Climate Change Impacts on the MED-Agro-Food Chain

Ecology of agricultural systems in the Mediterranean

Athanasios Koukounaras
Assistant Professor
School of Agriculture, Aristotle University of Thessaloniki, Greece
thankou@agro.auth.gr

Ecology

• ecology – οικολογία, in Greek: οἶκος, "house", or "environment"; -λογία, "study of"

• is the study of how organisms interact with one another and with their physical environment

• one core goal of ecology is to understand the distribution and abundance of living things in the physical environment

Environment

Environment

- biotic factors
  - ► living organisms, waste of organisms etc
- abiotic factors
  - ► air, temperature, light, soil, moisture etc
  - ► many species can survey in many conditions but has its more suitable home, ‘habitat’

Ecological levels

- for better understanding the interactions of the biotic and abiotic parts

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Ecological levels

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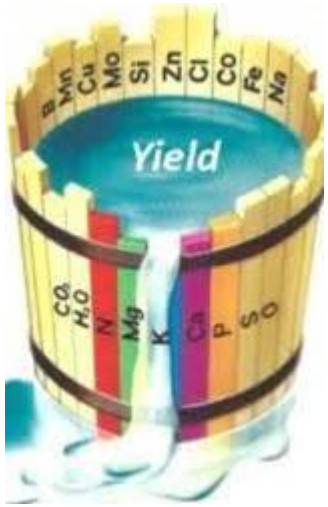
- organism, population, community, ecosystem, biosphere

Basic concept of ecology

- all organisms are independent, interact with one another and the physical environment
- competition: an important aspect for survival includes competition for the limited resources (water, sunlight, nutrients, etc)



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- limiting factors both abiotic or biotic
- carrying capacity
- biodiversity

Biodiversity

- variety of organisms
- genetic variation within a population (genetic diversity)
- variety of species in the community (species biodiversity)
- variety of communities in an ecosystem (ecosystem diversity)

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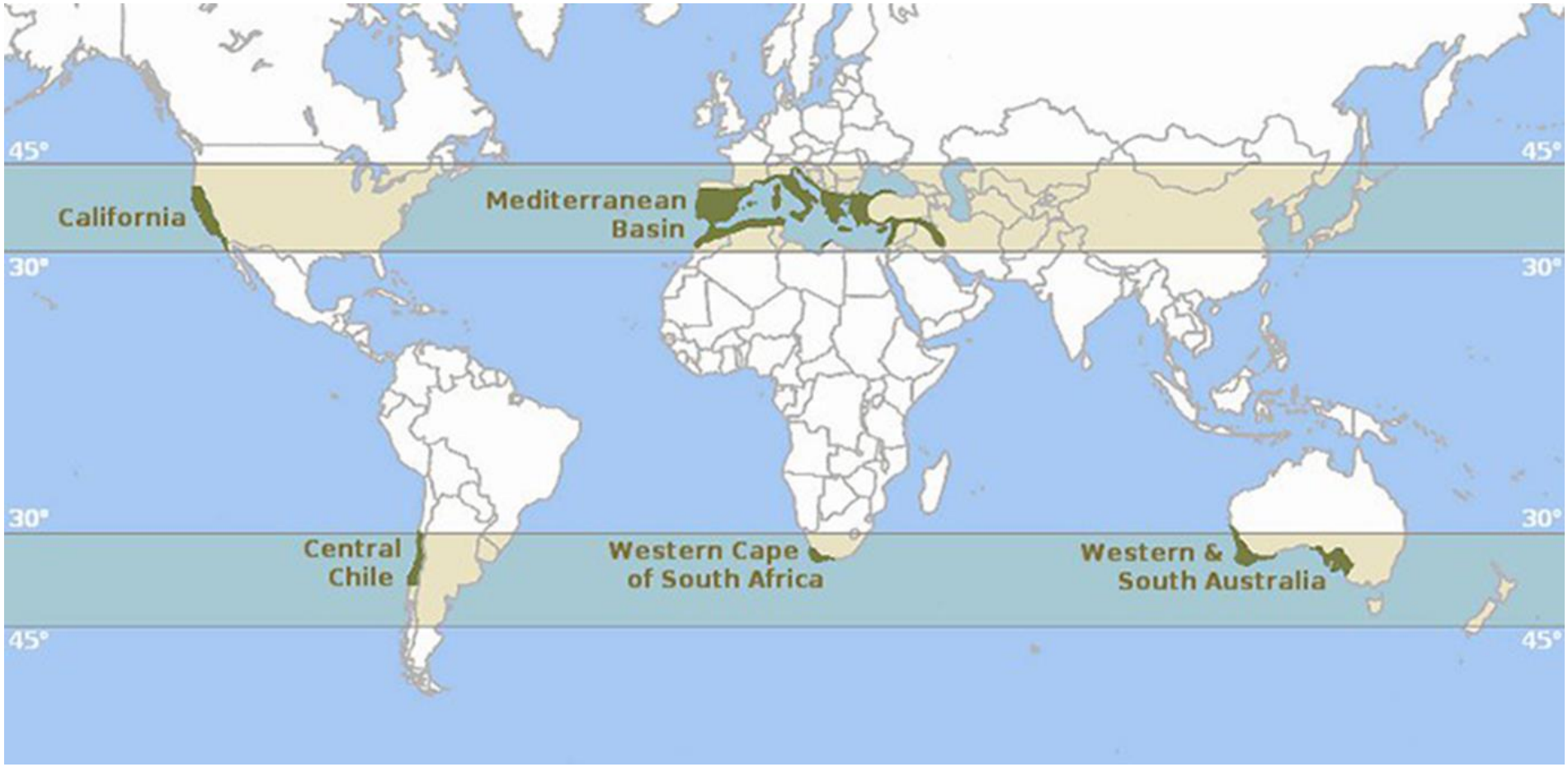
- biodiversity extremely important for
  - ► support healthy ecosystems
  - ► part of economy
  - ► integral part of culture and identity

Mediterranean agriculture

• The term 'Mediterranean agriculture' applies to the agriculture done in those regions which are having Mediterranean type of climate.

• There are five major regions in the world having Mediterranean type of agriculture. The largest of these nearly encircles the Mediterranean Sea and it's from there that the type derives its name

Mediterranean agriculture



Mediterranean agriculture

- This type of agriculture is determined by climatic conditions, which exert important influence on agriculture, with a dominance of horticulture
- Landscape typology: internal plain, coastal plain, mountain, internal hilly, coastal hilly
- Mediterranean woodlands normally form an integral part of local agricultural systems and should therefore not be considered as a source of raw material disconnected from agricultural practices and needs, as is the case in the "Northern" model

Mediterranean agriculture characteristics

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  - ► maximum temperatures and periods of precipitation do not coincide
  - ► droughts of two to six months during the dry summer

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- Mediterranean ecosystems suffer from strong climatic stress
- chemical weathering is generally slow and soils are therefore little developed and closely related to parent rocks
- low organic matter content of cropped Mediterranean soils

Mediterranean agricultural systems

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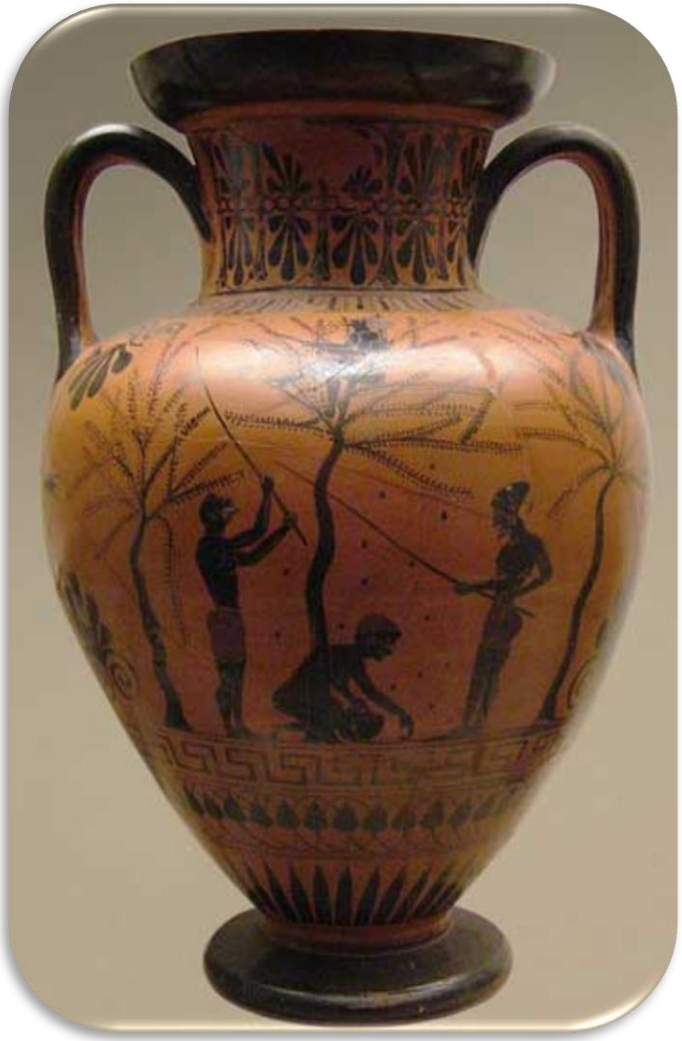
- People developed a variety of agricultural management practices which optimize the typical annual fluctuations in Mediterranean productivity without causing ecological degradation

Mediterranean agriculture in the past



Black-figure neck-amphora by the Antimenes Painter, Circa 520 BC

Mediterranean agriculture in the past

Shipwreck with thousands of amphoras, or vases, probably containing wine, 5th century B.C.

Mediterranean agriculture in the past

Female workers making bread and a flute player sets the work pace, 525–475 BC

Mediterranean agricultural systems

- The Mediterranean basin contains a high diversity of farming systems, as well as a high rate of land cover transitions
- Agricultural system focus on soil conservation and its ability to retain water as well as diseases and pest biological control
- Some of the traditional Mediterranean agricultural systems have been recognized to combine the production of food with the supply of other ecosystem services

Ecosystem services

Ecosystem services

- provisioning
  - ► production of food and water, pollination
- regulating
  - ► the control of climate and disease, erosion prevention
- Supporting
  - ► nutrient cycles, soil fertility, oxygen production
- Cultural
  - ► spiritual and recreational benefits

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- For these reasons, current agricultural systems are complex and inherited from a long history of agricultural and cultural Mediterranean traditions

Mediterranean agricultural systems

Old olive trees in Tunisia

Mediterranean agricultural systems

Agricultural terraces in Banyalbufar, Majorca

Mediterranean agricultural systems

Agroforestry system in Greece

Mediterranean agricultural systems

Agroforestry in southeastern France

Mediterranean agricultural systems

Conservation biological control in southeastern France

Mediterranean agricultural systems

Agroforestry in Sardinia, Italy

Olive tree with undergrowth of leguminous species and grassland

Mediterranean agricultural systems

Intercropping of carob trees into olive orchards, Morocco

Mediterranean agricultural systems

Grazing of weed fallow in Morocco in low input dryland cereal production

Mediterranean agricultural systems

Viticulture in Santorini, Greece

Mediterranean agricultural systems

Small scale home gardens

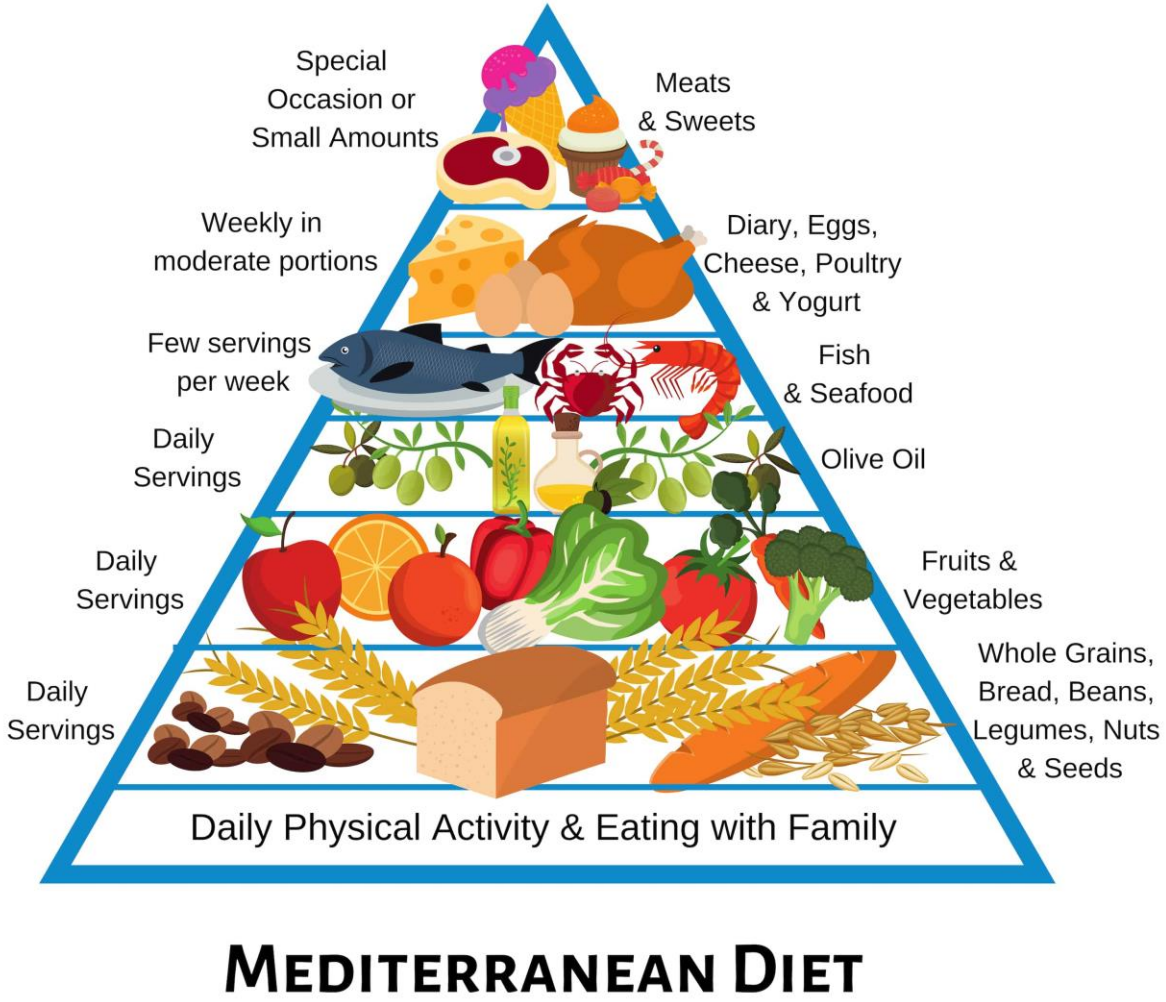
Mediterranean agriculture main crops

- From past until now the main crops are:
  - olive, grapes, citrus
  - vegetables
  - cereals

Mediterranean agriculture main crops

- Permanent crops are particularly important from an environmental point of view, because they create a stable landscape with a permanent, features that usually represent the mature elements of Mediterranean ecosystems
- Most annual Mediterranean crops are characterized by their long production cycles, being sown in autumn and harvested in summer, especially for cereal crops
- The low fertility of most soils increased the value put on traditional fallow practices
- Impact on people daily diet

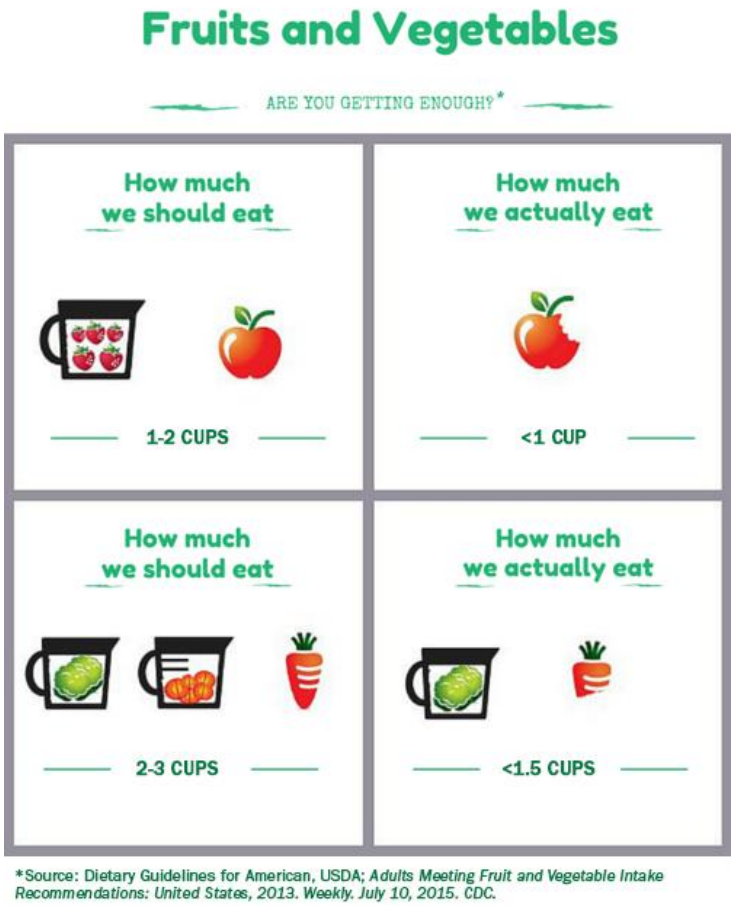
Mediterranean diet

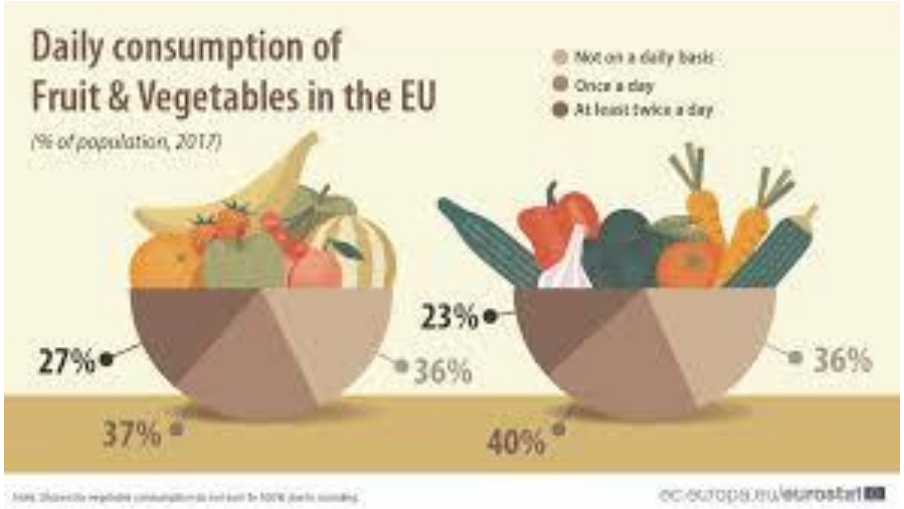


- The health benefits linked to the Mediterranean diet are supported by scientific evidence

Mediterranean diet

- WHO suggestion for 400 g daily conception of fruits and vegetables





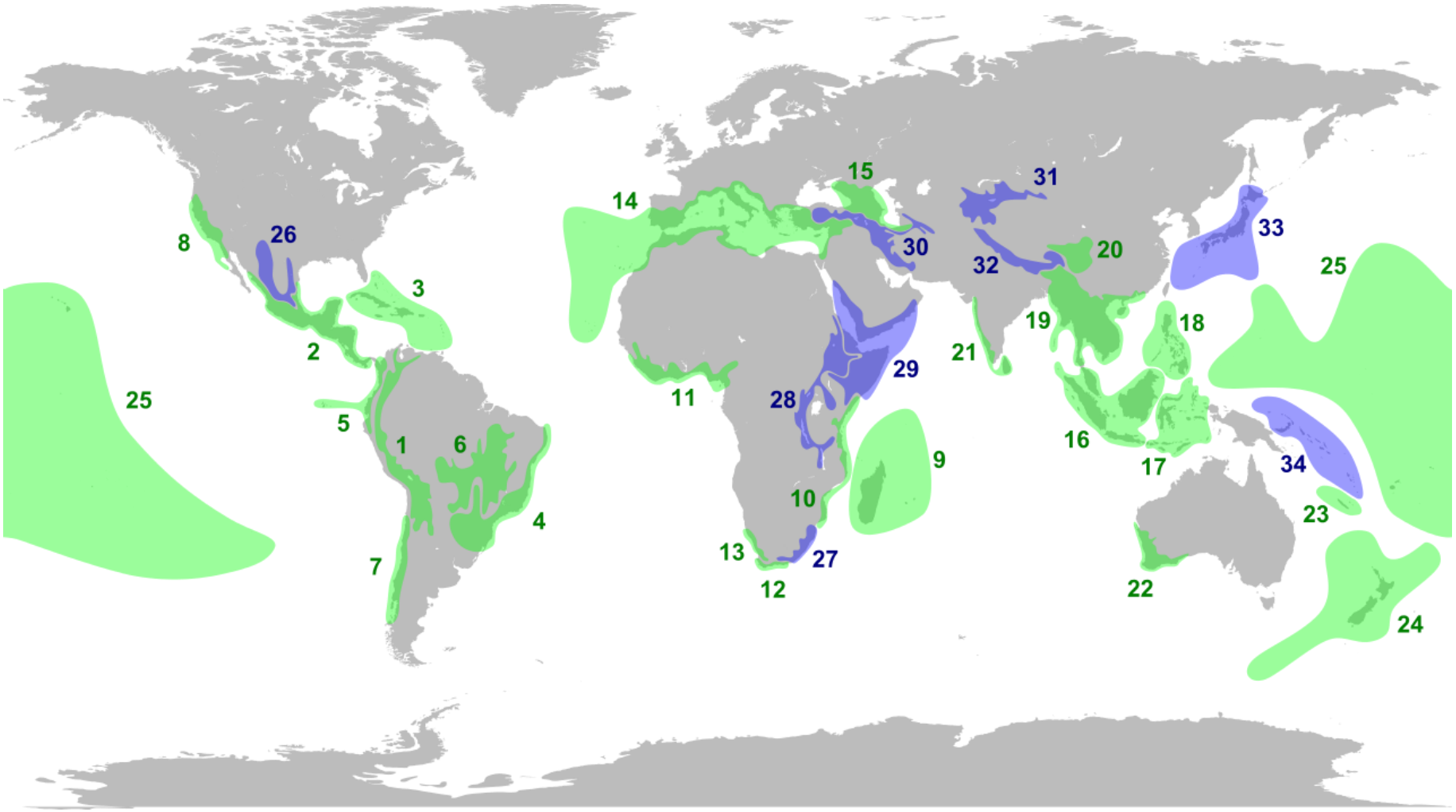
Mediterranean region advantages

- biodiversity hotspot

Mediterranean region advantages

- biodiversity hotspot
  - ►it must contain at least 0.5% or 1,500 species of vascular plants as endemics
  - ► it has to have lost at least 70% of its primary vegetation

Biodiversity hotspot



Mediterranean region advantages

- The existence of traditional ecological and agricultural knowledge in the Mediterranean area, characterized by a strict link between agriculture and society
- The Mediterranean diet is an assemblage of local ecological knowledge, practices, and traditions ranging from the landscape to the table, including crops, harvesting, fishing, food conservation, processing preparation, and particularly consumption

Changes in agriculture

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  - ► urban development
  - ► transportation
  - ► globalization of food market
  - ► specialization
  - ► industrialization mechanization
  - ► increase of inputs
  - ► abandonment of traditional farming practices

Changes in agriculture

- Mediterranean agriculture has evolved according to the two different tendencies that are caused by the general process of stepped up production and market competition
- One tendency is visible in areas that possess fertile soils and adequate water supplies. Production has been stepped up here to a high level, reaching productivity rates equivalent to those of the most developed areas in Atlantic Europe. Such areas tend to capitalize on climatic and locational advantages in relation to the European market, and concentrate most of their production on horticultural and out-ofseason crops found in Mediterranean regions
- The other tendency is visible in areas in which limiting environmental factors represent insurmountable obstacles for the introduction of modern agricultural techniques, and therefore are gradually being abandoned
- Intermediate

Mediterranean agriculture present

- Many crops (e.g. wheat, rise, barley etc) are raised for domestic consumption, while others like citrus fruits, olives, and grapes are mainly for export
- Vegetable sector increased
- The Mediterranean lands are also known as 'orchard lands of the world' and 'Europe's vegetable garden'

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√ Agricultural options range from high technology-based practices to ecology-based practices

Mediterranean agriculture present

- Characteristics

Mediterranean agriculture present

- Characteristics
  - ► monoculture
  - ► greenhouses
  - ► irrigation systems
  - ► high yield to achieve higher income

Ecological problems of present

Ecological problems of present

- biodiversity loss
- soil fertility decreases due to soil erosion
- salinization and acidification
- pollution of water, soil and air
- abandonment of rural territories, social injustice
- low quality food and diets
- eutrophication
- increasing fire risk in summer
- loss of scenic and environmental quality (monotonous formations, lose the important structural elements such as hedges and walls)
- greenhouse gases emissions

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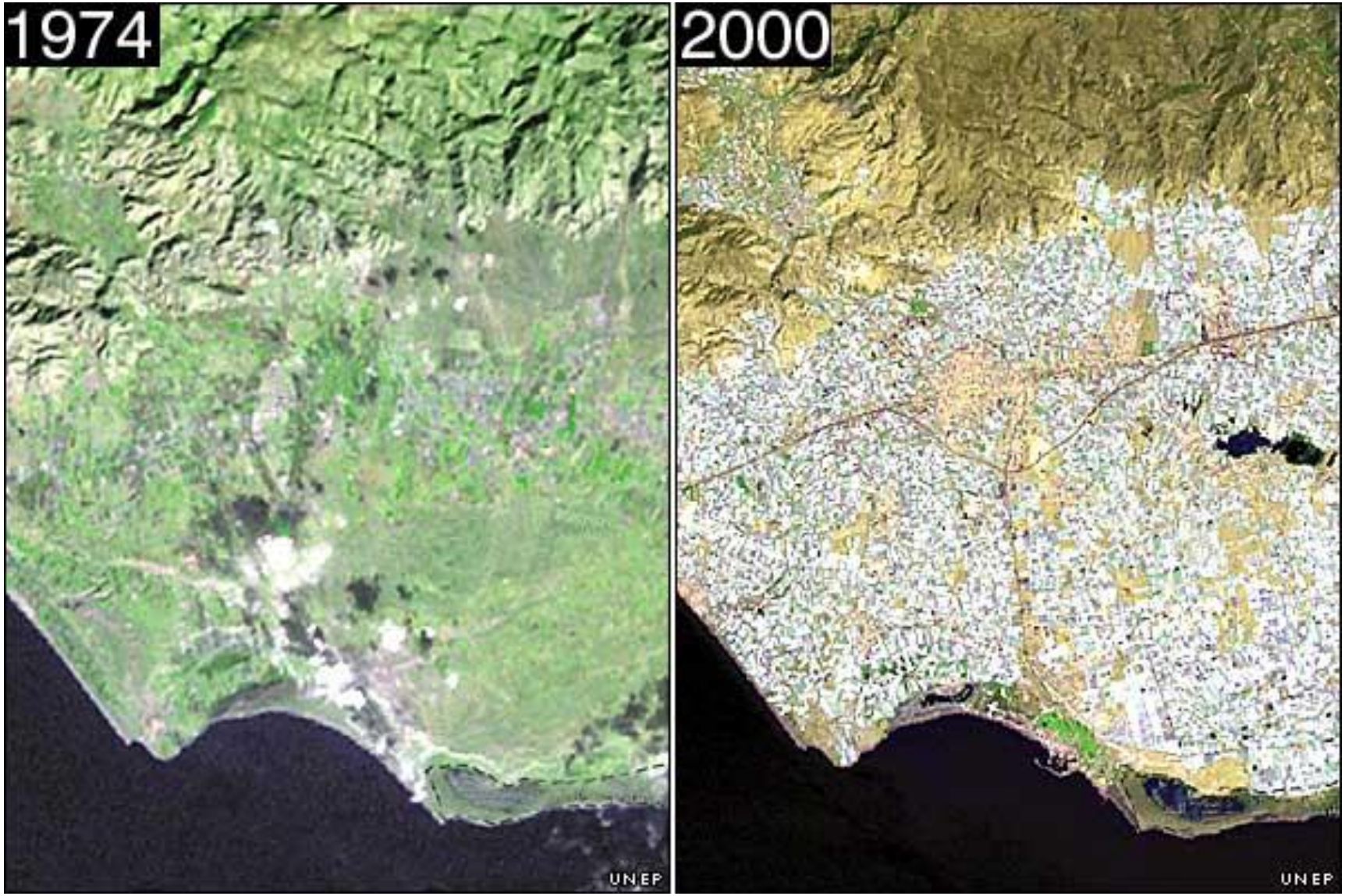
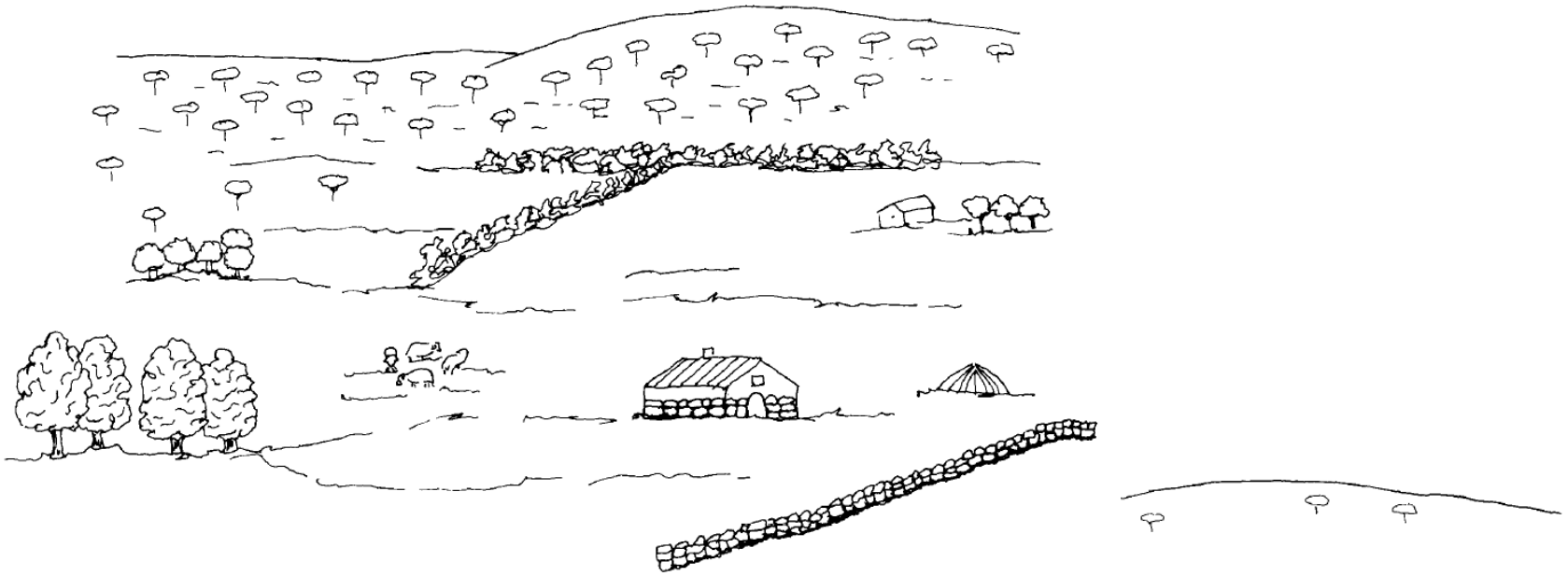
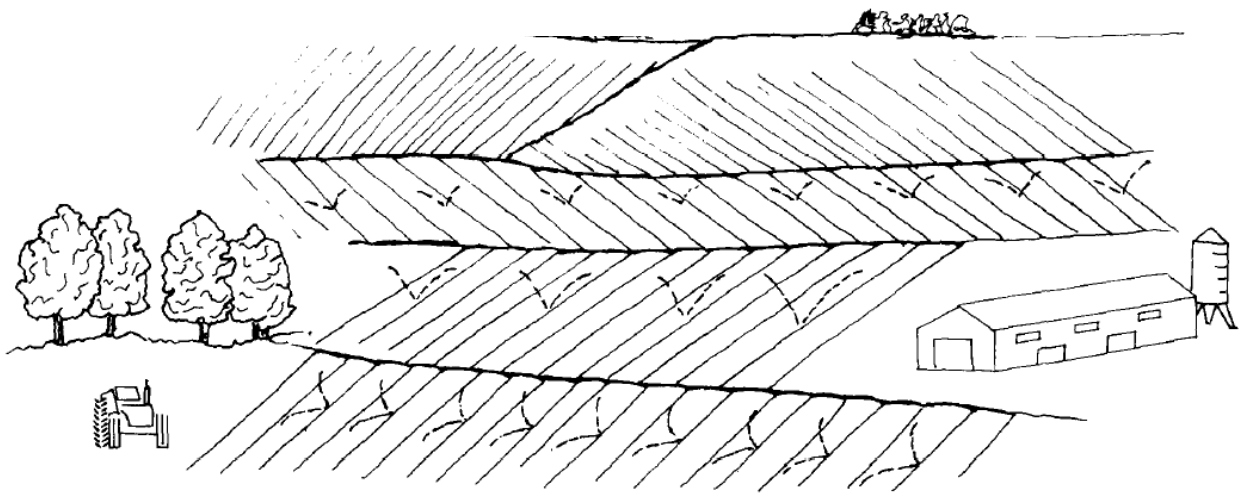


Changes period



Example of a dry lowland landscape.

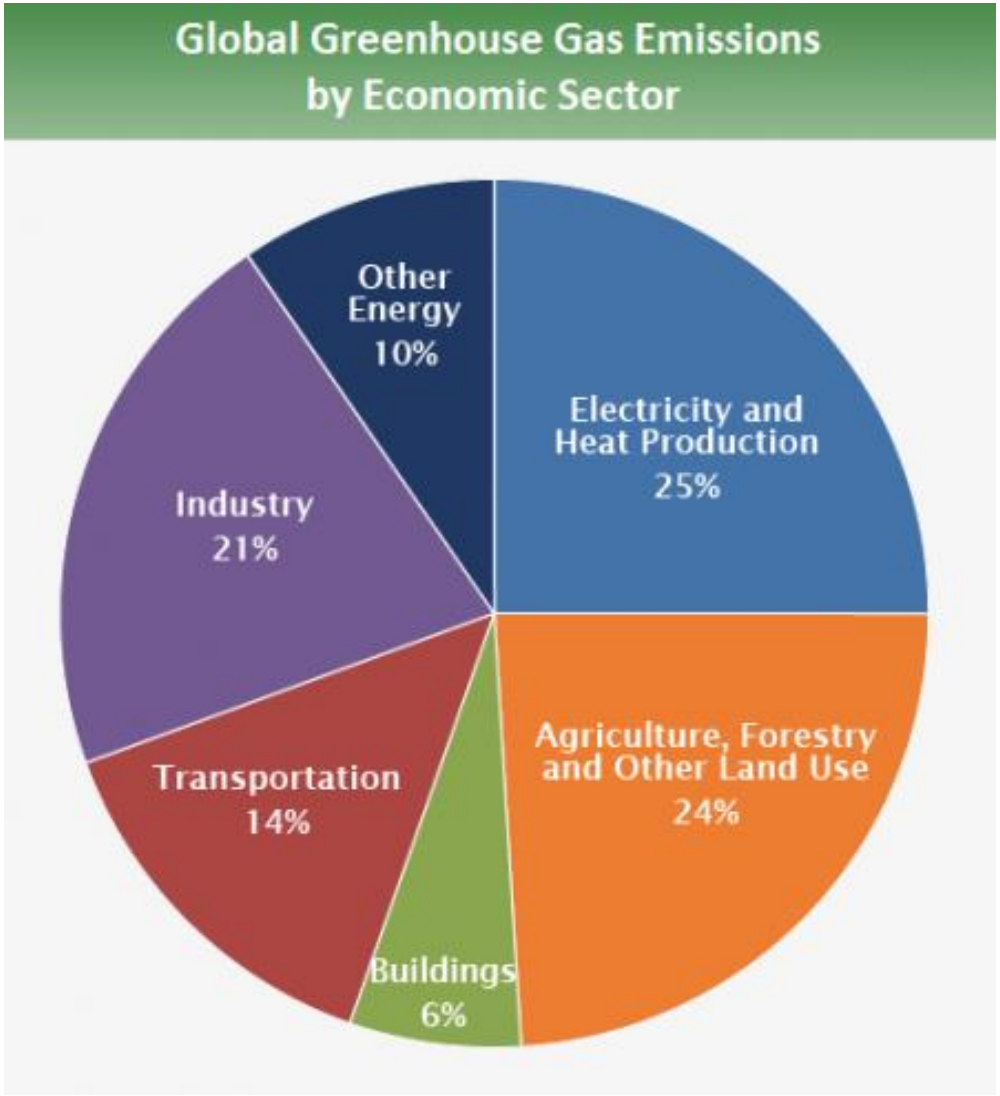


An irrigated lowland landscape.

Greenhouse gas emissions

- gases that trap heat in the atmosphere are called greenhouse gases
- sources: industry, transportation, electricity, agriculture etc
- establishment of national and regional targets

Greenhouse gas emissions



Source: IPCC (2014)

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- carbon footprint calculation
  - ► the sum of all emissions of CO2, which were induced by your activities in a given time frame

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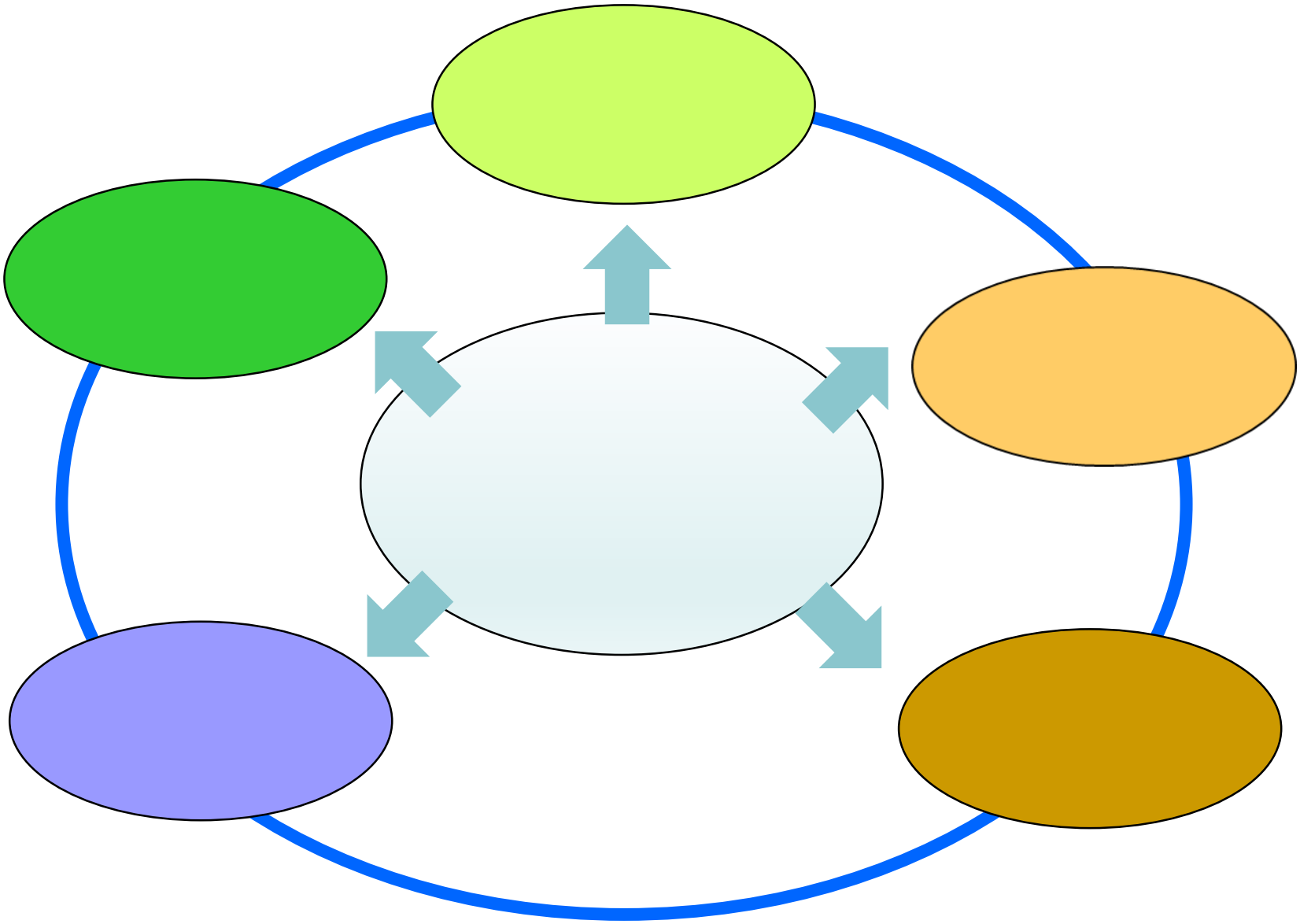
Major challenges for ecology in Mediterranean



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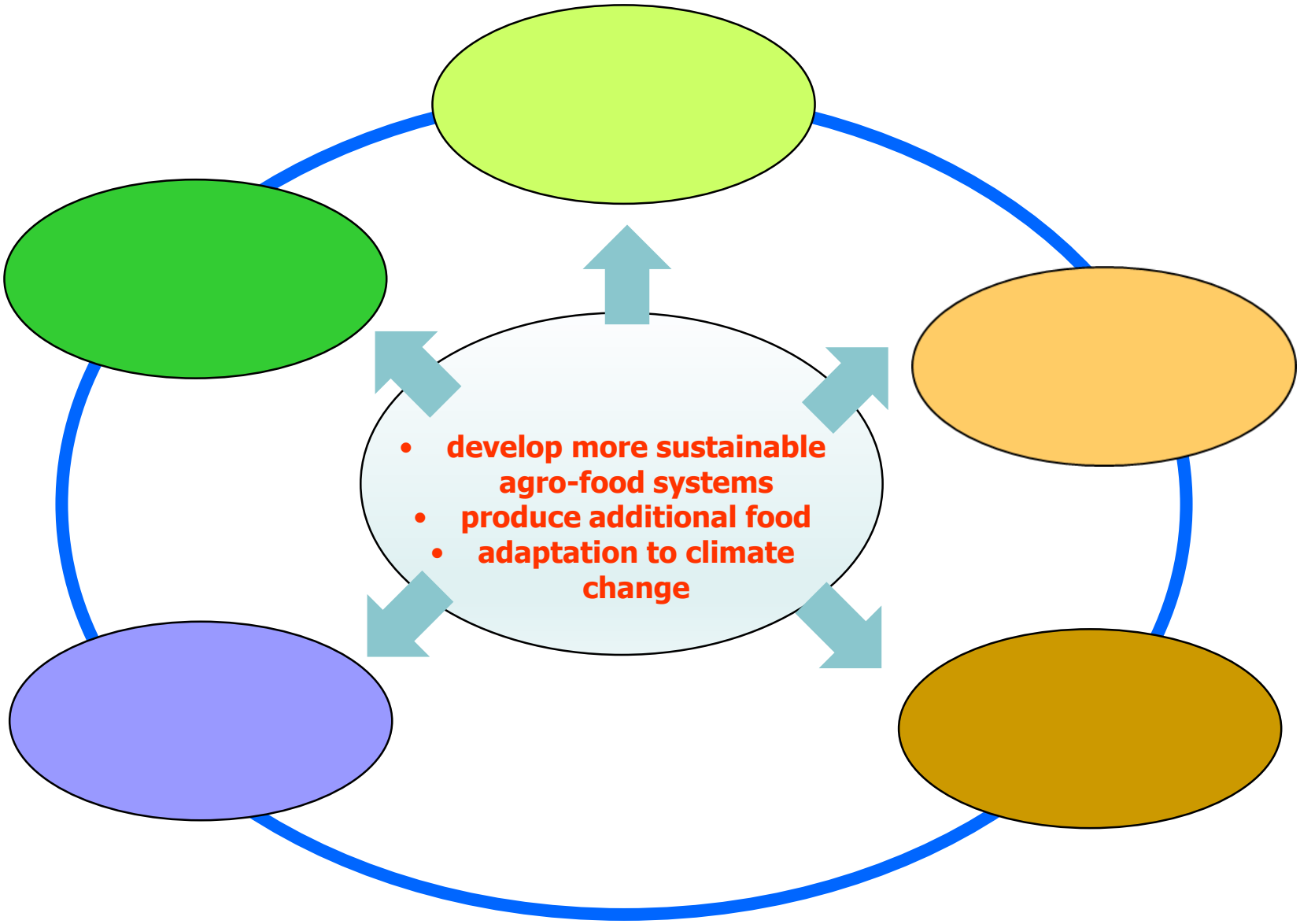
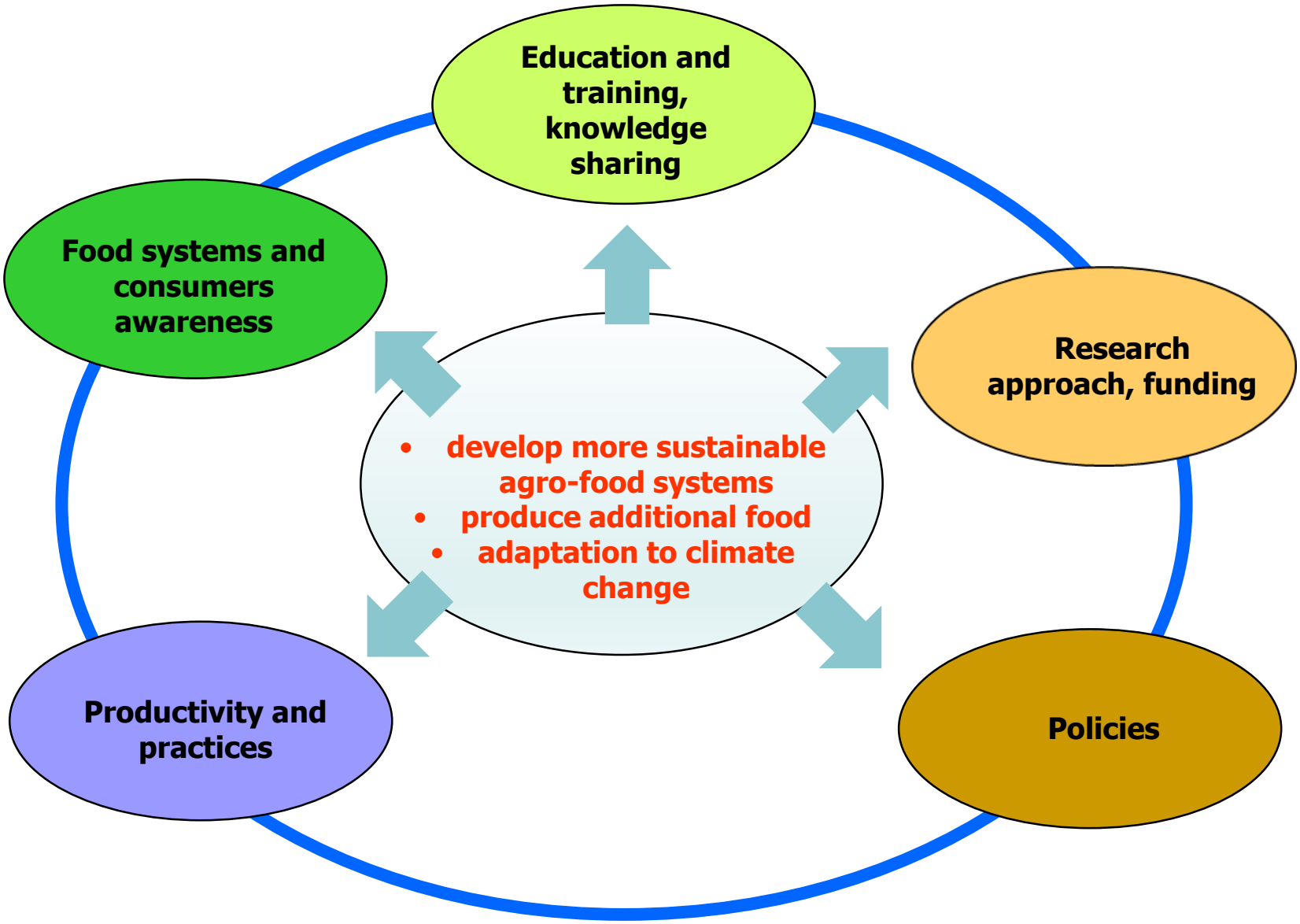


Major challenges for ecology in Mediterranean




Thank you for your attention