="list-style-type: none"> <li>• Take notes and ask questions.</li> <li>• In groups, brainstorm different ways to process the tomatoes (drying, making sauce) to avoid loss.</li> </ul>
2.	65 min	Lecture on seasonal forecasting data;  Action planning: "My Processing Plan"	<ul style="list-style-type: none"> <li>• Explain the main aspects of how to read seasonal forecasting data.</li> <li>• Provide/show the indicated Youtube video.</li> <li>• Guide learners to fill out a simple one-page plan for a crop they grow.</li> </ul>	<ul style="list-style-type: none"> <li>• Listen to the explanation, ask questions, watch the provided Youtube video.</li> <li>• Create a personal plan stating what crop they will process, when (based on season), and how (e.g., solar drying)</li> </ul>
3.	95 min	Lead a short discussion about potential actions	<ul style="list-style-type: none"> <li>• Give a presentation that provides</li> </ul>	<ul style="list-style-type: none"> <li>• Think of examples of weather-</li> </ul>

		<p>based on seasonal forecasting signals;</p> <p>Practical demonstration: "Solar Drying in Action"</p>	<p>space for discussion/brainstorming about informed actions after the reading forecast data.</p> <ul style="list-style-type: none"> <li>• Demonstrate how to build and use a simple, low-cost solar dryer using local materials.</li> </ul>	<p>adjusted actions from their community and participate in the brainstorming.</p> <ul style="list-style-type: none"> <li>• Help assemble a demo solar dryer and learn how to load it with food samples.</li> </ul>
<p><b>Materials (What trainers need to have prepared):</b></p> <ul style="list-style-type: none"> <li>• Youtube video for Activity 2: <a href="https://www.youtube.com/watch?v=JdwxliVqzbQ">https://www.youtube.com/watch?v=JdwxliVqzbQ</a></li> <li>• Materials for a simple solar dryer (wooden frame, netting, black plastic, transparent plastic).</li> <li>• Samples of fresh and solar-dried foods (e.g., mangoes, tomatoes).</li> </ul>				
<p><b>Other notes:</b></p> <ul style="list-style-type: none"> <li>• This session is best done in a location with access to sunlight for the solar dryer demo.</li> <li>• Encourage participants to bring a sample of a crop they would like to learn to process.</li> </ul>				

## PART 3 – ACTIVITY GUIDE

### DESCRIPTION OF THE ACTIVITIES

#### 1. Group Discussion & Scenario: “The Coming Drought”

In this activity, participants work through a realistic scenario to explore how seasonal forecasts can guide decisions in food processing during climate-related challenges. Using the example of an upcoming dry season and a surplus of tomatoes, groups discuss potential risks, interpret simple forecast information, and identify suitable processing strategies that can reduce post-harvest losses. Through collaborative brainstorming and presentation, learners practice applying climate information to real-life value-chain decisions, preparing them for situations where timely processing and planning are essential.

1. **Aim of the activity:** To help participants understand the role of seasonal forecasting in planning food processing activities and reducing post-harvest losses during climate-related challenges. Participants explore practical processing options when faced with a predicted dry season.
2. **Duration:** 50 min
3. **Material required:**
  - Scenario prompt on flip chart or projector
  - Seasonal forecast examples (simple charts, rainfall predictions, or local extension bulletins)
  - Markers and flip chart paper
  - Optional: photos/samples of processed tomato products
4. **Step-by-step instruction of the task/practical exercise/case study:**
  - Introduce seasonal forecasting: Explain what seasonal forecasting is and why it is important for farmers and agro-processors (e.g., predicting dry or wet seasons helps plan when to harvest, process, and store foods).
  - Present the scenario: *“The forecast says next season will be dry. You have a surplus of tomatoes. What do you do?”*
  - Group division: Form groups of 4–6 participants.
  - Group brainstorming: Each group discusses...
    - What risks a dry season brings
    - How seasonal forecasts help plan ahead
    - Which tomato processing options (drying, sauce, paste, pickling, etc.) best fit a predicted dry season
    - How early planning can prevent losses
  - Group presentation: Each group shares their processing strategies and how they used the seasonal forecast to guide decisions.
  - Summary: Trainer highlights the link between seasonal prediction and timely processing. Transition to the solar drying demonstration as one effective method for dry-season conditions.

**References/Sources/Further materials:**

No specific references or further materials are required.

## **2. Action Planning – “My Processing Plan”**

In this activity, learners develop a personalised processing action plan that uses seasonal forecasts to guide real-life decisions about when and how to process agricultural products. By working with a simple worksheet, participants identify suitable crops, select appropriate processing methods such as solar drying, and outline the materials and steps needed to prepare for the upcoming season. Through

guided reflection and feedback, learners practice applying climate information to their own farming or processing context, strengthening their ability to plan ahead, reduce losses, and make climate-smart choices.

1. **Aim of the activity:** To help learners create a realistic personal processing plan that uses seasonal forecasts to decide *when* to process, *which* crops to select, and *which* methods (e.g., solar drying) are most suitable.
2. **Duration:** 65 min
3. **Material required:**
  - “My Processing Plan” worksheet template
  - Pens or pencils
  - Local seasonal climate forecast or rainfall calendar
  - Examples of completed plans (optional)
4. **Step-by-step instruction of the task/practical exercise/case study:**
  - Explain how to read seasonal forecasting data (precipitation maps, drought levels, flood layers) and show some examples that can be discussed together with the students. Thereby, the suggested Youtube video can be helpful.
  - Explain the importance of seasonal planning: Show how seasonal forecasts guide decisions such as...
    - When crops will be harvested
    - When drying is most effective
    - When to prepare materials for processing
  - Planning task: Participants have time to analyse exemplary seasonal forecast information, whereby they look for...
    - Expected harvest month
    - Forecasted season (wet/dry)
    - Processing method selected (e.g., solar drying during dry months)
    - Materials needed
    - Possible climate risks and solutions
  - Individual action planning: Participants complete their own plan based on the crops they grow and the analysed seasonal forecast.
  - Sharing & feedback: Volunteers present their plans. Encourage discussion about timing processing activities according to the season.

#### **References/Sources/Further materials:**

Met Office. (2019). *Seasonal Forecasts Explained Part 1: The underpinning science* [Video]. YouTube. <https://www.youtube.com/watch?v=JdwxliVqzbQ>

### 3. Practical Demonstration: “Solar Drying in Action”

This practical activity introduces participants to solar drying as an effective food-processing technique that becomes especially valuable during forecasted dry seasons. Learners observe and assist in building a simple solar dryer, gaining hands-on experience with the materials, construction steps, and preparation of produce for drying. By linking the demonstration to seasonal climate forecasts, participants see how predictions of sunshine, low humidity, and dry conditions directly influence when solar drying is most efficient. The activity helps learners understand both the technical operation of a solar dryer and the importance of using climate information to plan processing activities that reduce post-harvest losses.

1. **Aim of the activity:** To provide hands-on experience in constructing and using a simple solar dryer, while demonstrating how seasonal forecasts guide the timing and choice of solar drying for different crops.
2. **Duration:** 95 min
3. **Material required:**
  - Materials for the theoretical part: poster or beamer with presentation slides
  - Materials for a simple solar dryer: wooden frame, netting, black plastic, transparent plastic
  - Tools: scissors/knife, nails/staples, hammer
  - Fresh produce (tomatoes, mangoes, etc.); Samples of previously solar-dried foods; Local/seasonal climate forecast charts;
  - Outdoor space with sunlight
4. **Step-by-step instruction of the task/practical exercise/case study:**
  - **Theoretical background:** Explain/give examples of logical actions based on specific seasonal forecasting signals. Let students think of examples from the local communities and farms.
  - **Seasonal forecasting for drying:** Explain how a forecasted dry season is ideal for solar drying because of the following reasons. Also, highlight the importance of choosing the right season before building or using dryers.
    - Strong sun = faster drying
    - Lower humidity = reduced spoilage risk
    - Easier scheduling for processing activities
  - **Introduction to solar drying:** Describe how solar drying works and its benefits in dry-season conditions.
  - **Review materials:** Show all materials needed to build a basic solar dryer.
  - **Construction demonstration:** Step-by-step assembly is as follows.
    - Preparing the wooden frame
    - Adding netting
    - Positioning black plastic for heat absorption

- Covering with transparent plastic to trap heat
- **Group Participation:** Participants help assemble and secure the dryer.
- **Loading the dryer:** Demonstrate slicing, arranging, and spacing produce for effective drying. Discuss how humidity and cloud cover - predicted in seasonal forecasts - affect drying times.
- **Observation & questions:** Show/taste dried samples and answer questions about best timing during the season.

**References/Sources/Further materials:**

No specific references or further materials are required.