VI. MODULE

Local agricultural practices

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Soil conditions

Climate change and intensive agriculture will intensify the process of soil degradation. An increase in soil temperature will result in an accelerated decomposition of organic matter in the soil, a decrease in the stability of soil particles and the amount of macropores, a significant increase in evapotranspiration, but also an increase in the water requirement of plants.

Picture 24: Effects of climate change
Source: https://unsplash.com/

Soil management measures should address the fundamental problems caused by climate change: soil degradation and increased soil erosion. Good soil practices include:

- maintaining and improving the organic ingredients in the soil by using the accumulated reserves with an appropriate crop rotation,
- use of organic fertilization,
- pasture management and other land use practices,
- maintenance of the soil cover, and to ensure a suitable environment for soil microorganisms and
- to minimize soil loss from wind and water erosion.

Measures for sustainable soil management include:

- **Reduced tillage**. The intensive processing and utilization of the soil, which is used in modern horticultural production, contributes to changing its natural structure, increased erosion, reduction of organic matter and microbiological activity and fertility of the soil. Reduced tillage (conservative plowing) as a measure to deal with climate change should prevent or reduce these harmful impacts and preserve soil fertility. With the reduced processing, one third of the plant residues remain on the field, which enables the reduction of erosive processes and the conservation of moisture in the soil. Reduced processing can also be performed without the use of plowing, whereby plant residues from the previous year are completely left and direct seeding is applied to them.
- **Mulching**. This is a measure that adds cover to the soil surface. Materials of organic and inorganic origin are used for mulching. Mulching can be used to prevent the emergence of weeds, protect the soil from drying and hardening, increase the capacity of the soil to conserve moisture, retain and increase the biological activity of soil microorganisms, reduce temperature oscillations, prevent erosion and washing. of nutrients and maintenance of soil structure, but also to save irrigation water.

Picture 25: Mulching
Source: Own photo

Water

It is expected that the greatest impact from climate change will be observed through water, as a result of the reduction of the annual amounts of water available for agricultural activities. Under the influence of climate changes, changes in the quantity and quality of available water are expected, and with an increase in temperature, the evaporation of surface water will increase. Climate change will also contribute to the reduction of soil moisture, due to the variability of precipitation and its reduction. The occurrence of intense rain or drought caused by climate change will result in enhanced erosion processes due to the occurrence of floods or fires.

Picture 26: Irrigation
Source: Own photo

Cultivation of agricultural crops on the largest part of the country's territory is impossible without additional irrigation. On the other hand, due to the frequent heavy rains that often coincide with periods of increased humidity, agricultural areas, especially along larger river flows, are often subject to flooding with large economic losses after production. Hence, expansion and rehabilitation of existing and construction of new irrigation systems is a policy priority, especially in terms of the expected negative effects of climate change, which will influence an increase in irrigation needs on the one hand, and a decrease in the available amount of irrigation water. on the other hand.
Water is a scarce and sensitive resource, the use of which is necessary to be realized rationally and efficiently, especially in the context of the increased impact of climate change. Mitigating the negative effects of climate change through adaptation measures is also one of the goals of investments in water management. In that direction, with the support of FAO, it is planned to prepare the "Irrigation and Drainage Strategy of the Republic of North Macedonia", which will define the directions and directions

for development, taking into account the degree of utilization of the systems and the efficient and rational use of irrigation water. in the next ten-year period 2021-2031.
The anticipated shortage of water as a resource is one of the biggest problems expected to arise as a result of climate change, so it is necessary to make adjustments to the ways in which water will be used in agriculture. Water management measures should ensure water conservation and its efficient use.
It is very important in the coming period to examine the possibilities:

- for waste water recycling,
- for rainwater collection and
- other methods for saving water.

Water conservation measures include

1. Selection of crops that are resistant to drought
2. Application of irrigation in the critical stages of plant growth and development.

With these measures, it is necessary to replace old and unsustainable irrigation techniques with new, efficient and economically viable systems. The use of the "drop by drop" system for irrigation of agricultural crops is an excellent opportunity to save water.
Introducing a drip system. Compared to furrow irrigation, which has 60% effective use of water used, and the application of artificial rain 75%, drip systems use as much as 90% of water used. The main reasons why this technology is most suitable for dealing with climate change is that it uses the least amount of water while eliminating surface evaporation. Fertilization can be done with the drip system, as well as some forms of plant protection. This technology is recommended for regions with seasonal droughts, as is the case in our country. Given the possibility to install timers that will automatically carry out the watering, it can be timed at times when there is the lowest demand for water (eg early morning). With overall water savings and labor savings, the costs of agricultural production are reduced. It has also been proven that this technology reduces the spread of diseases and pests and thus has an integrated effect on reducing the consequences, as well as facilitating the handling of other aspects of climate change..

Pictrue 27: Drip system
Source: Own photo

Concentration of CO_2

With climate change, an increase in the concentration of CO_2 is expected, which in turn will contribute to an increase in the photosynthetic activity of plants, and thus accelerated growth and an increase in the yield of vegetable plants. However, this phenomenon can have a positive effect only if other environmental factors are optimized (favorable temperatures, sufficient water, optimal light), which is very difficult to achieve in the conditions of climate change. With climate change, an increase in temperatures is expected.
If this increase is within the optimal limits, it can be expected to have a favorable effect on the growth of vegetable plants and enable the shortening of the vegetation period. However, temperatures higher

than the optimum and heat waves will have a strong negative effect on vegetable plants and will cause a disturbance in certain stages of plant development (overplanning, rejection of flowers), thereby reducing or failing yields.

Selection of varieties

One of the basic conditions for successful crop production is the correct choice of variety. Apart from the productive and quality properties of the variety, farmers should take into account the biological requirements of the variety and the environmental conditions prevailing in the production region, in order to make a correct assessment of the possibilities for successful production.
According to the predicted climate scenarios for our country, it is recommended to choose appropriate varieties that will be resistant to drought or to replace the species with others that have lower requirements in terms of irrigation.
It is recommended to choose suitable varieties that will be resistant to drought or to replace them with others that have lower requirements in terms of irrigation. Varieties should be suitable for existing environmental conditions and enable stable growth, development and quality yield.
Seedling grafting in horticultural production has many advantages because it allows greater resistance to abiotic and biotic stress in plants. In fruit growing and viticulture, grafting is a standard practice.
However, numerous advantages of seedling grafting have been established in horticultural production, especially for the production of fruit crops (tomato, pepper, eggplant) due to the introduction of resistance to abiotic and biotic stress.
And in this case, it is necessary to choose substrates that will be suitable for the existing environmental conditions and will enable stable growth, development and quality yield of the nursery stock.

Installation of safety nets

The application of protective nets in horticulture, more recently in viticulture is a relatively new technology and is expanding very rapidly. The use of the protective net ensures light regulation and protection of crops from other adverse external influences (hail, strong winds, strong solar radiation, etc.), as well as protection from insects and birds.

Crop rotation

Crop rotation refers to the practice of growing a range of plant species on the same land. It is an ancient practice that has been used for thousands of years. Crop rotation has regained global attention to address increasing agro-environmental problems such as soil quality degradation and climate change resulting from short rotation and monoculture cropping.
As an example of the positive effect of crop rotation, when rice was grown in rotation with maize and sweet sorghum in the dry season, a significant reduction in greenhouse gas emissions was observed by 68-78% compared to double rice cropping. Crop rotation is a sustainable approach that increases yield and water use efficiency while reducing soil erosion.

Organic farming

Organic production represents a significant measure for mitigation and adaptation of agriculture to climate change, as it promotes and practices the combination of sustainable examples of practice that should ensure the rational use of natural resources.
In organic horticultural production, efforts are made to reduce soil cultivation, that is, to reduce the movement along the soil surface and the depth of plowing the soil. This is achieved by reduced tillage. Reduced tillage contributes to reducing the possibilities of erosion, more rational consumption of water, reduction of the destruction of structural aggregates, increased efficiency of fuels used for agricultural machinery.

Combined soil protection measures are applied in organic gardening, the use of synthetic fertilizers is prohibited, mineral fertilizers obtained by chemical means are prohibited for use in organic gardening. In organic production, it is allowed to use mineral fertilizers of natural origin only. The mineral fertilizers used in organic gardening are: raw phosphates, wood ash, gypsum, marl, limestone, clay, sulfur and others, which prevent soil pollution and the emission of greenhouse gases.

Numerous studies show that the emission of greenhouse gases from organic production is lower compared to conventional production. This is due to the application of combined soil protection measures (organic waste, production of leguminous species, crop rotation, mulching, etc.). The non-use of synthetic fertilizers and protective agents also plays a role in the reduction of emissions, because large amounts of energy are consumed during their production.

Nitrogen oxides, which are a big problem in conventional production, are also reduced in this way due to the non-application of mineral nutrition, at the expense of the use of organic fertilizers and additional measures to improve and maintain the fertility of the soil, while achieving large yields. And organic animal production has low greenhouse gas emissions due to the fact that the standards require an adequate number of animals per unit area, and consequently excessive amounts of agricultural waste are not produced.

Animal nutrition is based on reduced protein intake and increased vegetable fiber intake, which facilitate the digestive process. The system of organic production promotes the application and combination of sustainable practices that ensure the rational use of natural resources, which is why it is included in the measures for mitigation and adaptation of agriculture to climate change.

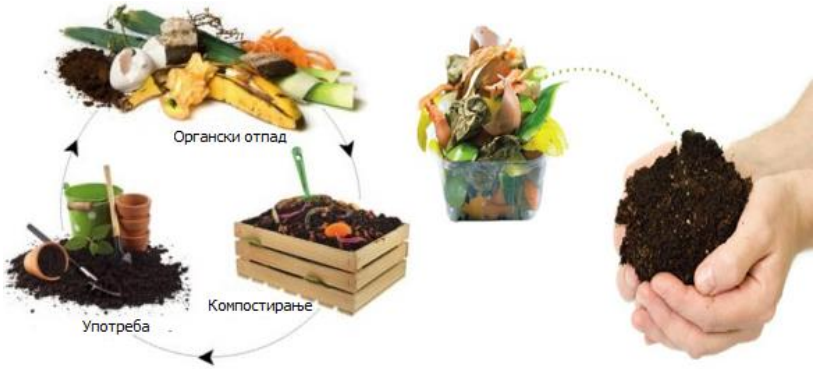
Traditional organic composting

Greenhouse gas emissions caused by fertilizers are the largest source of total greenhouse gas emissions from the agricultural sector. Inorganic nitrogen (N) fertilizers contribute to approximately 75% of the direct emission from agricultural soil. In addition to contributing to greenhouse gas emissions, nitrogen fertilizers reduce soil microbial activity and bacterial diversity.

On the other hand, the use of organic compost is a sustainable and climate-smart approach to increasing soil fertility. The use of composted organic waste to improve soil fertility and productivity is receiving enormous attention worldwide.

Composting is a traditional practice that has been used for centuries. Composting refers to the natural process of rotting or breaking down organic matter by microorganisms under controlled conditions. It is a biochemical process in which microbial degradation of organic waste results in a product known as organic manure or compost. Composting is a sustainable approach to organic waste management. It not only removes waste but also transforms the waste into a nutrient-rich organic product that can be used to improve soil fertility.

Various organic materials are used in the composting process such as straw, crop residues, agro-industry by-products, livestock waste, sewage sludge and kitchen waste.



Picture 28: Composting
Source: Own photo