AGRIWATER

SUSTAINABLE FARMING: Importance of Efficient Water Use

EDUCATIONAL MATERIAL FOR FARMERS

MODULE NO. 3

Co-funded by the
Erasmus+ Programme
of the European Union

IN THIS MODULE YOU WILL LEARN

- Introduction – the Importance of Water
- Water Use Efficiency (WUE)
- How to improve WUE?
- Methods and Technologies
- Sources and Useful Links

INTRODUCTION

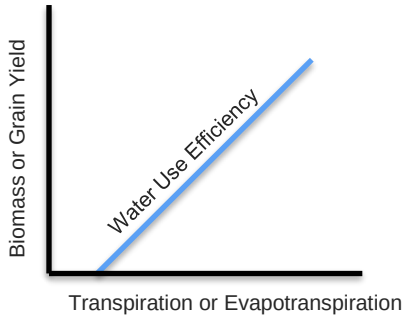
- The water is our most vital resource, but less than 1 % is available for human use.
- Water is a critical input for agricultural production and plays an important role in food security.
- Heavy rainfall causes enormous surface and subsurface runoff wherever land is sloping. Losses during intense rainfall events are enormous (30 to 50 thousand m3 of water per 100 ha).
- The demand (climate change, population growth, industrialisation..) for water increases, but limited water supplies decrease (e. g. water pollution).
- The increasing competition for water use will have direct impact on agriculture and the capability to feed the growing population.
- Globally more than 70% of water is used for agriculture.

Water Use Efficiency (WUE)

- Water use efficiency is the **amount of carbon assimilated as biomass or grain produced per unit of water used by the crop**.
- Water use efficiency is usually measured by harvesting plants, determining dry weight of the vegetative portion or grain, and dividing that by the rainfall or irrigation plus rainfall.
- Water use efficiency refers to the ratio of water used in plant metabolism to water lost by the plant through transpiration.
- Water use efficiency is an **important index** in climate change research and hydrological studies, as it reflects how the carbon and water cycles are coupled.

- Crop WUE
- $\text{WUE} = \frac{Yield}{W} = \frac{biomass}{E+T+losses}$

x HI



Where:

W – Global amount of water available (natural rainfall and irrigation)

T – Transpiration

E – Evaporation

Losses – Amount of water lost at any level of the process

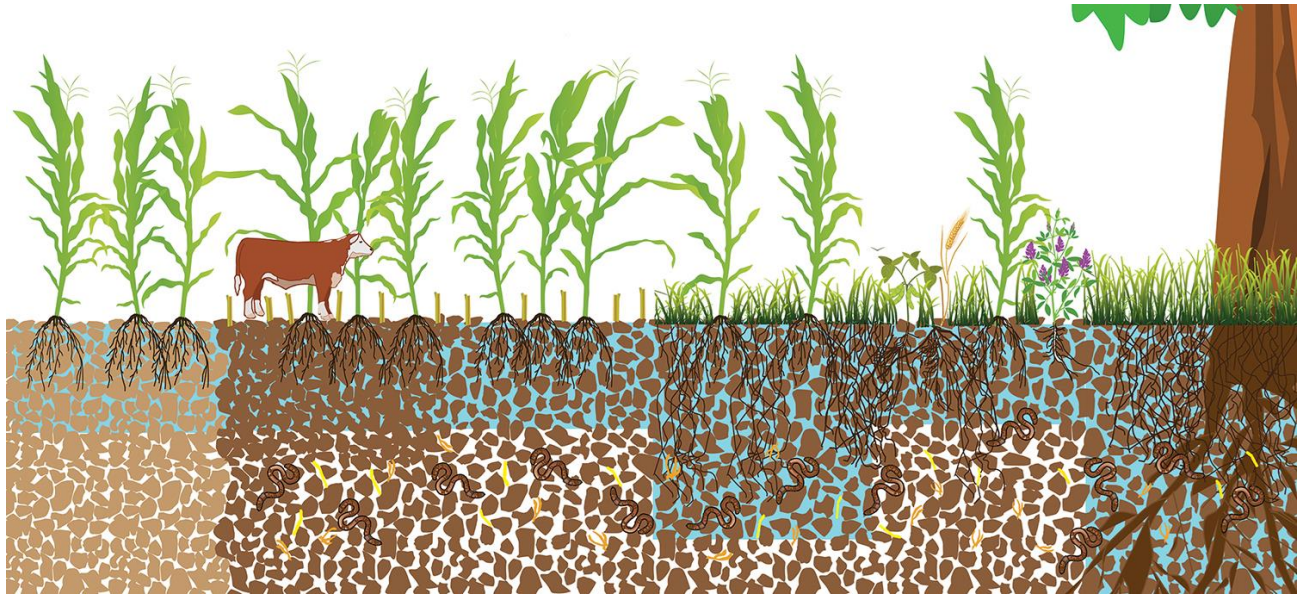
HI – Harvest Index

The Importance of WUE

- Productive use of water means better food and nutrition for families.
- More income and productive employment.
- Reduces cost of cultivation of crops and lower energy requirements for water withdrawal.
- Great significance to regional food security and ecological sustainability.

The WUE relies on

- The soil's ability to capture and store water
- The crop's ability:
  - to access water stored in the soil and rainfall during the season;
  - to convert water into biomass;
  - to convert biomass into grain (harvest index).



How to Improve WUE

- **Conservation of water:**
  - Reduce **conveyance losses** by lining channels or, preferably, by using closed conduits.
  - Reduce **direct evaporation** during irrigation by avoiding midday sprinkling. Minimize foliar interception by under-canopy, rather than by overhead sprinkling.
  - Reduce **runoff and percolation losses** due to overirrigation.
  - Reduce **evaporation from bare soil** by mulching and by keeping the inter-row strips dry.
  - Reduce **transpiration** by weeds, keeping the inter-row strips dry and applying weed control measures where needed.

How to Improve WUE

- **Enhancement of crop growth:**
  - Select most suitable and marketable crops for the region.
  - Use optimal timing for planting and harvesting.
  - Use optimal tillage (avoid excessive cultivation).
  - Use appropriate insect, parasite and disease control.

  The adoption of Integrated Pest Management (IPM) practices can reduce pesticide use which in turn can reduce the impact on surface and groundwater from pest management practices.

Suitable Crops

Optimal Timing

Optimal Tillage

Disease Control

How to Improve WUE

- **Enhancement of crop growth:**
  - Apply **manures and green manures** where possible and fertilize effectively (preferably by injecting the necessary nutrients into the irrigation water).
  - Practise **soil conservation** for long-term sustainability.
  - **Avoid progressive salinization** by monitoring water-table elevation and early signs of salt accumulation, and by appropriate drainage.
  - **Irrigate at high frequency and in the exact amounts** needed to prevent water deficits, taking account of weather conditions and crop growth stage.

Crops and WUE

Water-extensive crops examples:

- Tomatoes
- Potatoes
- Millets
- Sorghum
- Wheat

Water-intensive crops examples:

- Rice
- Soybeans
- Sugarcane
- Cucumber

Smart Technologies - Examples

Drip Irrigation

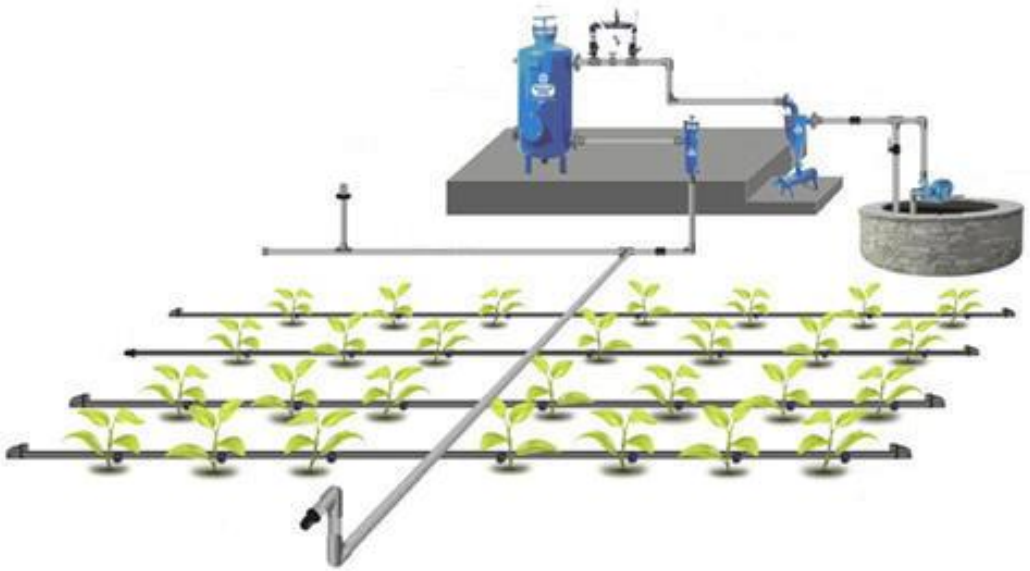
- Save water by allowing water to drip slowly to the roots of plants; the most effective water saving irrigation system.
- The goal is to place water directly into the root zone and minimize evaporation.

Disadvantages: Very high input cost; plastic tubes sometimes get broken for excessive sun heat…

Subsurface Drip Irrigation (SDI)

- Supplies water directly to the crop root-zone.
- Can free up above ground space.
- Great performance in windy and arid locations.

Disadvantages: Risk of clogging; a lot of repair work is caused by rodents chewing the tubes; heavy machinery can damage the laterals; emitter can be damaged or blocked by root hairs…



Precision Agriculture

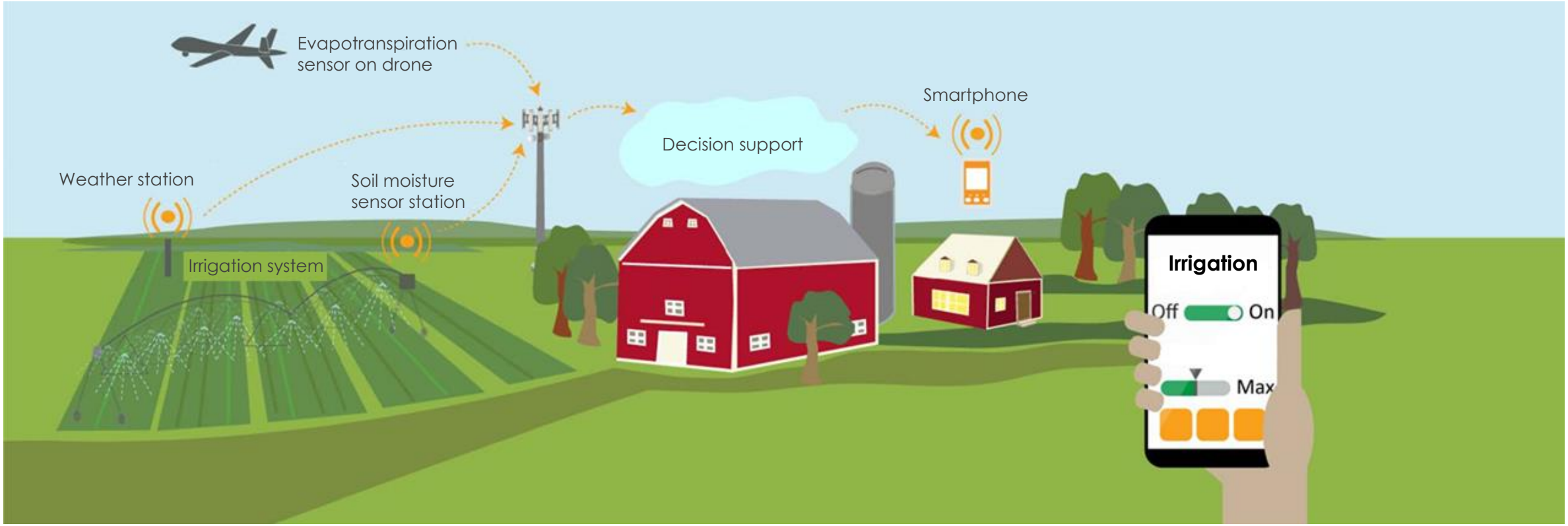
Precision Agriculture

- Make farming more controlled, accurate and reduce wastage.
- Use of new technologies: GPS, GIS, Drones, Robots, Smartphone applications, Soil moisture sensors…
- Use of technologies to observe, measure, and apply exact quantities of inputs to crops on a large scale.
- Allow to apply of precise and correct amount of inputs like water, fertilizer, pesticides etc.

Variable Rate Irrigation (VRI) technologies:

- Individual approach to the land - put water inputs to better use by irrigating areas that are in need and taking away unnecessary irrigation dead zones
- Artificial intelligence can process complex data inputs and create tailored schedules and recommendations for water application

Precision Agriculture



Agroforestry

Agroforestry:

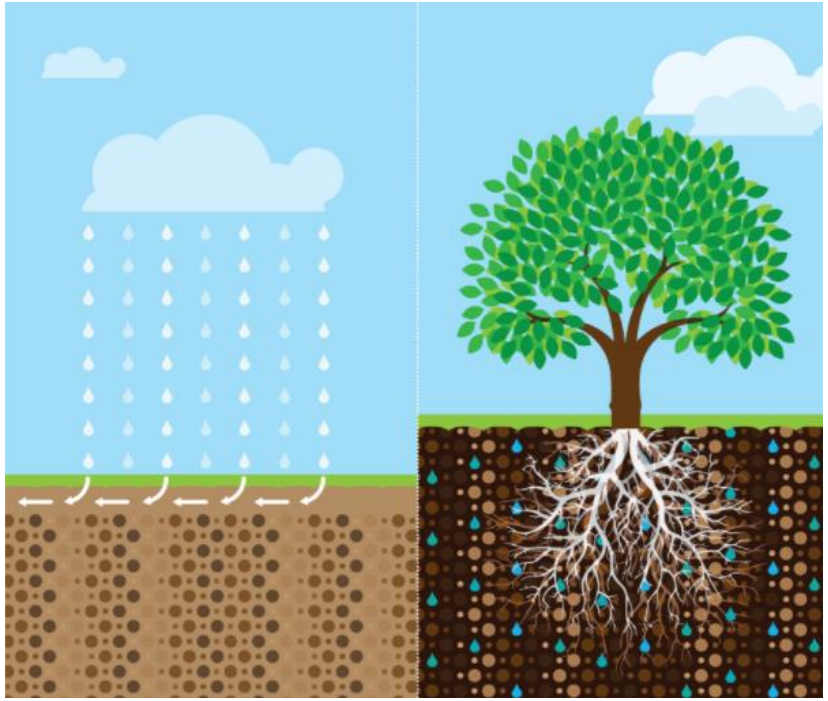
- The interaction of agriculture and trees, including the agricultural use of trees.
- Agroforestry is water-wise farming and can increase water use efficiency.
- Growing trees can reduce water consumption, help retain water for crops.
- The integration of certain trees can capture large amount of the rainfall, and produce high-value tree products (such as fruit or timber).

Benefits:

- Help retain water; can provide watershed protection.
- Can improve crop productivity by – increasing soil organic matter, infiltration and water storage; improving soil physical properties and biological activity; can reduce leaching and soil erosion.

Increase the Soil's Ability to Retain Water

- **Protect soil and increase the ability of agricultural soil to hold water.**
- Restore the natural character of the local landscape and protect/restore biodiversity increases the water retention capacity of the soil; protect the soil from the erosion and reduce risk of floodings.
- Examples:
  - reduce tillage and farm on appropriate field size;
  - restoring crops and field margins support biodiversity and protect soil from the erosion;
  - restore and protect natural wetlands.



Saving Water in the Landscape

Solution = a combination of technology use and application of nature-based measures on agricultural land is necessary

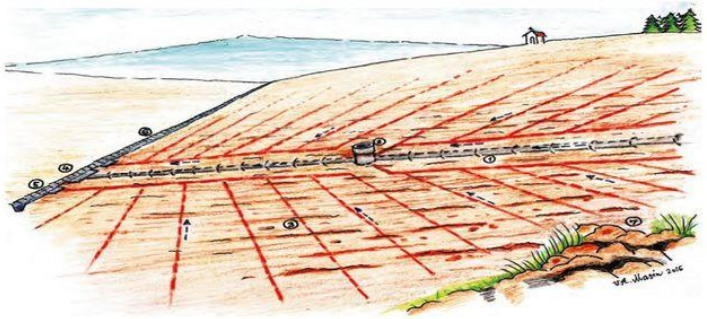
Technology (examples):

- *U*se of deep, chisel, disc, or combined cultivators as for example subsoiler digger
- The aim is to aerate the soil and allow better water absorption
- Efficient use of drainage systems

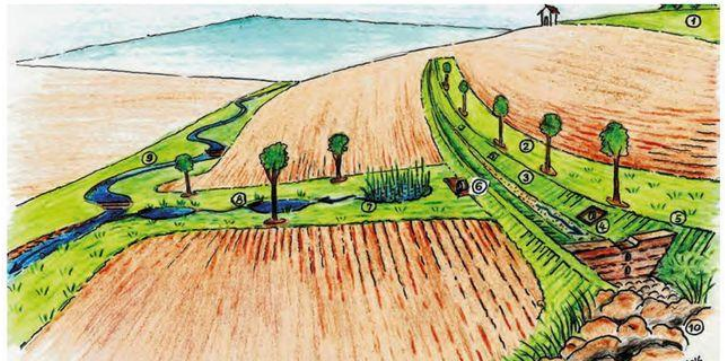
Nature-based measures (examples):

- Adopting less intensive agricultural practices
- Creating vegetated buffer strips or wetlands between cultivated land and watercourse
- Enhancing agricultural biodiversity
- Planting of trees, hedgerows….

The current state of the landscape



Vision of the solution: Blue-green landscape with water retention and storage



Useful websites

Useful websites with water/drought issues (in English):

- Knowledge Hub on Water and Agriculture (europa.eu)
- Safe water | European Commission (europa.eu)
- https://www.intersucho.cz/en/

Useful websites with water/drought issues (in Czech):

- http://www.suchovkrajine.cz/
- https://hamr.chmi.cz/
- Voda (eAGRI)

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