Water, the limiting factor of the productivity of the system

Water is the main limiting factor in terrestrial ecosystems. **The increase in the organic matter content of the soil linked to a sustainable agriculture** system makes the soils have a better structure, be more porous and present greater infiltration, while **guaranteeing greater water storage that can be used by the plants**. In dry or seasonal climates, whenever possible it is good to have systems that improve and increase the water supply. **Irrigation** obviously stands out among them, as do **terraces**, **contour systems** or **small reservoirs**.

Figure 1. In healthy soils the organic matter content is high, as is the associated water retention. Photo: Marc Gràcia.

Water is the main limiting factor in a terrestrial environment

In terrestrial ecosystems **the main limiting factor is water**. It is not distributed equally in all ecosystems. There is a **direct and very high relationship between the water available in ecosystems and their productivity**: the lack of water limits the growth of plants and, indirectly, of animals in many ecosystems, while in those with a large amount of water, productivity is very high.

In general, **conventional agriculture notably increases water losses** due to the use of the flood irrigation technique, the destruction of the soil structure and poor crop selection. For this reason, **most aquifers are being considerably reduced**, since water is being extracted at a rate that exceeds their capacity to replenish them.

Maintaining the coverage and structure of the soil with a higher content of organic matter linked to a **sustainable agriculture system is the main way to improve the infiltration and water retention capacity in the soil**. The increase in organic matter in soils improves their characteristics related to their ability to retain nutrients and water for plants. Thus, when **the organic matter content of the soils is higher** (**Figure 1**), they have a better structure, are more porous and present greater infiltration, a fact that reduces the volume of runoff water and the risk of erosion. In addition, the organic fraction of the soil is highly hydrophilic, it can retain between 4 and 6 times more water than its own weight, thus guaranteeing good storage of useful moisture for the plants.

Additional water supply systems

In dry climates, seasonal climates during the summer or in areas of intensive use such as vegetable gardens, water continues to be a limiting factor for agricultural production, even if the soil conditions in terms of organic matter content are adequate. Therefore, whenever possible, it is good to have systems that improve and increase the water supply. This contribution should respect the principles of soil function to increase the productive potential defined by the climatic conditions of each area.

• **Irrigation**. The possibility of watering is **conditioned by the availability of water and the cost of its application** (start-up investment and operating costs) (**Figure 2**). There are interesting technologies available today to improve the efficiency of its use. The quality of the water to be used must always be taken into account, together with the impact

that its use may have on the water sources, since if the resource is depleted, the investment will be lost.

• **Terraces**. This is the traditional system in mountain areas (**Figure 3**). Terraces **improve water infiltration and soil depth on steep slopes**. Traditionally terraces have been supported by stone walls. Where these walls are still standing, their use is very convenient, taking into account that, if the wall is lost, gullies and erosion phenomena can occur. The **construction of new stone terraces** is very expensive and usually cannot be carried out.

• **Runoff retention systems following contour lines**. There are systems that cost less to make than terraces to slow down the movement of water and facilitate its infiltration. At each site, various techniques adapted to the site can be used. One option is to **create small barriers following contour lines using logs and remnants of forest harvesting**. The Keyline system proposes a **very complete system for landscape design in order to distribute water in a homogeneous way** and turn the system into a large water store that is distributed along key lines according to the topography of the land.

• **Systems of small reservoirs to collect rainwater in the upper parts of the land**. This system requires planning and prior design. There are many examples of the construction of relatively low-cost small rainwater collection reservoirs with earthen dikes. **They require a water extraction system and distribution channels**. These systems represent a way to create water reserves that can be used for downstream use. For many areas with water problems, this can be an important goal.

Figure 2. Irrigation with sprinklers. Photo: CC0 Public domain

Figure 3. Terraces supported by stone walls. Photo: Parc Natural dels Ports distribution license under CC BY-ND 2.0

The regenerative production model optimises the use of water

The conventional model is based on tilling the soil that breaks its structure and any plant cover. At the same time, **it causes the waste of water** because the soils in this type of agriculture do not have a retention capacity. As a result of this type of agriculture, water resources are depleted and overexploitation occurs as water is withdrawn at a rate that exceeds its replenishment capacity.

Instead, **the regenerative model agriculture protects water sources** and reduces the need for them. This type of management, in contrast to the conventional one, is based on maintaining the soil structure and therefore, the humus layer. **Humus improves the water cycle on small and large scales**. Humus determines the infiltration capacity of water, the recharging of aquifers and the prevention of floods and droughts. **The water stored in the humus is transported to the deepest layers of the soil and finally, to the aquifers**. A soil rich in humus can absorb 150 l/m^2 in an hour, which will be distributed like a system of sponges. This ability to absorb water makes it possible to mitigate the effect of floods and erosion caused by heavy rains.

Permanent ground cover is another characteristic of the regenerative model as it protects against wind and water erosion. The vegetation cover also prevents the excessive evaporation of water from the soil, by exerting a regulating role of its temperature and reducing the loss of water by evaporation.