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# The FarmForward Project: Sustainable and Transformative Strategies for Climate-Resilient Agriculture in VET

## WP2

### Climate-Resilient Farming Handbook

#### Handbook 5

#### Future Climate Scenarios in Agriculture

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## **The FarmForward Project: Sustainable and Transformative Strategies for Climate-Resilient Farming in VET**

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## Introduction

Climate change is profoundly reshaping European agriculture, altering temperature patterns, precipitation regimes, and growing seasons across the continent. Projections indicate that by 2050, Europe will face warmer winters, more frequent heatwaves, and increased variability in rainfall, leading to greater risks of droughts, floods, and pest outbreaks (EEA, 2023). These climatic shifts directly affect crop productivity, soil health, and water availability, challenging the long-term stability of food systems.

Understanding future climate scenarios allows educators, advisors, and farmers to move from reactive crisis management to proactive and informed adaptation planning. Climate scenarios—built on scientific projections from the Intergovernmental Panel on Climate Change (IPCC)—explore how temperature, precipitation, and extreme weather patterns may evolve under different greenhouse gas concentration pathways.

This module supports VET trainers in turning climate projections into actionable planning tools through the use of:

- downscaled climate models,
- agro-climatic impact assessments,
- “no-regrets” pathways – adaptation strategies beneficial under all future scenarios.

By exploring what the agricultural landscape might look like between 2030 and 2050, trainers and farmers can assess how farming systems will perform under future conditions. This approach allows them to evaluate the long-term viability of specific crops and livestock, identify potential risks, and develop resilient strategies to maintain productivity. These strategies should be aligned with key European policy frameworks, including the EU Green Deal (European Commission, 2019), the Farm to Fork Strategy,

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which promotes sustainable food systems, and the Common Agricultural Policy (CAP) 2023–2027, which emphasizes climate resilience and environmental performance as core objectives.

Integrating climate foresight into agricultural education strengthens strategic thinking and equips learners with the skills to move beyond adaptation toward innovation. It fosters the development of regenerative and climate-smart farming systems that ensure both economic productivity and ecological sustainability for future generations.

## Learning Objectives

- Interpret localised scenarios and seasonal outlooks for teaching/planning.
- Use scenario thinking to stress-test crop/livestock choices and calendars.
- Translate model outputs into practical farm advisories.

After completing this module, VET trainers will be able to:

- Interpret localised climate scenarios and seasonal outlooks for teaching and farm planning.
- Use scenario thinking to stress-test crop/livestock calendars.
- Translate model outputs into practical farm advisories.
- Support learners in integrating scenario-based adaptation into farm management.

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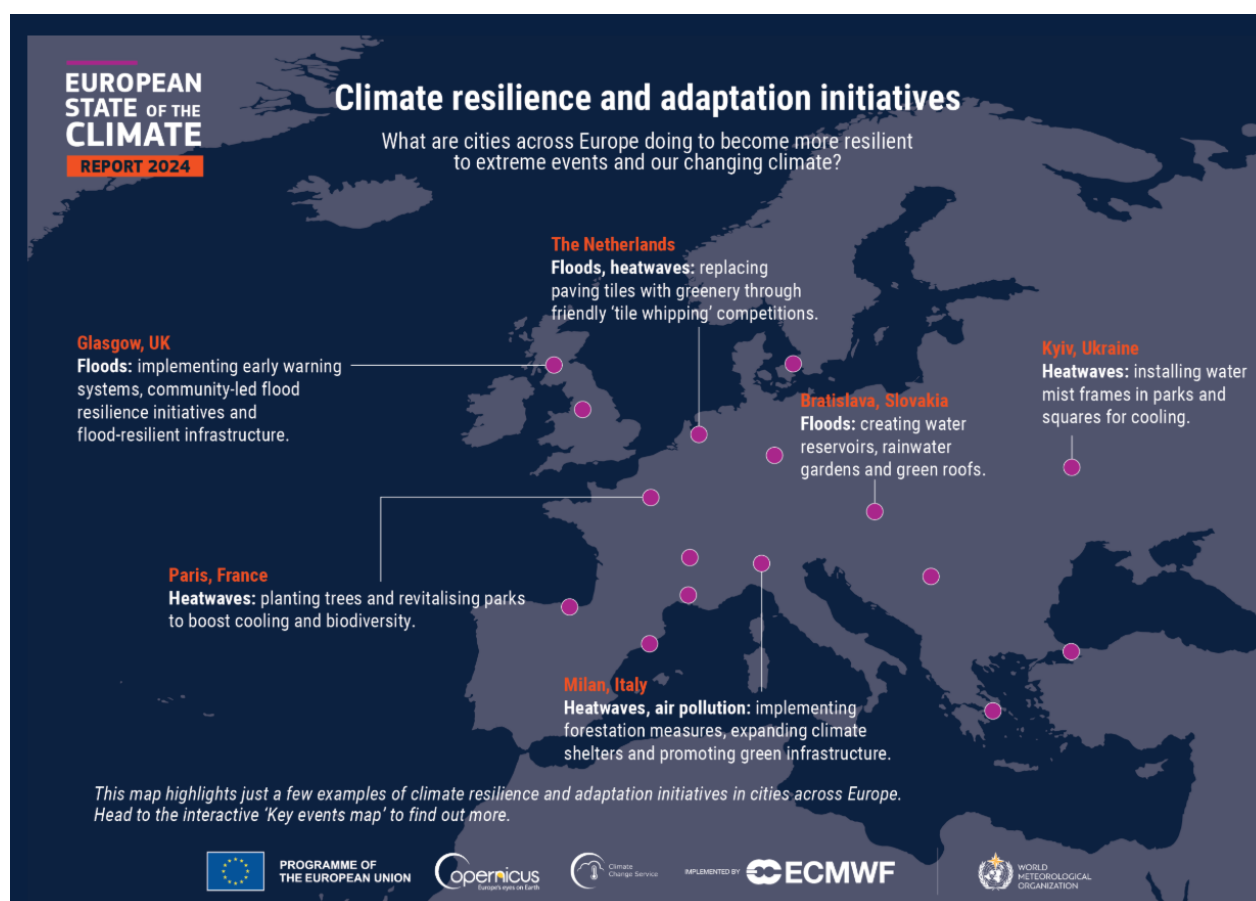
## Scenario Literacy for Trainers

### What Are Climate Scenarios?

Climate scenarios describe possible future climate conditions based on greenhouse gas emissions, technological development, and socio-economic trends.

They are “what-if” pathways used for exploring risks and guiding decisions—not

Graphic from the 2024 European State of the Climate (ESOTC) report, compiled by the Copernicus Climate Change Service (C3S) and the World Meteorological Organization (WMO)



<https://climate.copernicus.eu/esotc/2024>

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RCPs and SSPs – climate scenarios – different possible pathways for global development and greenhouse gas emissions

| Scenario                                                    | Description                                                                                                                                                                                                                         | Approximate global warming by 2100 |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>RCP2.6 / SSP1 – Sustainability, strong mitigation</b>    | This is a <b>sustainable development scenario</b> where societies successfully reduce emissions, invest in renewable energy, and adopt strong climate policies. CO <sub>2</sub> emissions peak soon and decline sharply after 2050. | <b>+1.5°C</b>                      |
| <b>RCP4.5 / SSP2 – Moderate emissions, “middle road”</b>    | A <b>moderate scenario</b> where the world takes a “middle path.” Some climate policies are implemented, but fossil fuels remain in use. Technological progress is steady, yet not enough to fully stop warming.                    | <b>+2.4°C</b>                      |
| <b>RCP8.5 / SSP5 – High emissions, fossil-fueled growth</b> | A <b>high-emissions scenario</b> driven by rapid economic growth powered by fossil fuels. Climate goals are not met, and greenhouse gas emissions continue to rise throughout the century.                                          | <b>+4°C or higher</b>              |

<https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-4/>

The table shows climate scenarios – different possible pathways for global development and greenhouse gas emissions. Scientists use these scenarios to model how much the Earth might warm by the year 2100, depending on the choices humanity makes today in terms of energy use, policy, and sustainability.

### What RCP and SSP stand for

- RCP (Representative Concentration Pathway) – represents a greenhouse gas concentration pathway that leads to a certain level of global warming.
- SSP (Shared Socioeconomic Pathway) – describes a possible socioeconomic storyline: how the world might develop in terms of economy, technology, population, and policies.

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Modern climate models combine both (e.g., RCP2.6/SSP1) to describe both emissions and the type of world that produces them.

## Why this matters for agriculture

Understanding these scenarios helps farmers, advisors, and educators to:

- anticipate how temperature, rainfall, and extreme weather might change in their region,
- assess risks to crops, livestock, and soil systems,
- design adaptation strategies, such as choosing climate-resilient crop varieties, improving water management, or adjusting planting times.

**Trainer tip:** Use IPCC graphics and data ([IPCC | Data](#)) or maps from Copernicus Climate Change Service ([Copernicus](#)) to show regional temperature and precipitation changes for different RCPs.

## Downscaling

Global models (e.g., CMIP6) are too coarse for farm-level use. Downscaling translates global results into regional or local projections using methods like:

- Statistical downscaling

## EURO-CORDEX

A European project providing regional climate model (RCM) data for Europe, including monthly air temperature and precipitation derived from global climate models (CMIP5).

<https://registry.opendata.aws/euro-cordex/>

## BCCAQ (Bias-Correction and Quantile Mapping)

A statistical downscaling method that generates high-resolution daily climate data from CMIP6 models using bias correction and quantile mapping techniques.

<https://www.nature.com/articles/s41597-023-02528-x>

- Dynamical downscaling (e.g., regional climate models at 10–25 km resolution)

### **CORDEX (Coordinated Regional Climate Downscaling Experiment)**

An international initiative coordinating regional climate downscaling. It provides data from various RCMs at resolutions of 10–50 km, suitable for analyzing climate change impacts across different regions.

<https://cordex.org/data-access/>

### **CMIP6 – Regional Climate Models**

Data from regional climate models within the CMIP6 framework, offering regional-level climate projections, useful for assessing climate change impacts on specific areas.

<https://cds.climate.copernicus.eu/datasets/projections-cordex-domains-single-levels?tab=overview>

These help VET learners explore how global climate trends appear in their own agro-climatic zone.

**Trainer tip:** Every climate projection includes a certain degree of uncertainty. Trainers should present the results as ranges or probability bands rather than single values. They should emphasize the direction of trends – for example, “warmer and drier summers” – instead of focusing on exact numbers. Additionally, trainers should teach learners how to compare multiple models to draw more robust and reliable conclusions.

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## Tools & Datasets Overview

### Key European Data Sources

| Name                                           | Description                                                                                                                                           | Use                                                                                       | Link                                                                                            |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| EURO-CORDEX                                    | Provides high-resolution (12.5–50 km) regional climate projections for Europe, derived from global climate models (CMIP5/CMIP6)                       | Assess impacts of climate change on agriculture, ecosystems, and water resources          | <a href="https://www.euro-cordex.net/">https://www.euro-cordex.net/</a>                         |
| Copernicus Climate Data Store (CDS)            | Open access to climate projections, reanalysis, and impact indicators for Europe and globally. Includes downscaled datasets for regional applications | Modeling future temperature, precipitation, droughts, and extreme events at local scales  | <a href="https://cds.climate.copernicus.eu/">https://cds.climate.copernicus.eu/</a>             |
| European Environment Agency (EEA) Climate Data | Provides climate change indicators, maps, and datasets for Europe, including projections for temperature, precipitation, and extreme weather events   | Supports policy-making, environmental assessments, and adaptation planning in agriculture | <a href="https://www.eea.europa.eu/themes/climate">https://www.eea.europa.eu/themes/climate</a> |

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|                                         |                                                                                                                            |                                                                                      |                                                                                                                                                                                                                                       |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| JRC<br>Climate &<br>Agriculture<br>Data | Offers datasets and models linking climate projections to agricultural productivity, crop suitability, and risk assessment | Assess climate impacts on European farming systems and explore adaptation strategies | <a href="https://ec.europa.eu/jrc/en/research-topic/climate">https://ec.europa.eu/jrc/en/research-topic/climate</a>                                                                                                                   |
| VITO<br>CLIMTAG<br>Toolbox              | Provides high-resolution climate projections and crop modeling tools for Europe, supporting climate-smart agriculture      | Evaluate how future climate affects crop growth, yield, and regional suitability     | <a href="https://blog.vito.be/remotesensing/future-climate-data-for-todays-decisions-introducing-the-climtag-toolbox">https://blog.vito.be/remotesensing/future-climate-data-for-todays-decisions-introducing-the-climtag-toolbox</a> |
| ICPAC<br>Open Data<br>Sources           | Aggregates European and regional climate data sources, including downscaled projections and agro-climatic indicators       | Facilitate integrated climate and agricultural planning                              | <a href="https://www.icpac.net/open-data-sources/">https://www.icpac.net/open-data-sources/</a>                                                                                                                                       |

## Agro-Climatic Indices

### What are Agro-Climatic Indices?

Agro-climatic indices are quantitative measures derived from climate data (temperature, rainfall, humidity, solar radiation, etc.) that describe the suitability of a given environment for crop or livestock production. They translate raw climate data

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into actionable information for farmers, advisors, and policymakers, allowing them to assess risks and optimize agricultural practices.

## **Key Types of Agro-Climatic Indices**

### **1. Temperature-based indices**

- Growing Degree Days (GDD): Measures accumulated heat required for a crop to reach maturity.
- Frost Days: Number of days with temperatures below 0°C, indicating frost risk.

### **2. Water-related indices**

- Aridity Index (AI): Ratio of precipitation to potential evapotranspiration; identifies water stress levels.
- Standardized Precipitation Evapotranspiration Index (SPEI): Monitors drought severity over different time scales.

### **3. Heat stress indices**

- Measures exposure of crops or livestock to extreme temperatures that may reduce growth, yield, or health.

### **4. Composite agro-climatic indices**

- Combine multiple parameters (temperature, rainfall, radiation) to assess overall suitability for specific crops or agro-ecological zones.

## **Applications in Agriculture**

- Crop suitability assessment: Identify which crops are best suited to a specific location under current or future climate.
- Risk assessment: Evaluate vulnerability to drought, heatwaves, or frost.

- Climate adaptation planning: Support decision-making for crop rotation, irrigation management, and selection of resilient varieties.
- Policy and planning: Help governments and institutions design climate-smart agricultural strategies aligned with the EU Green Deal or CAP.

## **Resources / Open Data for Agro-Climatic Indices**

1. FAO Global Agro-Ecological Zones (GAEZ) – crop suitability and climatic constraints.  
<https://gaez.fao.org/>
2. Copernicus Climate Data Store (CDS) – climate variables for calculating indices at European and local levels.  
<https://cds.climate.copernicus.eu/>
3. WorldClim / CHELSA datasets – high-resolution temperature and precipitation data for agro-climatic modeling.  
<https://www.worldclim.org/>  
<https://chelsa-climate.org/>
4. ICPAC Open Data – includes agro-climatic indices and climate risk indicators.  
<https://www.icpac.net/open-data-sources/>

## **Seasonal forecasts**

**Definition** (from the [Practical Guide to Seasonal Forecast](#)):

Seasonal forecasts predict climate conditions (temperature, rainfall, humidity, etc.) over the next few months to a year, providing a medium-term outlook for weather patterns. Unlike long-term climate projections, seasonal forecasts focus on near-future variability, which is highly relevant for agricultural planning.

## **Key Features:**

- Timeframe: typically 1–6 months ahead.
- Variables: temperature, precipitation, drought indices, frost risk, or extreme events.
- Probabilistic: expressed as likelihoods (e.g., 60% chance of above-average rainfall).

### **Applications in Agriculture:**

- Planting and sowing decisions: Selecting optimal times based on expected rainfall or frost risk.
- Irrigation planning: Adjusting water use according to predicted rainfall.
- Pest and disease management: Anticipating conditions favorable to outbreaks.
- Risk mitigation: Preparing for droughts, floods, or heatwaves in advance.

### **Resources / Open Data:**

1. **Copernicus Climate Data Store – Seasonal Forecasts**  
<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels>
2. **NOAA Climate Prediction Center (CPC) – Seasonal Forecasts**  
<https://www.cpc.ncep.noaa.gov/>

### **Crop models**

Definition (from the [Decomposing crop model uncertainty: A systematic review](#)):

Crop models are mathematical or computer-based simulations that describe crop growth, development, and yield as a function of weather, soil, water, nutrients, and management practices. They are used to understand how crops respond to climate conditions, both current and future.

### **Key Types:**

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1. Process-based models – simulate physiological processes of crops (e.g., CERES, DSSAT, APSIM).
2. Empirical/statistical models – based on observed relationships between climate variables and crop yields.
3. Integrated models – combine crop growth, soil, pest, and climate dynamics.

### **Applications in Agriculture:**

- Impact assessment: Evaluate how climate change affects yield, growth stages, and water requirements.
- Scenario testing: Explore outcomes under different climate projections or management strategies.
- Decision support: Inform farmers and policymakers on best practices, crop selection, and adaptation strategies.
- Research and breeding: Identify traits for climate-resilient crop varieties.

### **Popular Crop Models / Resources:**

1. DSSAT (Decision Support System for Agrotechnology Transfer)  
<https://dssat.net/>
2. APSIM (Agricultural Production Systems sIMulator)  
<https://www.apsim.info/>
3. FAO AquaCrop – focuses on water-limited environments.  
<https://www.fao.org/aquacrop/en/>

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## Stress-Testing Farm Systems

**Definition** (from the [FarmProgress](#)):

Stress-testing farm systems is the process of evaluating the resilience and robustness of agricultural operations by simulating extreme, unexpected, or adverse conditions. This involves applying “what-if” scenarios – such as droughts, floods, pest outbreaks, market disruptions, or supply chain shocks – to assess how farm systems respond, identify vulnerabilities, and develop strategies to mitigate risks and enhance adaptive capacity. It is essentially a proactive tool for risk management and decision support in farming systems.

### 1. What-If Drills

Stress-testing farm systems involves simulating extreme or unexpected conditions to evaluate the resilience and performance of agricultural operations. What-if drills are scenario-based exercises where different stress factors – such as drought, pest outbreaks, supply chain disruptions, or sudden market changes – are applied to the system. These drills help farmers, agronomists, and decision-makers identify vulnerabilities, test contingency plans, and improve adaptive strategies for risk management.

Key points:

- Simulates extreme or unlikely events to assess system robustness.
- Helps identify weak points in farm management, resources, or infrastructure.
- Supports planning for climate variability, market shocks, and operational risks.
- Encourages proactive adaptation rather than reactive responses.

**Trainer tip:** *Encourage participants to design “what-if” experiments, such as:*

- *What if rainfall decreases by 15% by 2040?*

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- What if the growing season shortens by 10 days?  
*These exercises foster adaptive thinking and link theory to real-world decisions.*

## 2. Crop Rotation and Cultivar Shifts

Stress-testing farm systems through rotation or cultivar shifts involves evaluating how changes in crop rotation patterns or the choice of crop varieties affect the resilience and performance of a farm under different stress conditions (e.g., climate variability, pests, diseases, or market fluctuations). By simulating alternative rotations or switching to more resilient cultivars, farmers can:

- Assess system stability: understand how different rotations or cultivars impact yields, soil health, and pest/disease dynamics.
- Identify risk reduction strategies: determine which combinations of crops or varieties reduce vulnerability to extreme weather or biotic stress.
- Optimize resource use: evaluate the effects on water, nutrient, and labor requirements under different scenarios.
- Plan adaptive management: develop contingency plans that maintain productivity and profitability under changing environmental conditions.

## 3. Irrigation Forecasting

Stress-testing farm systems through irrigation demand forecasting involves simulating different water availability and crop water requirement scenarios to evaluate the resilience of agricultural operations. By forecasting irrigation needs under varying climate, soil, and crop conditions, farmers and managers can:

- Assess water stress risks: Identify periods or conditions when crops may face water shortages.
- Optimize irrigation scheduling: Determine the best timing and amount of irrigation to maintain yields while conserving water.

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- Evaluate system capacity: Test whether existing irrigation infrastructure can meet peak water demand under extreme weather scenarios.
- Plan adaptive strategies: Develop contingency plans for droughts, heatwaves, or other events affecting water supply.

Example: Modeling irrigation needs for a maize crop under different rainfall scenarios to determine if current irrigation capacity is sufficient during an unusually dry season.

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## Extreme Events Preparedness

**Definition** (from: Change, N. I. P. O. C. (2023). [\*Climate Change 2022 – Impacts, adaptation and vulnerability\*](#)):

Extreme events preparedness in farm systems is a proactive approach to managing climate-related risks such as droughts, floods, heatwaves, and other environmental shocks. It focuses on minimizing losses, protecting resources, and maintaining productivity by ensuring timely and effective responses.

### Key Components:

#### 1. Early-Warning Linkages:

- Integration of meteorological forecasts, remote sensing data, and soil moisture monitoring to provide farmers with timely alerts.
- Collaboration with local weather stations, agricultural extension services, and climate information platforms to ensure accurate and actionable information.
- Use of mobile apps, SMS alerts, or digital dashboards to deliver real-time warnings directly to farm managers.

### Early-Warning Systems for Agriculture: Tools & Platforms

#### 1. FEWS NET (Famine Early Warning Systems Network)

Provides evidence-based early warning information and analysis covering more than 36 of the world's most food-insecure countries. It offers monthly reports on current and projected food insecurity, alerts on emerging crises, and specialized reports on weather and climate, markets and trade, and agricultural production.

<https://fews.net/>

#### 2. GEOGLAM Crop Monitor

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An open, timely, and science-driven platform offering information on crop conditions to support market transparency and early warning of production shortfalls. It publishes monthly crop condition bulletins and provides access to global crop conditions and supplemental reports.

<https://www.cropmonitor.org/>

### **3. FAO's Global Information and Early Warning System (GIEWS)**

Monitors food supply and demand and other key food security indicators at the country level. GIEWS generates regular reports on markets and crop production conditions and provides early warning of impending food crises at country and regional levels.

<https://www.fao.org/giews/en/>

### **4. PRISM (Platform for Real-time Impact and Situation Monitoring)**

An open-source climate risk monitoring platform that integrates geospatial data on climate-related hazards along with socioeconomic vulnerability in an interactive map interface. Managed by the World Food Programme (WFP), it helps in assessing and responding to climate-related impacts.

<https://innovation.wfp.org/project/prism>

### **5. EOS Crop Monitoring**

A smart agriculture platform that allows users to monitor crop health, predict risks, and optimize resources using satellite images. Features include vegetation index maps, field activity logs, and yield estimation tools.

<https://eos.com/products/crop-monitoring/>

### **6. Drought.gov**

Provides information on drought early warning systems, integrating observation and monitoring, prediction and forecasting, planning and preparedness, communication and outreach, and interdisciplinary research and applications.

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<https://www.drought.gov/about/drought-early-warning>

## **7. UNCCD Drought Toolbox**

Offers a catalog of databases and developed systems to monitor drought in various regions. It provides resources for assessing drought risks and implementing mitigation strategies.

<https://www.unccd.int/land-and-life/drought/toolbox/monitoring-and-early-warning>

### **2. Playbooks / Action Plans:**

- Predefined, step-by-step protocols outlining what actions to take before, during, and after extreme events.
- Example measures include adjusting irrigation schedules, applying protective shading for crops, reinforcing drainage systems, relocating livestock, or harvesting early to avoid losses.
- Playbooks can be crop-specific, location-specific, and tailored to different types of extreme events.

## **European Agricultural Playbooks & Action Plans**

### **1. TransformAr: Compendium of Pathways and Action Plans**

This document outlines various adaptation pathways and action plans tailored to the agricultural sector. It includes strategies for managing water-sensitive farming areas, developing vulnerability maps for agricultural land, and utilizing remote sensing techniques to monitor and respond to extreme events.

[Compendium of Pathways and Action Plans](#)

### **2. EU Adaptation Strategy: Agriculture Sector Policies**

The European Environment Agency's Climate-ADAPT platform provides an overview of the EU Adaptation Strategy, focusing on sector-specific policies for agriculture. It

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discusses instruments like the Common Agricultural Policy (CAP) and the Land Use, Land Use Change, and Forestry (LULUCF) Regulation, which aim to stimulate adaptation solutions and improve resilience to climate risks.

[Agriculture - Climate-ADAPT](#)

### **3. European Commission: Climate Change Adaptation in the Agriculture Sector**

This report by the European Commission delves into the impacts of climate change on agriculture, highlighting the increasing risks of extreme weather events. It discusses the need for adaptation strategies and the role of EU policies in supporting the agricultural sector's resilience.

[Climate Change Adaptation in the Agriculture Sector in Europe](#)

### **4. European State of the Climate 2024: Extreme Events in Europe**

The World Meteorological Organization's report provides an overview of extreme weather events in Europe, focusing on widespread flooding, extreme heat, and droughts. It offers insights into the impacts of these events on agriculture and the importance of preparedness and adaptation measures.

[European State of the Climate: Extreme Events](#)

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## Decision Calendars

**Definition** (from the [FAO Crop Calendar](#)):

A Decision Calendar is a time-based planning tool that helps farmers and agronomists schedule key management actions throughout the growing season. It integrates environmental, biological, and operational information to optimize crop and livestock management, reduce risks, and improve productivity.

### Key Functions and Applications:

#### 1. Windows for Sowing and Harvesting

- Decision calendars indicate the optimal periods for planting and harvesting, taking into account climate, soil conditions, and crop phenology.
- They help farmers avoid adverse weather conditions such as frost, heatwaves, or heavy rainfall, which could damage seeds or reduce yields.
- For example, maize sowing in Europe can be scheduled according to soil temperature thresholds and rainfall patterns to ensure optimal germination and growth.

#### 2. Pest and Disease Pressure Timing

- Decision calendars incorporate both historical and predictive data on pest and disease occurrences to identify periods of high risk.
- This allows farmers to plan timely interventions, such as targeted pesticide applications or biological control measures, reducing crop losses and minimizing unnecessary chemical use.
- For example, wheat farmers can monitor aphid life cycles to accurately time preventive treatments and improve pest management efficiency.

#### 3. Feed and Resource Planning

- In livestock systems, decision calendars guide feed allocation and grazing schedules by anticipating seasonal changes in pasture growth and feed availability.
- They support feed storage and procurement planning, ensuring that animals' nutritional needs are met throughout the year.
- For example, dairy farms can plan silage harvests and feed supplementation based on predicted dry periods and pasture growth cycles.

#### **4. Integration with Climate and Stress-Testing Tools**

- Decision calendars can be integrated with crop models, climate forecasts, and early-warning systems to allow dynamic adjustments of farming actions. This integration enhances resilience by enabling farmers to adapt management strategies in response to predicted extreme events or abnormal conditions.

#### **Benefits:**

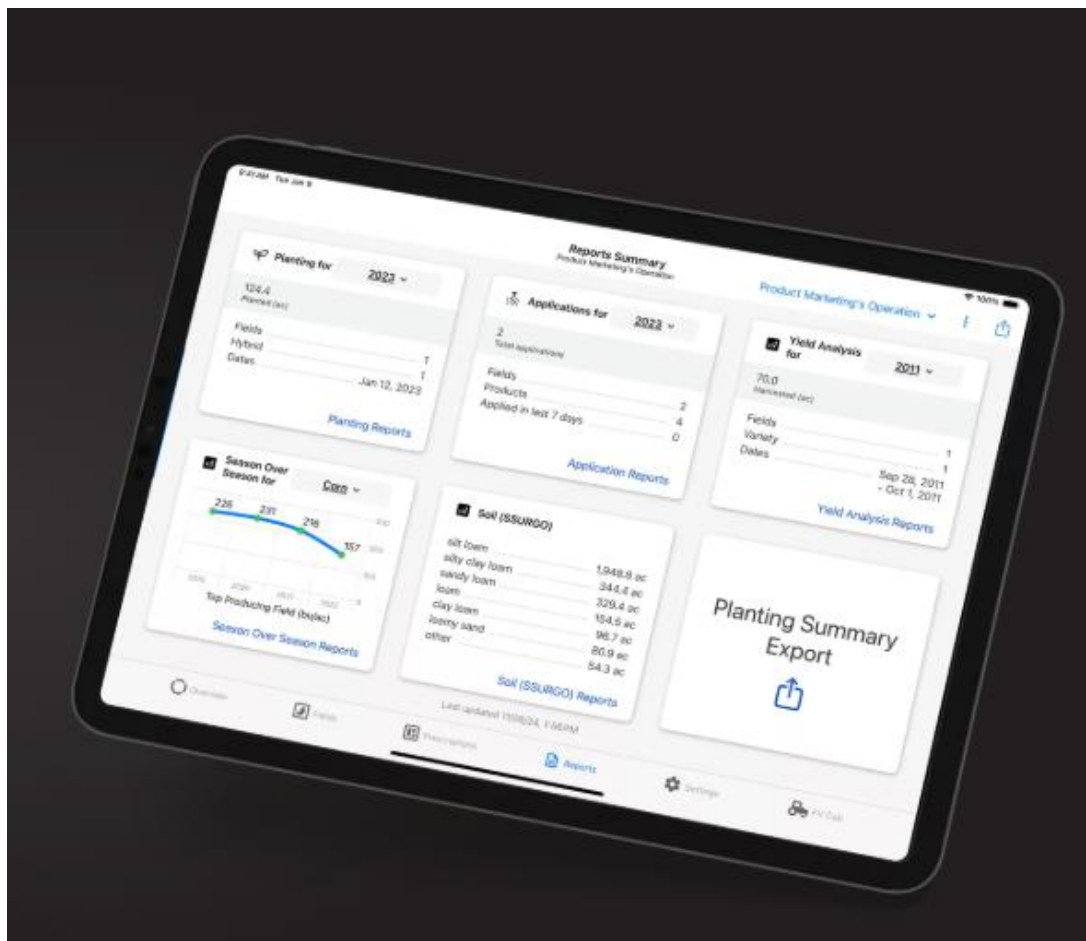
- Decision calendars improve efficiency and help reduce crop and livestock losses.
- They optimize the timing of key inputs such as fertilizers, irrigation, and pesticides.
- By promoting proactive rather than reactive decision-making, they enable more effective farm management.
- Additionally, they facilitate compliance with agricultural regulations and support the achievement of sustainability goals.

#### **Example Tools / Platforms:**

- **DSSAT / APSIM** – Crop simulation models can feed into decision calendars ([DSSAT](#), [APSIM](#))

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- **FarmLogs / Climate FieldView** – Digital farm management platforms providing season-long planning and monitoring ([Climate FieldView](https://climate.com/en-us/solutions/analyze-data.html))



<https://climate.com/en-us/solutions/analyze-data.html>

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## Communicating Uncertainty

Communicating uncertainty involves presenting information about risks, variability, and incomplete knowledge in a clear and actionable way. In agriculture, this is crucial for helping farmers, agronomists, and decision-makers make informed choices under uncertain conditions, such as weather variability, pest outbreaks, or market fluctuations.

### Key Concepts:

#### 1. Scenarios vs Predictions

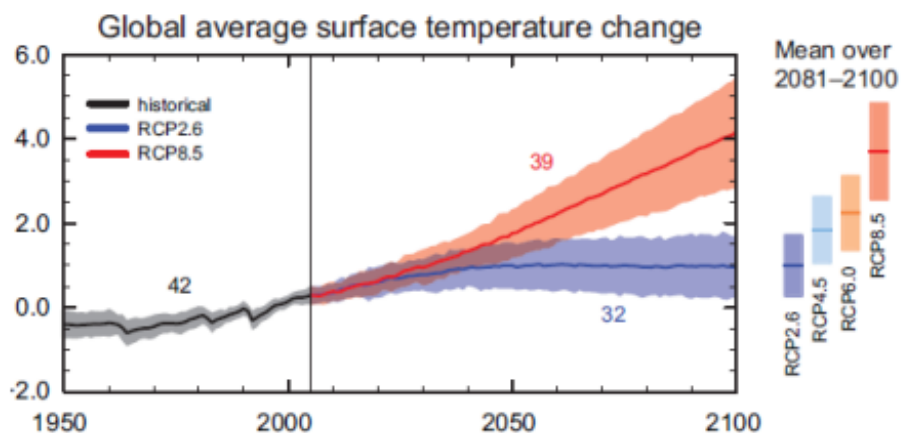
Predictions provide specific forecasts based on current data and models, such as the expected rainfall for the upcoming week. Scenarios represent multiple plausible outcomes built on different assumptions or drivers, for example, high, medium, and low rainfall scenarios for a given season. Using scenarios enables farmers to prepare for a range of possible conditions rather than relying on a single forecast.

#### 2. Farmer-Friendly Visuals

Visual tools can make complex probabilistic or scenario-based information easier to understand and act upon. Examples include:

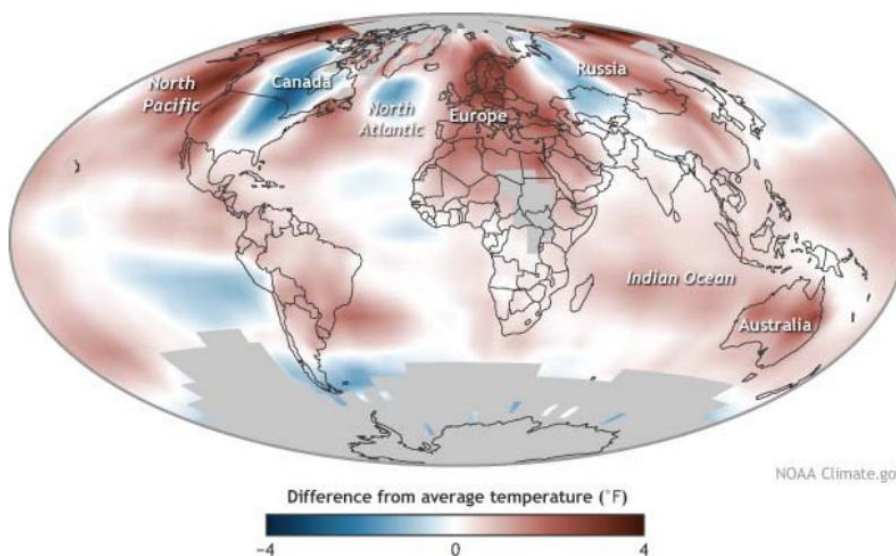
- **Fan charts** showing ranges of likely outcomes over time.

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[https://unfccc.int/sites/default/files/resource/Ch\\_4\\_Climate\\_change\\_scenarios\\_2021.pdf](https://unfccc.int/sites/default/files/resource/Ch_4_Climate_change_scenarios_2021.pdf)

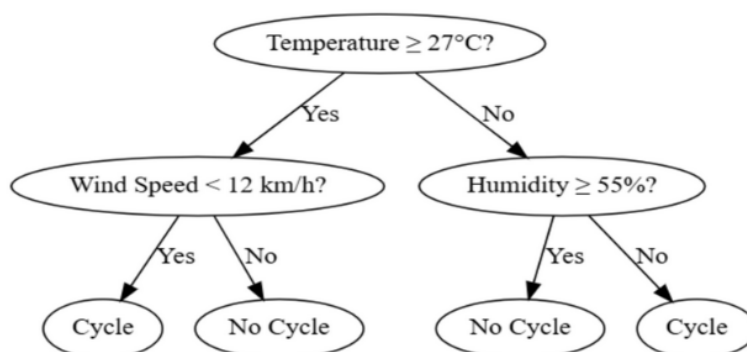
- **Color-coded risk maps** indicating areas of higher or lower probability of stress events (drought, pests, flooding).



[https://unfccc.int/sites/default/files/resource/Ch\\_4\\_Climate\\_change\\_scenarios\\_2021.pdf](https://unfccc.int/sites/default/files/resource/Ch_4_Climate_change_scenarios_2021.pdf)

- **Scenario trees** illustrating different decision pathways under alternative conditions.

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<https://askfilo.com/user-question-answers-smart-solutions/scenario-a-decision-tree-predicts-whether-to-go-cycling-3238313239323438>

Visuals should be simple, intuitive, and actionable, enabling farmers to integrate uncertainty into planning and management decisions.

### 3. Integration with Decision Support Tools

- Probabilistic forecasts and scenario analyses can be incorporated into crop models, irrigation scheduling tools, and risk management platforms to guide decisions under uncertainty.
- Examples: DSSAT, APSIM, Climate FieldView, and digital early-warning platforms.

The effective communication of uncertainty encourages risk-aware decision-making, helping to reduce exposure to extreme losses. It also improves trust in and the adoption of forecast and advisory services. Additionally, it enhances resilience by enabling farmers to prepare for a range of possible conditions.

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## Self-Assessment Questions

### Self-Check Questions

1. What is the difference between RCP and SSP?
2. Why is downscaling important for agricultural decision-making?
3. Name two agro-climatic indices useful for crop planning.

### Knowledge-Based Questions

1. How can seasonal forecasts support farm-level decision calendars?
2. Describe one advantage and one limitation of using “no-regrets” strategies in adaptation planning.

### Application-Based Exercises

#### 1. Mini-Scenario

Under RCP4.5, maize yield in southern France is expected to decrease by 10%. Suggest two adaptive measures and discuss their feasibility.

#### 2. Mini-Scenario

A dairy farmer in Hungary faces 5–10 more heatwave days annually by 2040. Identify infrastructure or management adaptations.

#### 3. Mini-Scenario

Use data from the Copernicus Climate Data Store to visualize projected temperature for your region in 2040. How would this affect local crop calendars?

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## Annexes

### Glossary

**RCP:** Representative Concentration Pathway (emission trajectory).

**SSP:** Shared Socioeconomic Pathway (development storyline).

**Downscaling:** Method to derive local projections from global models.

**Scenario Thinking:** Exploring multiple futures to improve preparedness.

**Agro-Climatic Index:** Quantitative indicator of climate stress on farming.

### Abbreviations

CAP – Common Agricultural Policy

CDS – Climate Data Store

EDO – European Drought Observatory

EMS – Emergency Management Service

IPCC – Intergovernmental Panel on Climate Change

JRC – Joint Research Centre

RCP – Representative Concentration Pathway

SSP – Shared Socioeconomic Pathway

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