Sustain4Rural

BE RESPONSIBLE, BE SUSTAINABLE

# Part 2: Climate change and environmentally sustainable plants and trees



Funded by the Erasmus+ Programme of the European Union

Sustain4Rural

BE RESPONSIBLE, BE SUSTAINABLE

# Consortium

***Co-Ordinator:*** ECECT

***Partners:*** PSC PARPOUNAS SUSTAINABILITY CONSULTANTS

ΜΙΛΕΤΙΑ ΒΙΩΣΙΜΗ ΚΟΙΝΩΝΙΚΗ ΑΝΑΠΤΥΞΗ

Funded by the Erasmus+ Programme of the European Union

# What will you learn in this module?

- Part 1: Climate change
- Part 2: Climate change and agriculture
- Part 3: Consequences in agriculture
- Part 4: Extreme weather conditions
- Part 5: Impact on the ground
- Part 6: Fires and climate change
- Part 7: Beekeeping and climate change
- Part 8: Environmentally sustainable plants and trees


Funded by the Erasmus+ Programme of the European Union

# Part 1: Climate change

- What is climate change?
- Fact or myth?
- Facts
- Fixing the problem
- Complexity of the problem
- Impact
- Climate change adaptation




Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## What is climate change?

Climate change is one of the most complex issues facing us today. It involves many dimensions (science, economics, society, politics, and moral and ethical questions) and is a global problem, felt on local scales that will be around for thousands of years. Carbon dioxide, the heat-trapping greenhouse gas that is the primary driver of recent global warming, lingers in the atmosphere for many thousands of years, and the planet (especially the ocean) takes a while to respond to warming. So even if we stopped emitting all greenhouse gases today, global warming and climate change would continue to affect future generations. In this way, humanity is “committed” to some level of climate change.




Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## What is climate change?

People are increasingly influencing the climate and temperature of the earth due to various activities, such as the use of fossil fuels, livestock farming, and deforestation. These activities add huge amounts of greenhouse gases to the atmosphere, causing an increase in the greenhouse effect and global warming.


Global climate change causes:

- Increase in temperature
- Rainfall changes
- Rise of the sea level
- Melting ice caps
- Changes in flowering times of flowers and plants.

The Earth's climate is constantly changing; however, scientists have noticed unusual changes in recent decades. For example, the Earth's average temperature is rising much faster than would have been expected for the past 150 years.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Fact or Myth?

Climate change is real and human-made, and there is overwhelming scientific consensus that this is true. Human-produced pollution is the main cause of climate change, and this will become much more dangerous in the future if we do not act.


## Evidence

- While Earth's climate has changed throughout its history, the current warming is happening at a rate not seen in the past 10,000 years.
- Scientific information taken from natural sources (such as ice cores, rocks, and tree rings) and from modern equipment (like satellites and instruments) all show the signs of a changing climate.
- From global temperature rise to melting ice sheets, the evidence of a warming planet abounds.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Facts


There is no time to waste as climate change is affecting, in one way or another, all of us. With the new EU growth strategy, we are trying to, not only have an impact on the climate, but also to create opportunities and competitive advantages on people's life and economy. By doing so, we want to inspire others around the world to follow our example.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Complexity of the problem

To mitigate climate change, we need to significantly reduce global greenhouse gas emissions. Mitigation requires concrete measures and an understanding of a complex system that links emissions from different sources to national and regional impacts and global governance.


Because we are already committed to some level of climate change, responding to climate change involves a two-pronged approach:

- ✓ Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere ("**mitigation**");
- ✓ Adapting to the climate change already in the pipeline ("**adaptation**").



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Complexity of the problem

Is It Too Late To Stop Climate Change? Well, it's Complicated.




Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Complexity of the problem

Can YOU Fix Climate Change?




Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Can we fix the problem?

Our lifestyles have a profound impact on our planet. Our choices matter. Around two-thirds of global greenhouse gas emissions are linked to private households. The energy, food, and transport sectors each contribute about 20 per cent of lifestyle emissions. From the electricity we use, to the food we eat, the way we travel, and the things we buy, we can make a difference.


United Nations
https://www.un.org/actnow?gclid=Cj0KCQjwy5maBhDdARIsAMxrkw263ODl5t2DiJVtoKChpoCKlItYp9ctUR7wZ51QYo4EO53oL6aRaQYaAndrEALw_wcB



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

Causes and Effects of Climate Change



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## Europe and impact

Key observed and projected climate change and impacts for the main biogeographical regions in Europe

**Arctic region**
- Temperature rise much larger than global average
- Decrease in Arctic sea ice coverage
- Decrease in Greenland ice sheet
- Decrease in permafrost areas
- Increasing risk of biodiversity loss
- Some new opportunities for the exploitation of natural resources and for sea transportation
- Risks to the livelihoods of indigenous peoples

**Atlantic region**
- Increase in heavy precipitation events
- Increase in river flow
- Increasing risk of river and coastal flooding
- Increasing damage risk from winter storms
- Decrease in energy demand for heating
- Increase in multiple climatic hazards

**Mountain regions**
- Temperature rise larger than European average
- Decrease in glacier extent and volume
- Upward shift of plant and animal species
- High risk of species extinctions
- Increasing risk of forest pests
- Increasing risk from rock falls and landslides
- Changes in hydropower potential
- Decrease in ski tourism

**Coastal zones and regional seas**
- Sea level rise
- Increase in sea surface temperatures
- Increase in ocean acidity
- Northward migration of marine species
- Risks and some opportunities for fisheries
- Changes in phytoplankton communities
- Increasing number of marine dead zones
- Increasing risk of water-borne diseases

**Boreal region**
- Increase in heavy precipitation events
- Decrease in snow, lake and river ice cover
- Increase in precipitation and river flows
- Increasing potential for forest growth and increasing risk of forest pests
- Increasing damage risk from winter storms
- Increase in crop yields
- Decrease in energy demand for heating
- Increase in hydropower potential
- Increase in summer tourism

**Continental region**
- Increase in heat extremes
- Decrease in summer precipitation
- Increasing risk of river floods
- Increasing risk of forest fires
- Decrease in economic value of forests
- Increase in energy demand for cooling

**Mediterranean region**
- Large increase in heat extremes
- Decrease in precipitation and river flow
- Increasing risk of droughts
- Increasing risk of biodiversity loss
- Increasing risk of forest fires
- Increased competition between different water users
- Increasing water demand for agriculture
- Decrease in crop yields
- Increasing risks for livestock production
- Increase in mortality from heat waves
- Expansion of habitats for southern disease vectors
- Decreasing potential for energy production
- Increase in energy demand for cooling
- Decrease in summer tourism and potential increase in other seasons
- Increase in multiple climatic hazards
- Most economic sectors negatively affected
- High vulnerability to spillover effects of climate change from outside Europe

European Environmental Agency
https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016/key-findings



Funded by the Erasmus+ Programme of the European Union

# Climate change

## Impact

Climate change affects all regions around the world. Polar ice shields are melting, and the sea is rising. In some regions, extreme weather events and rainfall are becoming more common, while others are experiencing more extreme heat waves and droughts. We need climate action now, or these impacts will only intensify.
Climate change is a very serious threat, and its consequences impact many different aspects of our lives. Below, you can find a list of climate change's main consequences.

### Threats to business

- ✓ Infrastructure and buildings
- ✓ Energy
- ✓ Agriculture and forestry
- ✓ Insurance
- ✓ Tourism
- ✓ Cross-cutting issues for businesses

### Social threats

- ✓ Health
- ✓ Vulnerable population
- ✓ Employment
- ✓ Education

### Natural consequences

- ✓ High temperatures
- ✓ Drought and wildfires
- ✓ Availability of fresh water
- ✓ Floods
- ✓ Sea-level rise and coastal areas
- ✓ Biodiversity
- ✓ Soils
- ✓ Inland water
- ✓ Marine environment



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change

## European Green Deal, 2030 Climate Target Plan

The Commission’s proposal to cut greenhouse gas emissions by at least 55% by 2030 sets Europe on a responsible path to becoming climate neutral by 2050.

Based on a comprehensive impact assessment, the Commission has proposed to increase the EU's ambition on reducing greenhouse gases and set this more ambitious path for the next 10 years. The assessment shows how all sectors of the economy and society can contribute and sets out the policy actions required to achieve this goal.


**Objectives**

- Set a more ambitious and cost-effective path to achieving climate neutrality by 2050
- Stimulate the creation of green jobs and continue the EU’s track record of cutting greenhouse gas emissions whilst growing its economy
- Encourage international partners to increase their ambition to limit the rise in global temperature to 1.5°C and avoid the most severe consequences of climate change

European Commission
https://climate.ec.europa.eu/eu-action/european-green-deal_en



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE

Funded by the Erasmus+ Programme of the European Union

# Climate change

## European Green Deal

European Green Deal is an ambitious package of measures ranging from ambitiously cutting greenhouse gas emissions, to investing in cutting-edge research and innovation, to preserving Europe's natural environment.

First climate action initiatives under the Green Deal include:

- ✓ European Climate Law to enshrine the 2050 climate-neutrality objective into EU law
- ✓ European Climate Pact to engage citizens and all parts of society in climate action
- ✓ 2030 Climate Target Plan to further reduce net greenhouse gas emissions by at least 55% by 2030
- ✓ New EU Strategy on Climate Adaptation to make Europe a climate-resilient society by 2050, fully adapted to the unavoidable impacts of climate change.


European Commission
https://climate.ec.europa.eu/eu-action/european-green-deal_en



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Part 2: Climate change and agriculture

- Situation
- Reverse problem
- Future
- European Policies
- National strategy



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Situation

The challenge is intensified by agriculture's extreme vulnerability to climate change. Climate change's negative impacts are already being felt, in the form of increasing temperatures, weather variability, shifting agroecosystem boundaries, invasive crops and pests, and more frequent extreme weather events. On farms, climate change is reducing crop yields and the nutritional quality of major cereals and lowering livestock productivity. Substantial investments in adaptation will be required to maintain current yields and to achieve production and food quality increases to meet demand.

## Reverse problem

The problem also works in reverse. Agriculture is a major part of the climate problem.

The main determinant parameters of GHG emissions from agriculture are the animal population, the quantities of synthetic nitrogen fertilizers applied on soils and the agricultural crop production.




Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Climate change affects agriculture

Before reaching our plates, our food is produced, stored, processed, packaged, transported, prepared, and served. At every stage, food provisioning releases greenhouse gases into the atmosphere. Farming in particular releases significant amounts of methane and nitrous oxide, two powerful greenhouse gases. Methane is produced by livestock during digestion due to enteric fermentation and is released via belches. It can also escape from stored manure and organic waste in landfills. Nitrous oxide emissions are an indirect product of organic and mineral nitrogenfertilizerss.

and

## agriculture contributes to climate change

Crops need suitable soil, water, sunlight, and heat to grow. Warmer air temperatures have already affected the length of the growing season over large parts of Europe. Flowering and harvest dates for cereal crops are now happening several days earlier in the season. These changes are expected to continue in many regions.

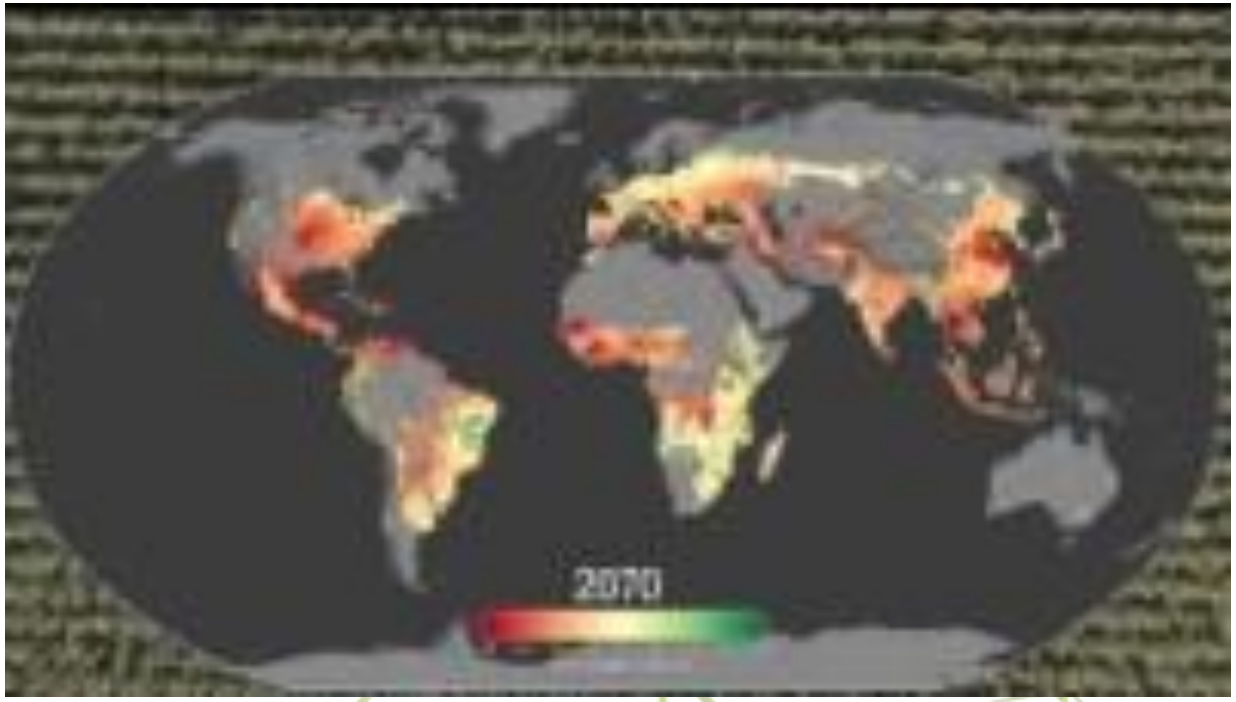


Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Future

Climate Change Could Affect Global Agriculture Within 10 Years






Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Common agricultural policy, European Commission

The common agricultural policy (CAP) is about food, the environment and the countryside.

The CAP is a partnership between society and agriculture that ensures a stable supply of food, safeguards farmers' income, protects the environment and keeps rural areas vibrant.

The objectives are:
- to ensure a fair income for farmers;
- to increase competitiveness;
- to improve the position of farmers in the food chain;
- climate change action;
- environmental care;
- to preserve landscapes and biodiversity;
- to support generational renewal;
- vibrant rural areas;
- to protect food and health quality;
- fostering knowledge and innovation.


European Commission
https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/new-cap-2023-27/key-policy-objectives-new-cap_en



Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Farm to Fork

Published in May 2020, the F2F strategy outlines how the EU wants to overhaul the food system to make it “fair, healthy and environmentally-friendly.” This future “farm to fork” food system would incorporate primary production (farming), the supply (value) chain and consumption. It shall have a neutral or positive environmental impact, help mitigate climate change, adapt to its impacts and reverse the loss of biodiversity, the European Commission has said.


European Commission



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Farm to Fork

The Farm to Fork Strategy aims to accelerate our transition to a sustainable food system that should:

- have a neutral or positive environmental impact
- help to mitigate climate change and adapt to its impacts
- reverse the loss of biodiversity
- ensure food security, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food
- preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade


European Commission
https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Greece - Policy

Rural Development Policy's actions contributes directly to the decrease of greenhouse gas emissions are the following:

- Organic farming.
- Decrease of the use of synthetic nitrogen fertilizers.
- Disengagement of subsidies from the agricultural production (reduction of the rate of intensity of agricultural land use).
- Use of environment-friendly livestock farming methods and improvement of the management of animal waste.
- Improvement of energy efficiency, renewable energy generation and use, including biomass.
- Improve management of soil (maintenance of agricultural activities in mountainous areas, green cover, and permanent grassland) and increase carbon sequestration.

(Hellenic Republic, Ministry of Environment and Energy)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE

Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Cyprus - Policy

Rural Development Policy of Cyprus includes:

- Knowledge transfer and innovation in agriculture, forestry, and rural areas
- Enhancing farm viability and competitiveness of all types of agriculture
- Food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture
- Restoring, preserving and enhancing ecosystems related to agriculture and forestry
- Resource efficiency and a low carbon-climate resilient economy
- Social inclusion, poverty reduction and local development in rural areas

(Future climate change impact, vulnerability and adaptation assessment for the case of Cyprus, CYPADAPT)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Part 3: Consequences in agriculture

- Impacts
- Challenges



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Impacts

**Direct impacts from changing weather patterns**
- ✓ Rising temperatures
- ✓ Heat waves
- ✓ Changes in rainfall (droughts and floods)

**Direct impacts from increased atmospheric CO2 levels**
- ✓ Higher crop, grass and forestry yields due to CO2 fertilization
- ✓ Reduced nutritional value of crops

**Climate driven changes in pests, plant diseases and weeds (indirect impacts)**
- ✓ Pest insects
- ✓ Weeds, invasive species and plant pathogens
- ✓ Technological solutions to pests and weeds

**Other indirect impacts from changed conditions**
- ✓ Food security, undernutrition and food prices
- ✓ Agricultural land loss from sea level rise
- ✓ More arable land due to less frozen land
- ✓ Less irrigation water availability due to melting glaciers
- ✓ Erosion and soil fertility
- ✓ Early blooms and effects on growing periods
- ✓ Food safety and losses
- ✓ Impacts of surface level ozone on crops
- ✓ Financial burden



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Climate change and agriculture

## Challenges

Climate, Agriculture and the Challenges Ahead



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Part 4: Extreme weather conditions

- Droughts
- Floods
- Problems



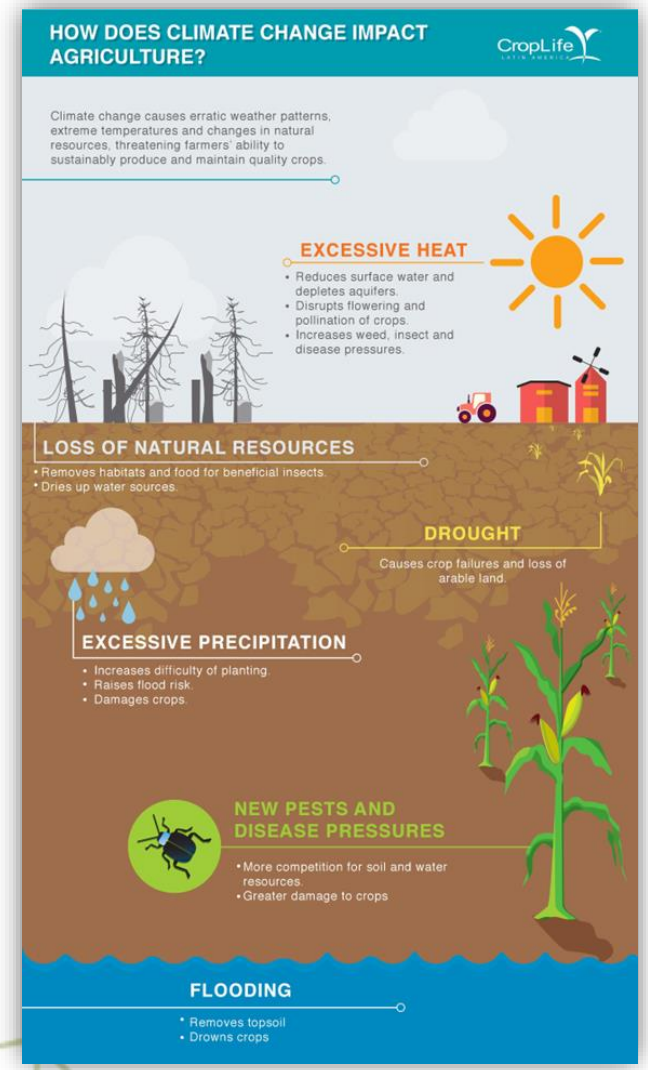
Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Droughts and floods

Droughts and floods contribute to decreases crop yields due to climate change, and extreme weather events become more common. In extreme cases, floods destroy crops, disrupt agricultural activities and render workers jobless and eliminate food supply. Droughts can also wipe out crops. Irrigation of crops is able to reduce or even remove the impacts on yields of lower rainfall and higher temperatures - through localized cooling. However, using water resources for irrigation has downsides and is expensive. Also, the water must come from somewhere, and if the area has been in a drought for a long time, the rivers may be dry, and the irrigation water would have to be transported from further distances.

Droughts have been occurring more frequently because of global warming, and they are expected to become more frequent and intense in the future. Their impacts are aggravated because of increased water demand, population growth, and urban expansion in many areas. Droughts result in crop failures and the loss of pasture grazing land for livestock. Some farmers may choose to permanently stop farming in a drought-affected area and go elsewhere.

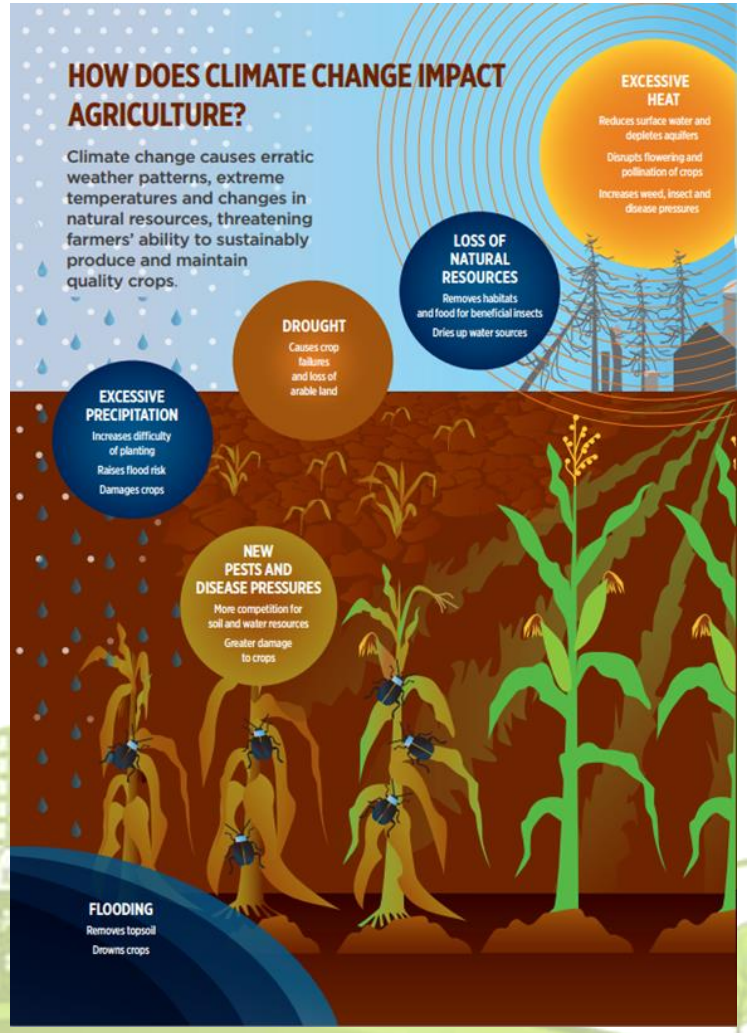





Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Droughts and floods




Flood damage can impact an agricultural operation in many ways. Not only can a flood make a field unsuitable for planting, but it can also ruin crops that have already been harvested.

Flood water may be “inherently unsanitary” and “food that has been in contact with floodwater to be unfit for human consumption.” Damage to crops stored in grain silos can mean thousands of dollars in losses. As floods grow more common in many parts of the earth due to climate change and unpredictable weather patterns, professionals will have to find ways to mitigate the risk of flood damage to their crops and farmland investments.

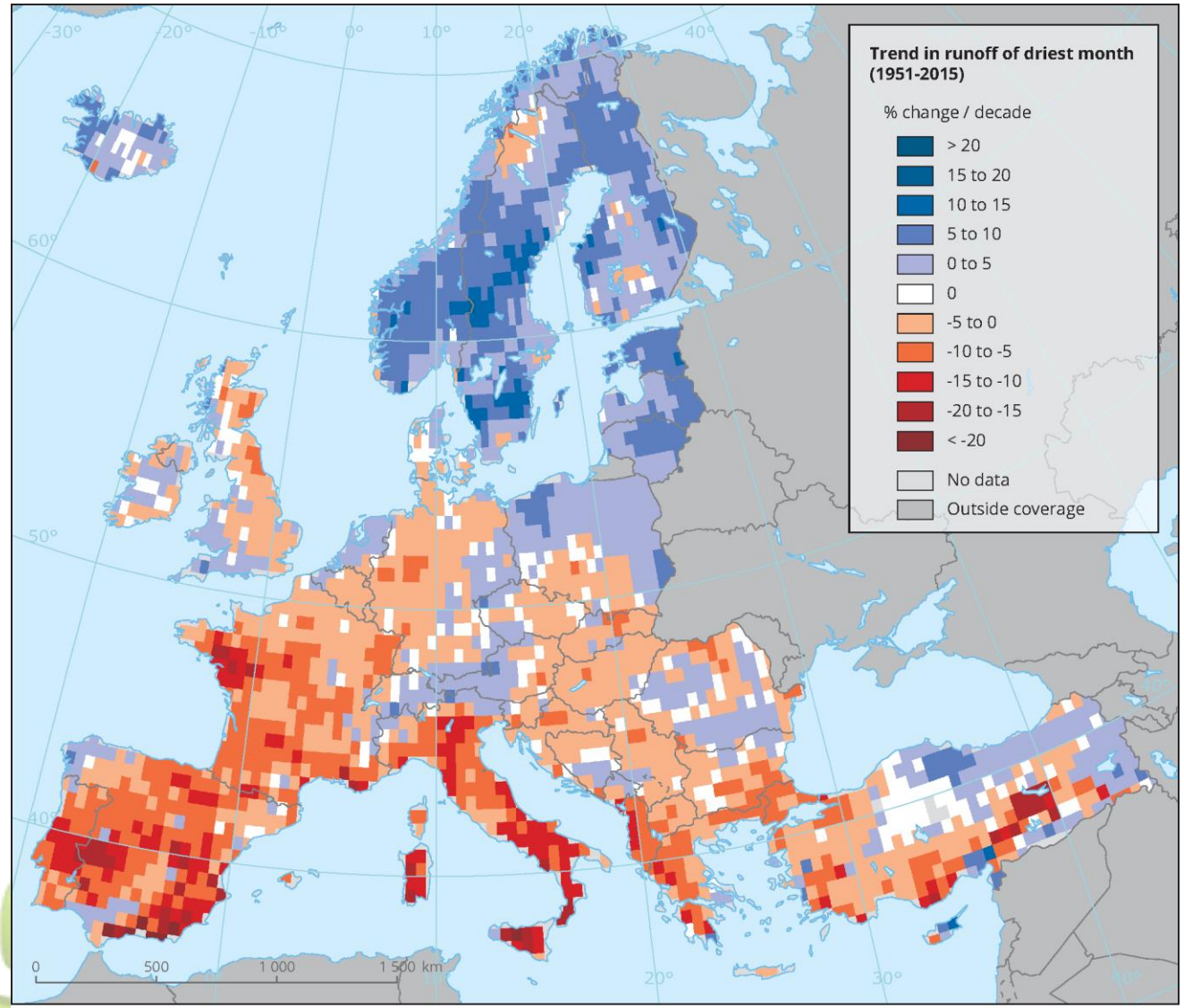


Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Europe

Trend in runoff of driest month (1951 to 2015)




(European Environment Agency)

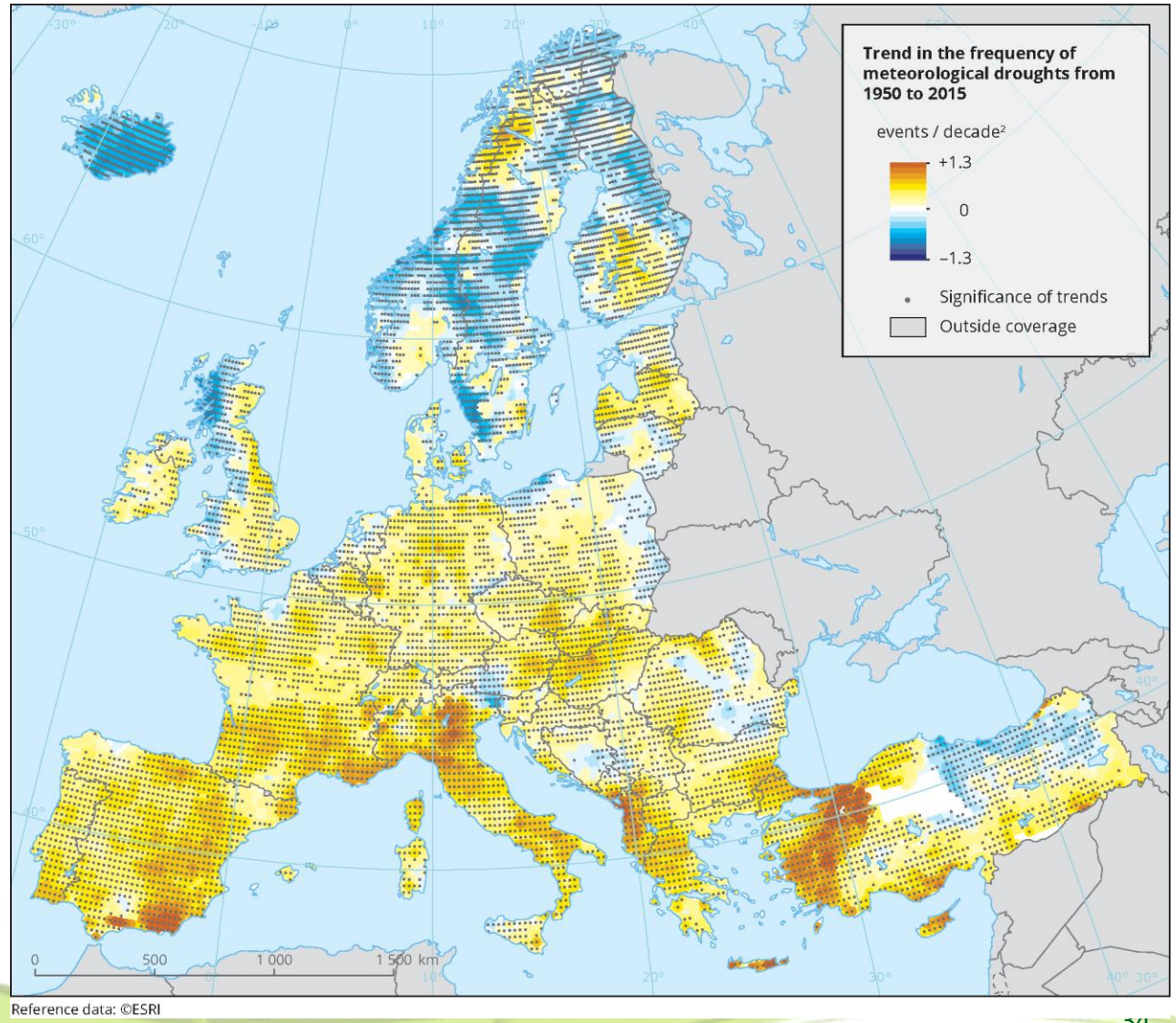


Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Droughts - Europe

Trend in the frequency of meteorological droughts from 1950 to 2015



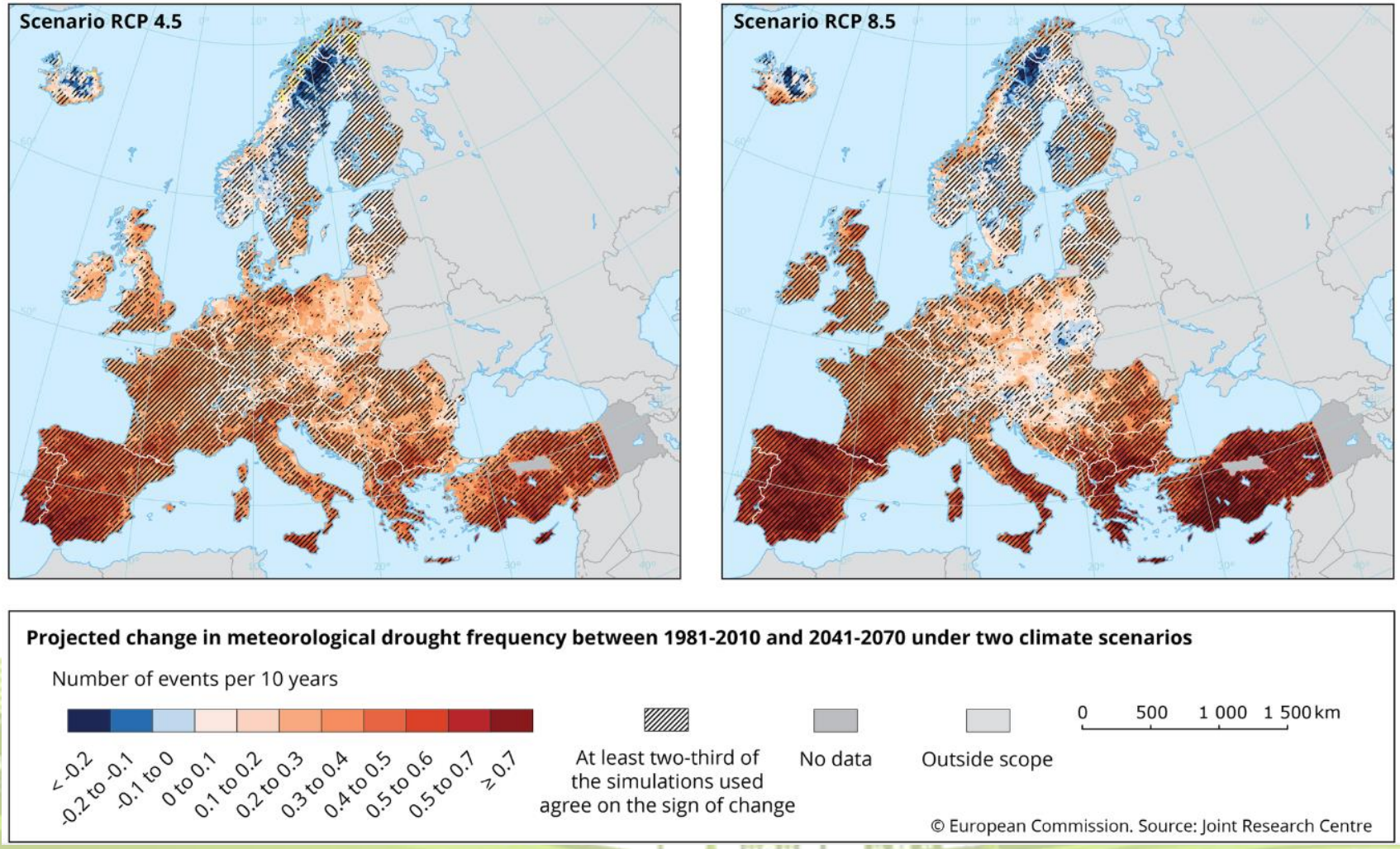

(European Environment Agency)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Droughts - Europe




(European Environment Agency)

Projected change in meteorological droughts frequency between 1981-2010 and 2041 -2070 under two climate scenarios

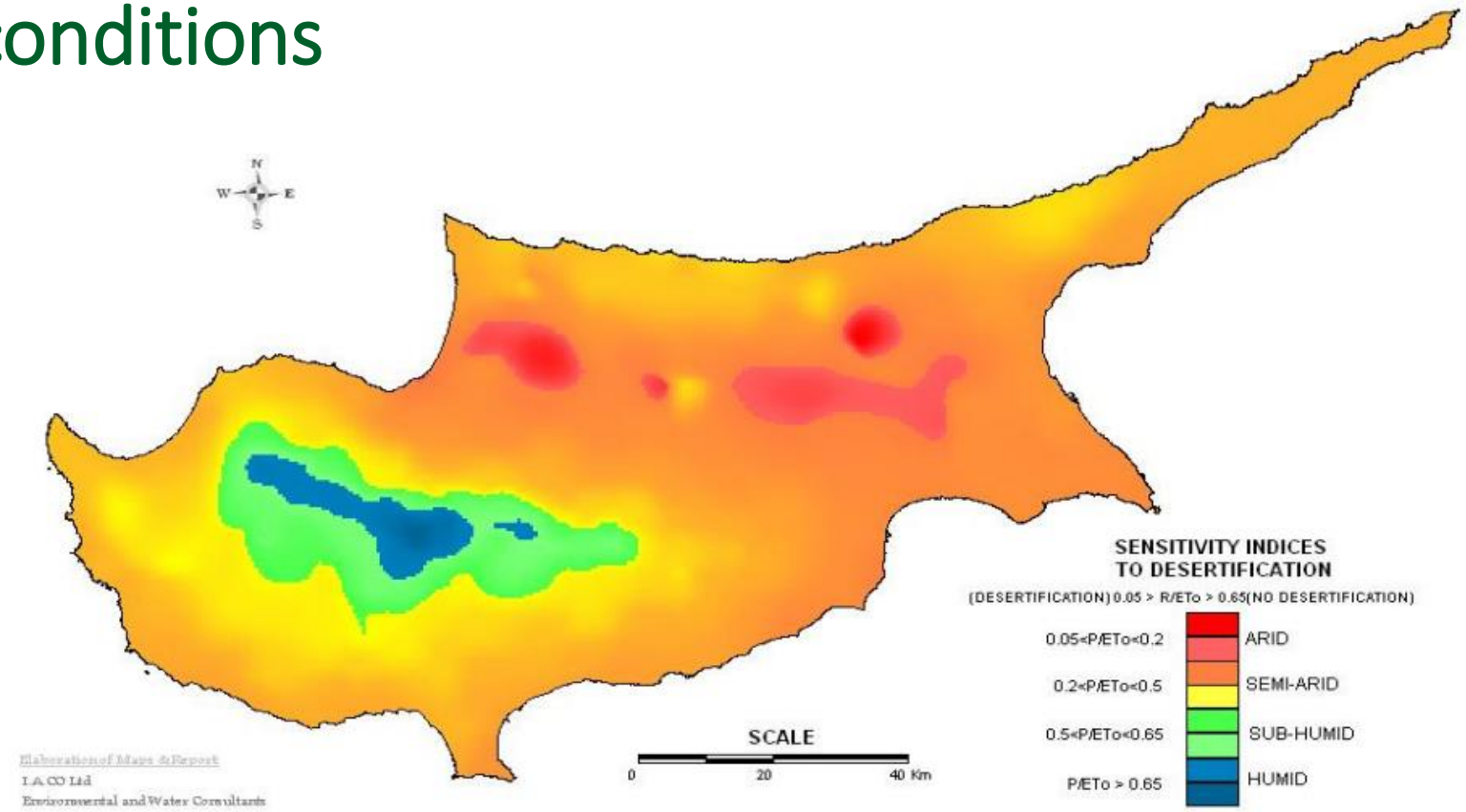


Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Droughts - Cyprus

In the last decades, Cyprus has suffered from a number of severe droughts. In all cases, the events initiated as meteorological droughts but very quickly, they developed into hydrological droughts since Cyprus has no perennial rivers and the length of the rivers is very short.




(Future climate change impact, vulnerability and adaptation assessment for the case of Cyprus, CYPADAPT)

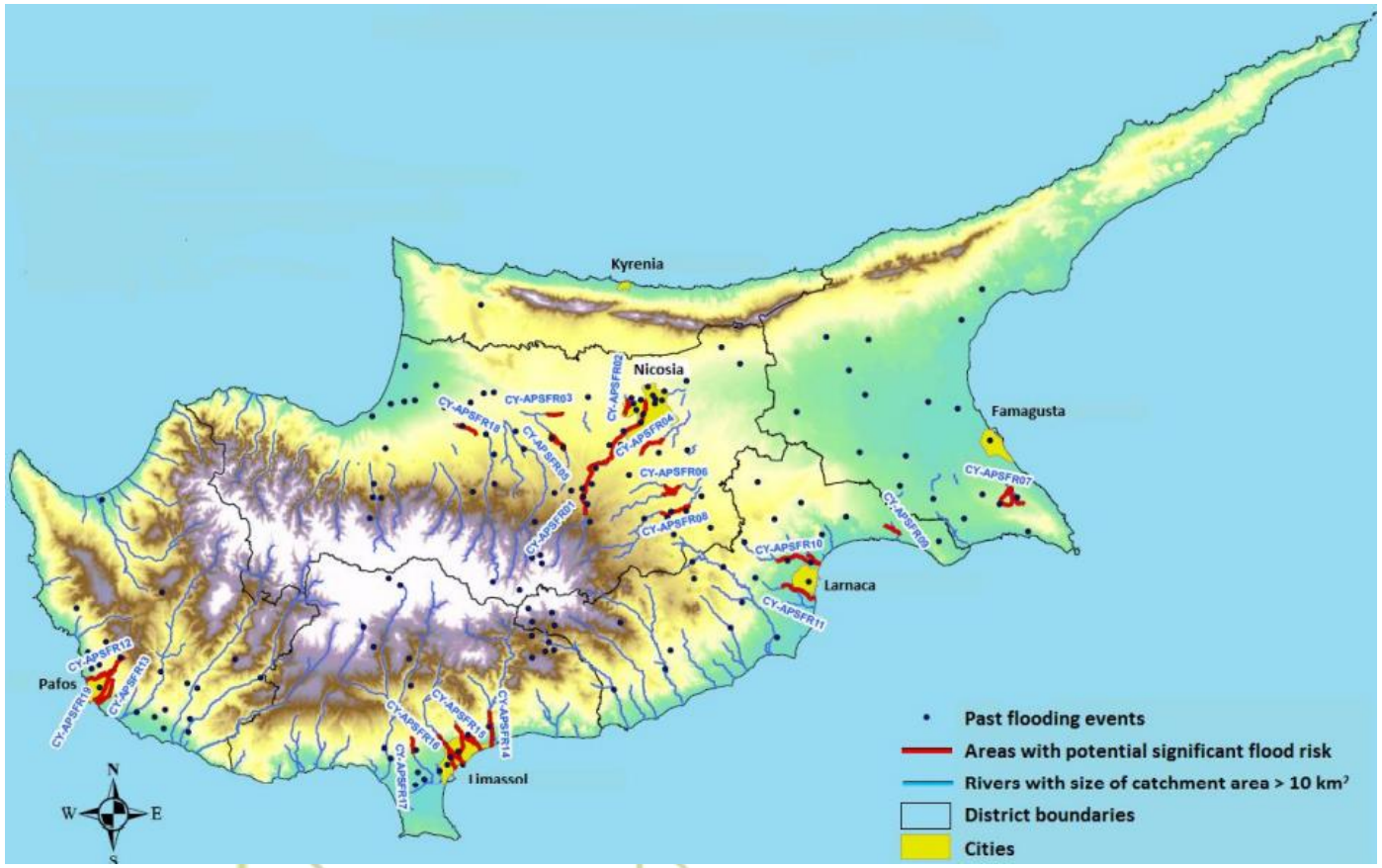


Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Floods - Cyprus

The urban centers of Larnaca, Limassol and Nicosia are sensitive to flood risks mainly due to their dense structuring and the restriction of green space, the elimination of natural waterways for the construction of roads, the deficient or even absent stormwater drainage system and the covering of waterways and drain entrances with garbage. On the other hand, mountain areas are less sensitive to floods, given that the inclination of terrain together with the infiltration capacity of forested areas do not allow for flooding events to take place. To sum up, urban areas are considered to present moderate to high sensitivity to floods while mountain areas present limited sensitivity to floods.



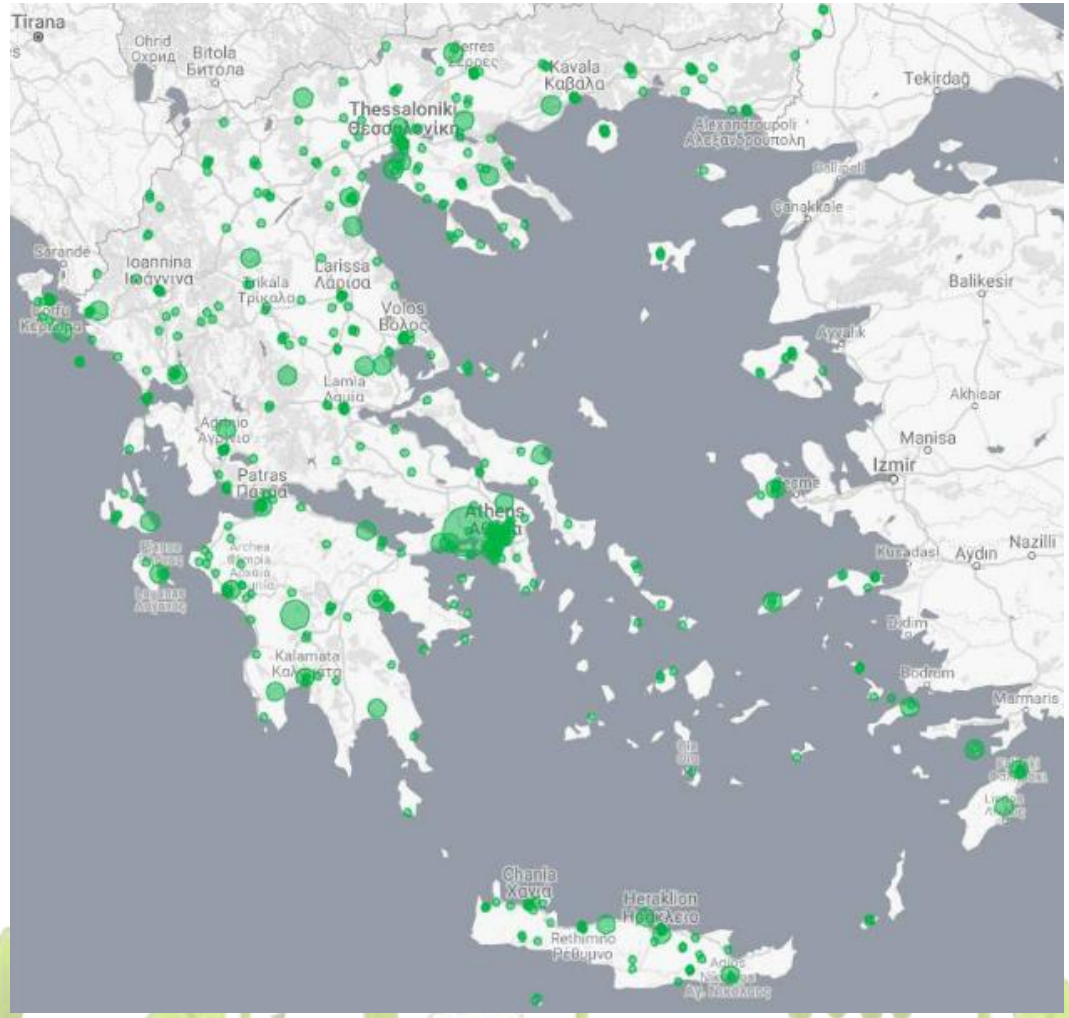

(Future climate change impact, vulnerability and adaptation assessment for the case of Cyprus, CYPADAPT)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Floods - Greece



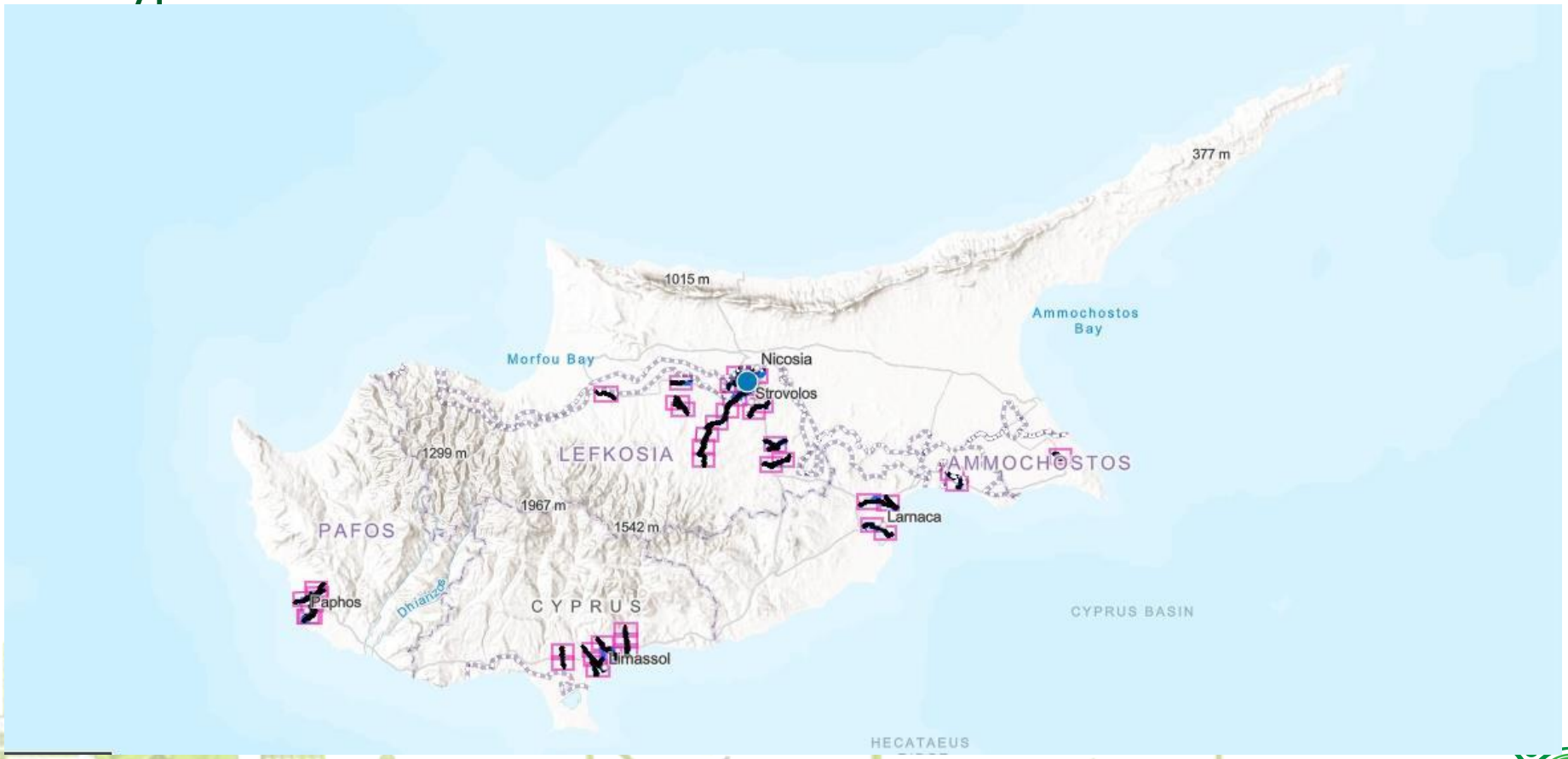

Floods in Greece (2001-2018)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Floods - Cyprus




Areas most likely to flood in Cyprus



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Problems

Not only are floods expected to become more frequent due to climate change, but the swings between wet and dry seasons can exacerbate the risk of flood damage. Droughts can make farmland more susceptible to subsequent flooding when the to weather extremes happen one after the other.

## Droughts

- ✓ As soil moisture decreases, crops desiccate and become more vulnerable to pests.
- ✓ Even short-term drought can cause significant damage to crops, particularly when it occurs during key stages of crop development, such as after planting or during flowering. Drought can stunt the growth of crops, resulting in a decline in the size and quality of produce.
- ✓ Consumers may expect to see higher prices for local food as farmers cope with lower yields and higher expenses.
- ✓ Limited water availability for washing produce may lead to sanitation and health issues for consumers.
- ✓ Underground waterlogging (mainly in islands, such us Crete and Cyprus)



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Problems - Floods

### Oxygen Depletion

Flooding depletes crop plants of oxygen and since water contains less oxygen than soil and air, plants could suffocate. Oxygen depletion is increased as a result of the factors below:

- Warmer floodwaters
- Stagnant water
- Less mature plants
- Crops submerged underwater too long

### Nitrogen Loss

Plants need nitrogen to grow; flooding only weakens plant defense. Nitrogen levels drop due to runoff washing away freshly applied fertilizers or the flourishing of anaerobic microbes due to lower levels of oxygen in floodwaters. Without nitrogen, the result is a smaller crop yield and the development of plant pathogens which leads to diseases.

### Weed Growth

Flooding slows the growth of crops and increases the growth of weeds due to weed seeds washing in from other areas. Farmers must be careful when dealing with weeds since they can harm plants.

### Erosion

Erosion and soil displacement from flooding can ruin fields and destroy crops. Erosion washes the fertile top soil away which leaves crop plants with nowhere to set roots. Sand, gravel, and rocks deposited by flood waters can smother and destroy exposed crops.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Extreme weather conditions

## Avoidance and preparation - Droughts

**Watering Best Practices**

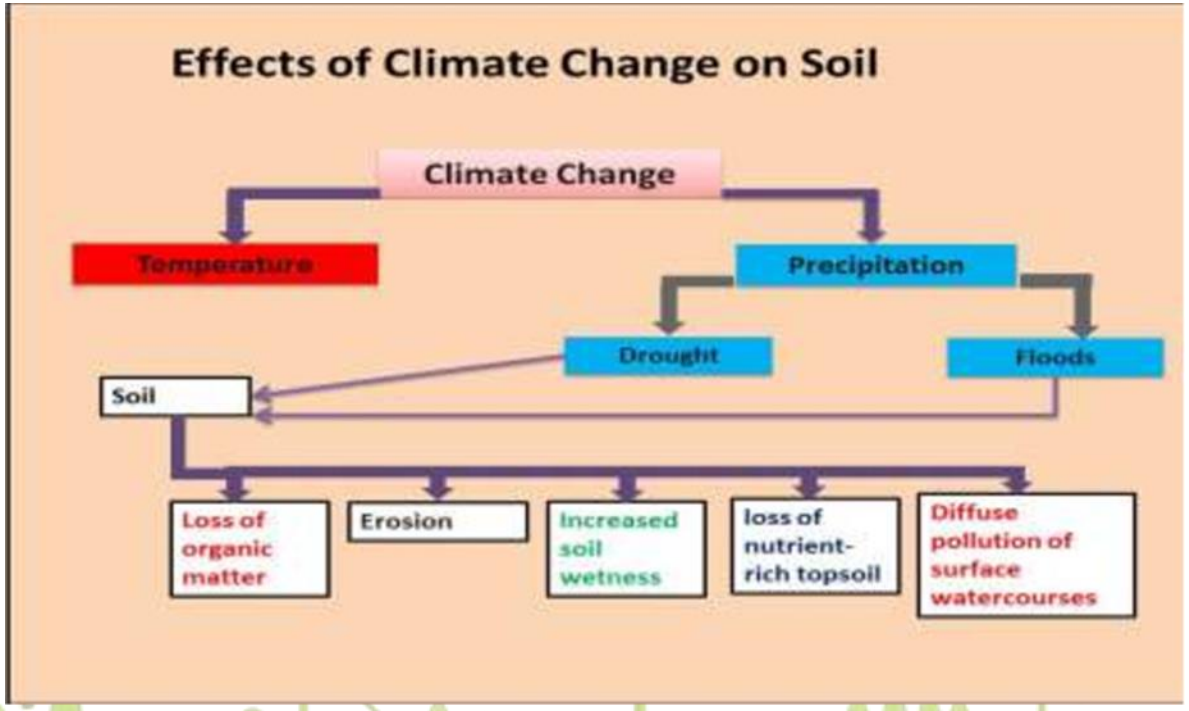
During a drought, your plants aren't receiving the one thing they need the most, water. However, there are a number procedures that you can use that will help maximize the water that you do have. These include:

- Watering for longer intervals, but less often during the day.
- Paying close attention to the placement of your sprinklers so that water only hits plants.
- Watering earlier in the day.
- Getting rid of weeds so that they don't reduce your water supply.
- Using water from deep aquifers, if available, instead of surface water.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

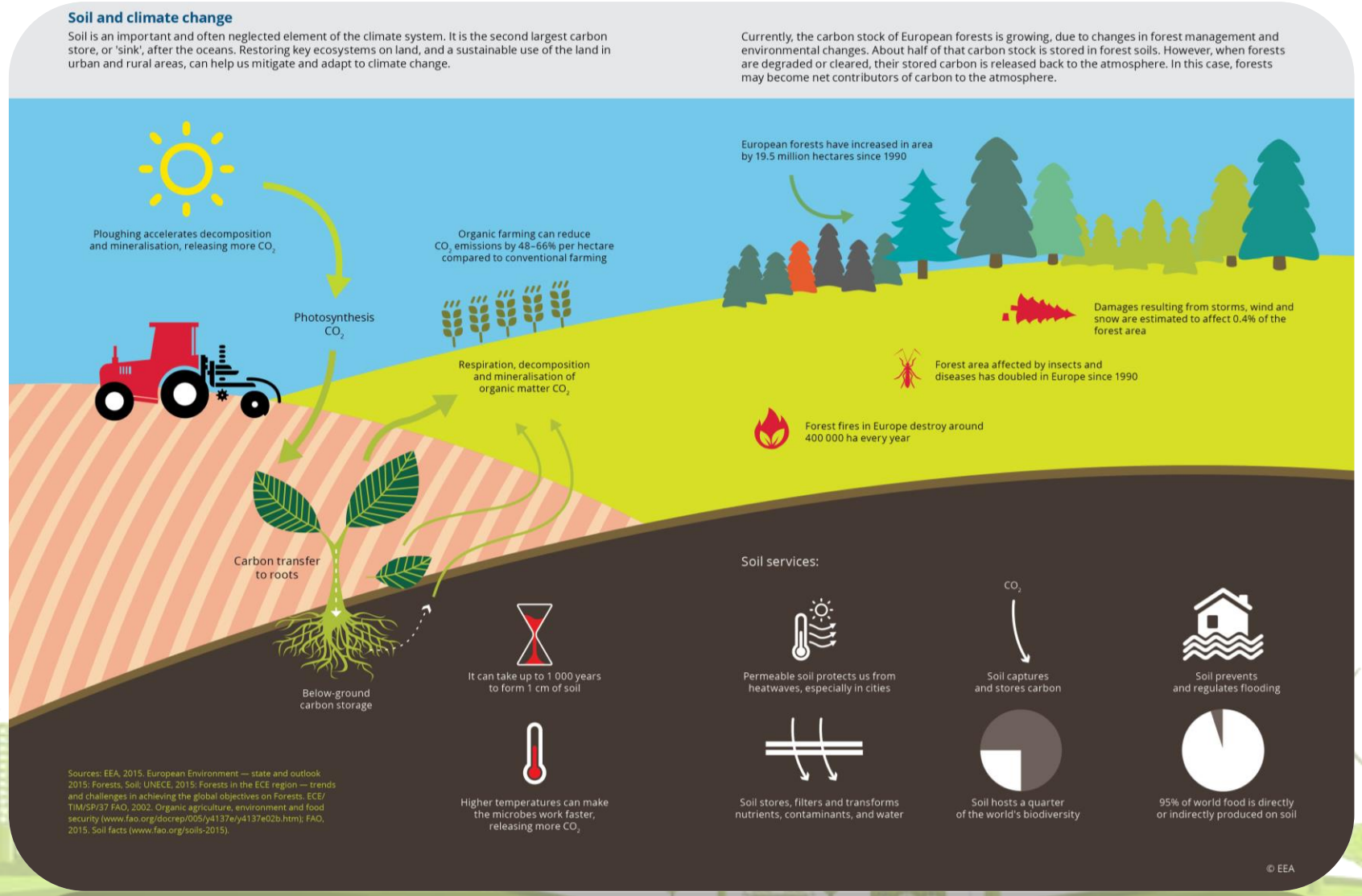
# Part 5: Impact of climate change on the ground






Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Impact of climate change on the ground




Healthy soils play an important role in climate change mitigation by storing carbon (carbon sequestration) and decreasing global greenhouse gas emissions in the atmosphere.

**Can soil carbon practices reverse climate change?**

European Environmental Agency
https://www.eea.europa.eu/media/infographics/soil-and-climate-change/view



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Impact of climate change on the ground

## Impact in EU

Researchers can already see the effects of climate change globally and in European soil. For example, according to the EEA's most recent report on climate change, impacts and vulnerability in Europe, soil moisture has significantly decreased in the Mediterranean region and increased in parts of northern Europe since the 1950s. The report projects similar effects for the coming decades, as the rise in average temperatures continues and rainfall patterns change.

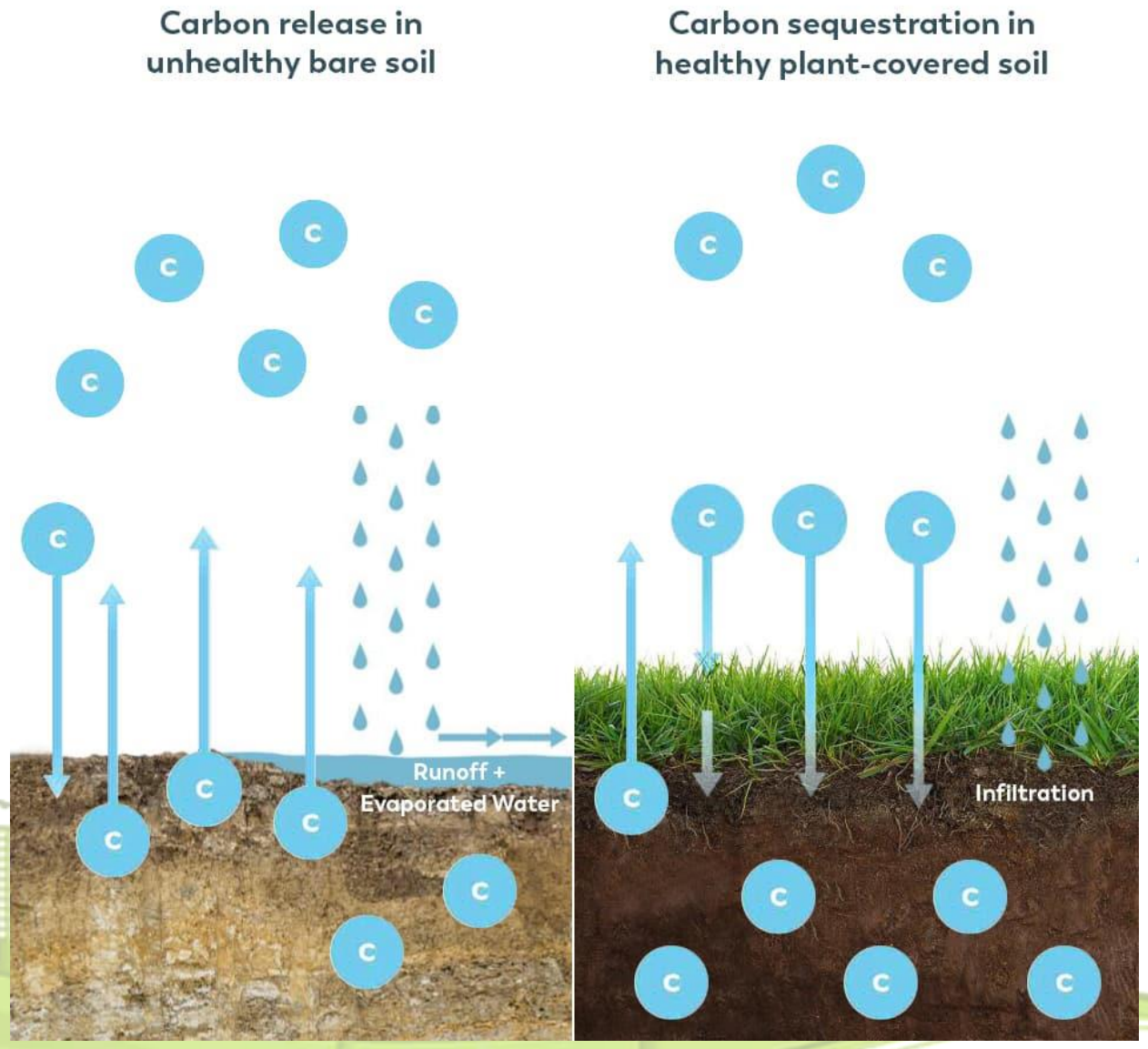
Continuing declines in soil moisture can increase the need for irrigation in agriculture and lead to smaller yields and even desertification, with potentially dramatic impacts on food production. A total of 13 EU Member States have declared that they are affected by desertification. Despite this acknowledgement, a recent report by the European Court of Auditors concluded that Europe does not have a clear picture of the challenges linked to desertification and land degradation and that the steps taken to combat desertification lack coherence.

Changes in seasonal temperatures can also shift the annual cycles of plants and animals, resulting in lower yields. For example, spring can arrive earlier and trees can blossom before their pollinators have hatched. With the expected population growth, world food production needs to increase rather than decrease. This hinges largely on maintaining healthy soil and managing agricultural areas sustainably. At the same time, there is a growing demand for biofuels and other plant-based products, driven by the urgent need to replace fossil fuels and prevent greenhouse gas emissions



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Impact of climate change on the ground






Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Impact of climate change on the ground

## Impact in EU

The EEA report on impacts and vulnerability also highlights other impacts on soil related to climate change, including erosion, which can be accelerated by extreme climate events, such as intense rain, drought, heat waves and storms. In addition to causing the loss of areas of land, rising sea levels may change soil in coastal areas or bring contaminants, including salt, from the sea. In relation to land use, climate change may make some agricultural areas, mainly in the south, unusable or less productive while possibly opening up new possibilities further north. In forestry, the decline in economically valuable tree species might cut the value of forest land in Europe by between 14 and 50 % by 2100. A recent EEA report on climate change adaptation and agriculture highlights that the overall impacts of climate change could produce a significant loss for the European agricultural sector: up to 16 % loss in EU agriculture income by 2050, with large regional variations.

Yet perhaps the biggest climate concern linked to soil is the carbon dioxide and methane stored in permafrost in boreal regions, mainly in Siberia. As the global temperatures increase, the permafrost melts. This thawing causes the organic material trapped in the frozen soil to disintegrate, which can lead to the release of massive amounts of greenhouse gases into the atmosphere, which could hence lead to the accelerating of global warming far beyond people's control.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Part 6: Beekeeping and climate change



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Beekeeping and climate change

Potentially, the most significant problem is the disruption of vital plant-pollinator relationships. This is most likely to be characterised by a change of the timing of nectar flows. There are now sufficient independent observations available to confirm that plants are flowering earlier. Bees and flowering plants have a long evolutionary relationship, developed over the millennia to be mutually beneficial. The relationship is predicated on maximum colony populations coinciding with peak flowering times so that maximum food is available to meet the bees' nutritional demands. This arrangement also maximises pollination opportunities for the plants. When the timing of this relationship breaks down the bee colony is damaged, maybe to the point where the nectar and pollen resources available are insufficient to support the life of the colony, while the plants suffer from inadequate pollination services. How disruption of these complex relationships will affect both agriculture and whole ecosystems needs detailed research, but it may affect both plants and pollinators in ways that may be critical their survival.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Beekeeping and climate change

The effect of climate change on beekeeping is currently entirely speculative and likely to occur in ways that are not predictable.

Insufficient forage and unpredictable weather conditions at peak population times encourages swarming. This is a consequence of bees not being able to get out to forage which reduces the number of bees in the hive at any given time. Over crowding results in inadequate spreading of queen substance among workers which would normally suppress their swarming instinct. Excessive swarming occurring when there are insufficient flowering plants to meet a new colony's nutritional needs may lead to high numbers of colony deaths or poor productivity that will discourage beekeepers from caring for bees. Particularly in places where varroa makes beekeeper input essential to the bees' survival this could lead to loss of, or dramatic reduction in, entire populations.



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Part 7: Environmentally sustainable plants and trees



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Environmentally sustainable plants and trees

A key to selecting a sustainable plant is to follow some basic guidelines. The first guideline is "**right plant, right place**." In other words, conduct a site evaluation and determine what plants would do well in that location. In order to do that, we need to know the following:

- **Ultimate height and width of the plant:** How big will the plant grow? Is there enough space or will it outgrow the location?
- **Sunlight:** What does the plant require? Is there enough light to sustain the plant? Is there too much sunlight?
- **Drainage:** Is the soil well drained? Is it too well drained?
- **Pest resistance:** Is the plant prone to a particular or serious insect or disease problem that would require frequent pesticides to maintain it?
- **Drought tolerance:** Is the plant drought tolerant, once it is established?
- **Hardiness:** Will the species survive the cold, winter temperatures in that location? What hardiness zone is it listed for?
- **Invasive potential:** Does the plant produce seed in a way that may cause it to become invasive? Is the plant known to be invasive?
- **Soil type/soil pH:** Is the soil type and pH conducive to good growth for that plant?
- **Maintenance needs:** Is the plant a weak grower that will require frequent pruning, etc.
- **Longevity:** Is the plant species known to be long-lived?



Sustain4Rural
BE RESPONSIBLE, BE SUSTAINABLE
Funded by the Erasmus+ Programme of the European Union

# Further Reading

- Ελληνική Εθνική στρατηγική για προσαρμογή στην κλιματική αλλαγή
- Κυπριακή Εθνική στρατηγική για τη προσαρμογή στη κλιματική αλλαγή
- European Commission, Agriculture
- Report on the future climate change impact, vulnerability and adaptation assessment for the case of Cyprus, CYPADAPT
- Climate ADAPT, Greece
- Climate ADAPT, Cyprus


Funded by the Erasmus+ Programme of the European Union

# Sustain4Rural

BE RESPONSIBLE, BE SUSTAINABLE

Please complete the participants' feedback and evaluation form.



Funded by the Erasmus+ Programme of the European Union

Sustain4Rural

BE RESPONSIBLE, BE SUSTAINABLE

# Thank you!

## For more information:

www.sustain4rural.eu

www.facebook.com/Sustain4Rural

www.class365.eu

www.youtube.com/@sustain4rural572

ecect.projects@gmail.com

+ 357 22462920 (Cyprus)

+30 210 922 4392 (Greece)



Funded by the Erasmus+ Programme of the European Union