

REPORT ON SUSTAINABILITY IN AGRI-FOOD VALUE CHAINS.

CASE STUDIES FROM THE MEDITERRANEAN REGIONS & THE MIDDLE EAST.

CASE STUDY: AGRICULTURAL RESOURCE USE

Mirela: Hello Izabela! In this recording we will focus on best practices concerning the efficient and sustainable resource use in agriculture. We will talk mainly about land and water management, using examples from Spain and Jordan, and we will explain why promoting sustainability in agriculture should start with the ways agricultural inputs are used. Some of these resources such as land, water and energy, have an important impact on the implementation of the UN Sustainable Development Goals. Let me start with this question. Why did you choose these agricultural resources for our case study?

Izabela: *As you mentioned Mirela, ensuring healthy soils and responsible water use in agricultural systems is fundamental to achieving the UN Sustainable Development Goals, such as addressing zero hunger and ensuring sustainable life on land. Yet, land degradation is a significant and growing concern globally. Land degradation refers to the deterioration or loss of the productive capacity of soils for present and future, and can be a result of processes such as soil erosion caused by wind or water; deterioration of the physical, chemical and biological or economic properties of soil; or the long-term loss of natural vegetation. Land degradation is estimated to affect 25 percent of the total land area and 3.2 billion people globally, and is a particularly important concern for countries and regions reliant on agricultural production for income and growth. Land degradation is one of the most significant contributors to climate change, as when land is degraded, soil carbon and nitrous oxide are released. At the same time, challenges in meeting growing demands for food, water, and energy, are likely to be further exacerbated by climate change over time.*

Given these complex challenges, we were keen to understand what sort of practices for responsible soil and water management are being implemented by agricultural

producers in different contexts, to see what lessons could be learnt for application in other geographies.

Mirela: Now, I would like to explore in more detail with you the lessons learned from the examples provided in our case study.

Izabela: *We looked at a few examples, to understand the different ways in which water and soil resources are being managed in agricultural systems. We examined practices being used to mitigate soil erosion in Cànyoles river watershed, Eastern Spain; reviewed studies that explored the effects of irrigation in an olive-growing region in Andalusia, Spain; and looked at water harvesting techniques, micro-catchment and mulching in pistachio plantations in Northern Jordan.*

In the Cànyoles river watershed, soil erosion is increasing due to drip irrigation systems, a lack of vegetation cover, soil compaction and low soil organic matter, as well as new plantings of citrus orchards on slopes. A study examining straw mulching to prevent soil erosion came back with promising results – the study found that the use of straw mulching resulted in improved soil moisture, soil water infiltration, and reduced runoff. Note that mulching is a technique generally used to save water, suppress weeds and improve the soil around plants. Materials used for mulching can include straw, plastic, and gravel.

The combined impact of the yearly use of straw and a no-tillage strategy resulted in a reduction of the sediment yield, and 11 years later soil erosion rates were significantly lower – in fact, degrees of magnitude lower. Studies in the region found that farmers' attitudes towards straw mulching were extremely negative due to its cost, and in the Cànyoles citrus production area, there was resistance to the use of catch crops or weeds, as farmers traditionally prefer weed-free farms ('clean soil') and are reluctant to take up no-till farming techniques. The studies found that incentives and subsidies for farmers could play a really import role in encouraging these responsible practices.

Turning to our next example, we were interested to look at the effects of irrigation in an olive-growing region in Andalusia, Spain. Over the last 50 years, the irrigated land area in Spain has increased almost eightfold with the intention to increase

agricultural production. Studies examining the effects of irrigation in olive groves showed that although irrigation increases the productive level of the groves, the process of irrigation progressively alters the soil, compared with groves that are rainfed. Farmers may not necessarily benefit from increased production due to the costs of irrigation and due to a lower selling price associated with irrigated olive groves. Irrigation also alters the physical and chemical characteristics of the soil in ways that can aggravate erosion. So, the productive benefits of irrigation may be unsustainable in the long term, both ecologically and economically. These findings really highlight important challenges for long-term sustainable water management, especially when considering the impacts of climate change on drought-prone regions.

Our third example looked at water harvesting techniques, micro-catchment and mulching in pistachio plantations in Northern Jordan. Micro-catchment areas are in-field systems of water harvesting consisting of small structures such as basins, pits, and holes. Such areas are designed to decrease runoff from rain and concentrate it in a basin where it penetrates and is stored in the soil.

A study examined the effects of in-situ water-harvesting techniques, micro-catchment and mulching on soil moisture content, plant morphology, gas exchange, and midday stem water potential of young pistachio trees. This was examined in pistachio farms under rainfed conditions for two growing seasons. In this case, it was found that water harvesting techniques can provide a supplementary source of water for the cultivation of pistachio, especially during drought periods. Furthermore, combined water harvesting techniques (mulching and micro-catchment) significantly improved soil water content, plant morphology and the physiology of pistachio trees.

Mirela: These are very interesting examples. Let's now look closer at the advantages that farmers can have by adopting certain techniques. Do you think there are also some disadvantages, or challenges?

Izabela: Thank you Mirela, we do find that nature-based solutions may play an important role in sustainable resource stewardship in agricultural settings. Solutions at the level of soil can include the use of cover crops and straw mulching, and can

bring many benefits. At the landscape level, nature-based solutions promote the disconnection of water and transfers across the landscape, such as vegetative buffer strips and riparian vegetation.

Farmers can gain advantages from adopting certain techniques, or avoid the negative impacts of land degradation that can threaten their long-term productivity and livelihood security. Good soil management can affect the quantity and quality of crops produced, and in turn the economic sustainability of production practices.

The increasing use of irrigation systems in regions means that farmers can produce vegetables and fruits at competitive prices, but overextraction of groundwater can result in the depletion of aquifers and reduction in water resources with associated social and economic problems. For example, in the case of the Cànyoles river watershed, water flows are insufficient to sustain the traditional spring-supplied irrigation by flooding.

The use of vegetation cover is a cost-efficient treatment for soil erosion that is not always taken up, so it is clear that the perception of farmers can either support or impede the success of sustainable management plans. In many Mediterranean landscapes there is significant social pressure to maintain clean soil, limiting the adoption of nature-based management solutions such as organic farming and the use of straw as a mulch. As previously mentioned, this is where incentives could play a role in supporting more sustainable practices. Subsidies, however, may also promote irrigation in dryland farming areas, or herbicide use with resulting land degradation, so really attention is required to make sure subsidies are carefully designed and their impacts monitored over time.

A lack of collective implementation measures across landscapes can limit the impact of individual land users. Holistic systemic approaches (e.g. at landscape or watershed level) that consider local context and culture are needed to address environmental sustainability in the use of agricultural resources. It is important that land managers have access to appropriate landscape-specific knowledge and the capacity and technologies to examine and anticipate the potential trade-offs of particular land management practices.

The impacts of climate change, land degradation and water scarcity pose significant social challenges for farmers and agri-food value chain actors more broadly. Horton et al. in 2016 therefore proposed a framework for integrated solutions based on mapping agri-food systems using life cycle assessment, the free access of data to all stakeholders – all intended to encourage more democratised agri-food system, in which sustainability and resource efficiency are embedded. When policies are developed, farmers' views should be understood and taken into consideration to drive more sustainable practices that are sensitive to culture and everyday practices.

Mirela: Thank you Izabela for introducing us to the case study on agricultural resource use.

Izabela: Thank you Mirela!

Mirela: More information and sources can be found in the “Report on Sustainability in Agri-food Value Chains. Case Studies from the Mediterranean Regions and the Middle East”. This Report is available on our project website <https://agricultural-voices.sussex.ac.uk/>.