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TRANSITION
Transition Promotion Program

Environmentally Sustainable Agriculture for Waters

Environmentally Sustainable Agriculture for Waters
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Motto

"We basically have three choices [as to how to react to climate change]: mitigation, adaptation and suffering. We're going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required and the less suffering there will be."

Dr. John Holdren,
scientific advisor to President Obama

Introduction

Sustainability means focusing on meeting the needs of the present without compromising the ability of future generations to meet their needs. It is a complex notion including environmental, economic, and social aspects.

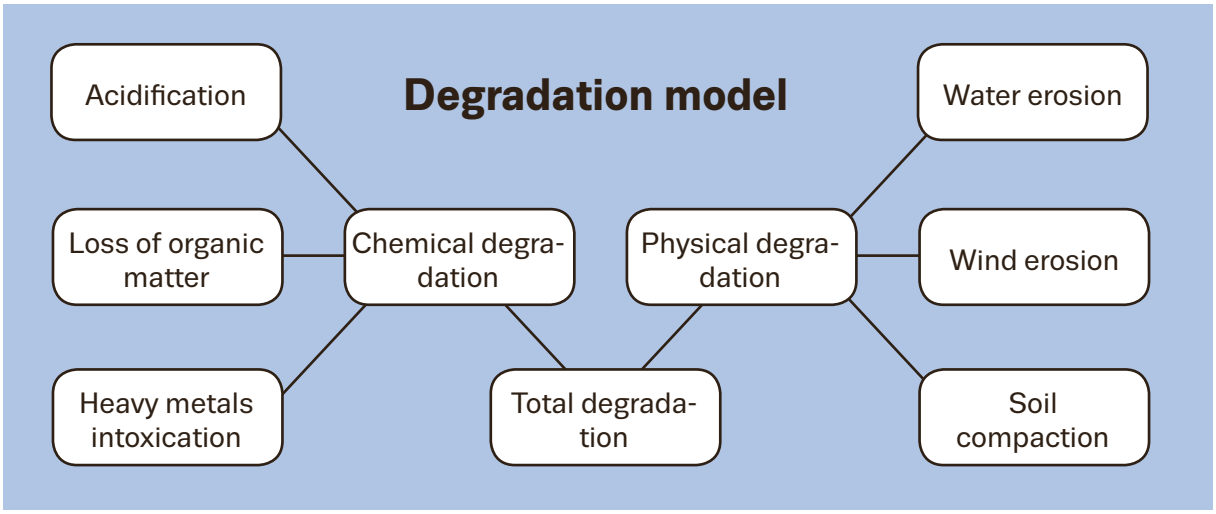
Environmental sustainability in agriculture means basically:

- building and maintaining healthy soil
- managing water resources responsibly
- minimizing air, water, and climate pollution
- supporting and restoring biodiversity

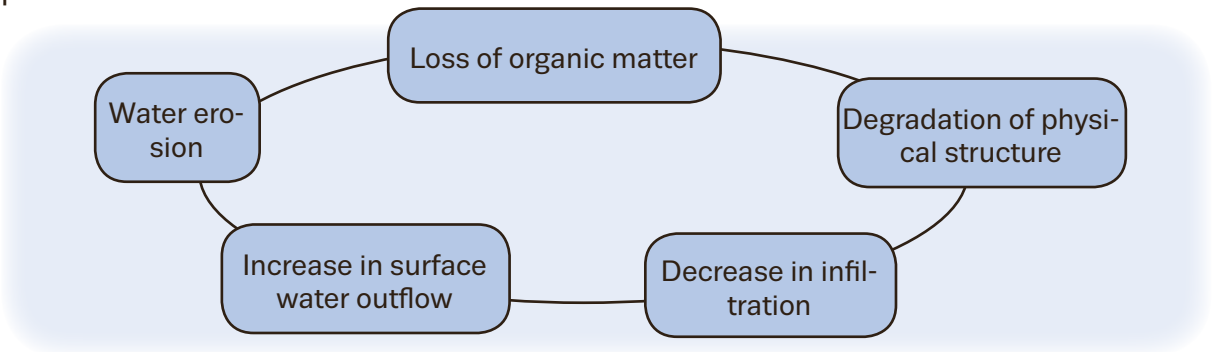
This publication focuses especially on sustainable practices in agriculture that aim to improve the water regime in the landscape and the quality of the water in watercourses. While we fully appreciate the benefits of organic and other alternative forms of agriculture, we consider the greening of conventional, intensive agriculture to be of decisive importance for healing the landscape on a global scale. Therefore here we mostly describe measures that are compatible with this kind of agriculture.

1. Soil Protection

Intensive industrial-like agriculture causes significant degradation of its main resource – the soil. If we simplify the degradation model, we can see how physical degradation comes from compaction of the soil caused by heavy machinery and water and wind erosion; chemical degradation by pollutants is accompanied by a loss of organic matter (caused by pesticides killing soil animals and the replacement of organic fertilizers by artificial ones and exacerbated by physical degradation).



One of the vicious circles of soil degradation is connected with erosion, the loss of organic matter, and the ability of the soil to absorb water (infiltration capacity). It can be presented like this:



To tackle the issue of soil degradation, we have to reduce the pollution intake, increase the content of organic matter, and limit erosion. Many of the measures described below work both ways, but of course we describe them only once, so if you want to have a full overview, read Chapter 1 as a whole.

1.1 REDUCING pollution

Integrated PEST management

Integrated pest management is a method or strategy for how to solve pest problems in conditions of conventional agriculture with a minimum use of potentially dangerous chemical substances. It is based on knowledge of ecosystems and uses approaches such as biological control, habitat manipulation, modification of cultural practices, and the use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are employed with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes the risks to human health, beneficial and non-target organisms, and the environment.

Crop rotation

Crop rotation is defined as the intentional planting of different types of crops in different parts of the field and during different seasons in a sequential manner. It also entails not choosing to plant anything at all in a given season and allowing the land to rejuvenate until the next season.

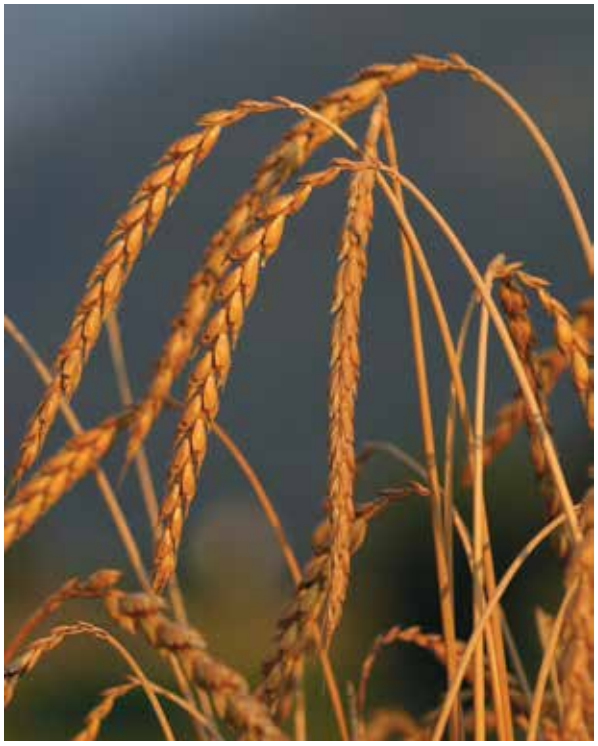
Crop rotation increases soil fertility and reduces the need for artificial fertilizers. It also increases and improves the organic matter in the soil caused by the microorganisms left behind by each type of crop planted and by the biomass left behind when harvesting. Some crops may be used for grazing, and thus enrich the soil with manure.

There is also the aspect of limiting the use of pesticides. Similar plants tend to have the same pathogens; therefore, crop rotation intercepts the pests' life cycle and their habitat. Farmers can see a decrease in the incidence of insect pests and pathogens when they try crop rotation.

To use crop rotation effectively, it is, however, necessary to have good knowledge regarding each type of crop harvested and choose the succession of crops carefully, and it sometimes requires more diverse equipment and other resources.

Resistant crops

Avoiding fragile high-yield uniform crops and the use of local varieties of plants, adapted to local conditions, can also reduce the spread of pests and limit the use of pesticides and synthetic fertilizers.



Precision agriculture

Precision agriculture is a high-tech form of intensive agriculture, using advanced surveillance and information technologies (satellites, GPS, drones, computers) to deliver precise amounts of inputs to exact locations and at exact times according to the needs of crops. It requires specific knowledge and high financial investments, but it can result in high yields with optimized levels of inputs including water, pesticides, and fertilizers.

1.2. Content of organic matter in soil

Organic matter in the soil is of fundamental importance to its quality in both “living” and “dead” forms. It makes the soil better structured, less compact, more porous, and less prone to erosion and crusting. Healthy, well-structured soil holds water and nutrients much better than degraded soil.

The quality of soil in intensive agriculture can be improved by, among others, the following measures.

Organic fertilizers

We use the term ‘organic fertilizers’ for both manure as well as plant-based fertilizers and green crops. What are their main advantages?

Organic fertilizers improve the soil. Organic materials and fertilizers improve the soil texture, allowing it to hold water longer, and increase the bacterial and fungal activity in the soil. Thus, they not only assist your plants, they also help the soil. Synthetic fertilizers, on the other hand, deplete the soil of its nutrients, making it unproductive.

Organic fertilizers work slowly. In order for organic fertilizers to work, the soil has to first break them down. This means that both the soil and the plants in it get the nutrition they need when they need it. Synthetic fertilizers, although speedy, often overfeed the plant and do nothing for the soil, and can damage plants by burning them.

Cover crop can be seeded into the mulch of previous crops.

Crops exploit organic fertilizers with minimal residue. Large parts of the nutrients from synthetic fertilizers, on the other hand, are left unused and washed away by rainwater.

Cover crops

Keeping land green even after the main crops are harvested can help to manage erosion, fertility, soil quality, water, weeds, pests, diseases, biodiversity, and wildlife in an agroecosystem – an ecological system managed and shaped by humans. Cover crops may be an off-season crop planted after the harvesting of the cash crop. They may grow over the winter.

1.3. Anti-erosion measures

Counter-erosion ditches, terraces, or balks

Line structures such as ditches, terraces, or balks can limit erosion by obstructing the surface outflow of water or by collecting and transporting rainwater and keeping the sediment in suitable locations.

They are also important landscape elements with the potential to create habitats for wild plants and refuges for animals and thus increase biodiversity.

Counter erosion ditch

Green belts

Green belts are the grassland zones around fields, roads, watercourses, etc. With proper localization, they have an anti-erosion function, improve the water regime, and protect watercourses and wetlands against an excessive intake of nutrients and pollutants from fields.

Along watercourses, wherever it is possible, the green belts should consist of trees and bushes.

Green belts

Windbreaks

Belts of trees can also be the most efficient protection against wind erosion. The use of domestic species appropriate for site conditions can improve the stability and resistance of greenery and contribute to bio-diversity.

Zoning and localization of crops

Row crops, typically corn or sunflowers, are especially prone to erosion and when they are planted in sloping terrain, it should be ploughed along the contours. If that is not possible, it is better to use slopes for plants such as clover or grass.

What is even more effective than contour ploughing is to alternate zones of row crops with belts of grass or clover. This method is traditionally used in the USA.

Alternating belts of crops and grass is an effective way to limit erosion also near water courses.

2. Water Retention

Intensive agricultural land use often leads to fast surface outflow of rainwater. Cultural crops used in the west usually require drainage and are not flood-resistant. Huge areas of wetlands have been drained, the majority of natural wetlands directly destroyed, and many have also suffered as a result of the modification of watercourses (straightening, deepening, embankments) and a changed water regime in floodplains. For example, in the Czech Republic, 90% of wetlands were destroyed in the period from 1843 to 2015.

The consequences of this loss are dire. The landscape lost its ability to retain water; heavy rains lead to flesh floods, which alternate with long periods of drought. This effect is worsened by the impact of climate change. Wetlands, pools, and fish ponds in a healthy environment have an important cooling effect – the evaporation of water absorbs the heat in the day, while condensation during the night releases it and thus softens the changes of temperature.

Similarly, wetlands and small reservoirs retain water in wet periods and release it afterwards. Thus they stabilize the flow levels in watercourses and levels of water in the soil.

Wetlands in agricultural land also help to manage the flow of nutrients. They contribute to the self-cleaning ability of water and, last but not least, benefit the biodiversity of the cultural landscape significantly.

2.1 Restoration of wetlands and small water reservoirs in agricultural land

Wetlands can be restored by different measures – by digging pools below the level of the soil water, by blocking drainage systems, or as a part of the restoration of watercourses.

Fish ponds are watered by natural or artificial watercourses and use some kind of technical structure (a watergate) for managing the water level. The ecological benefits of fish ponds depend heavily on their design and operation. Fish ponds with extensive littoral zones which are not overfished can have similar positive effects to natural wetlands.

Restored wetland in agricultural land.

2.2 Restoration of watercourses on agricultural land

The restoration of small watercourses on agricultural land can renew the dynamic hydrological and ecological system, with extremely valuable ecosystem services.

The current approach to river restoration gives as much space as possible for the natural development of the watercourse and surrounding landscape.

There are many possible approaches to river restoration. The decision as to which one to choose should be based on the evaluation of hydromorphology, the character of the terrain, including geological and pedological conditions as well as the character of the vegetation appropriate for local conditions. In many cases, we also have to consider the limits resulting from ownership relations and land use.

Some examples of possible restoration approaches are:

- redirect the watercourse to the old channel, if it is still preserved;
- create a new initial channel, and redirect water flow to it;

- remodel the existing channel;
- remove embankments and other technical structures and let the watercourse restore itself

Especially in the case of small watercourses in flat areas, it is possible to very simply just redirect the watercourse into a very basic shallow initial channel ("shovel-made") in the floodplain, and let the water flow to find the most natural way.

Restored stream and floodplain, two years after construction.

3. Biodiversity

Many of the measures mentioned above also contribute significantly to increasing biodiversity. We can use this potential fully with some very simple and low-cost methods. When planting or seeding trees, bushes, and plants, we should prefer local species and varieties on the basis of local conditions. We should consult with biologists what kinds of species (especially rare and endangered ones) we expect to colonize restored or replanted areas with and include supporting structures (improving conditions for nesting, feeding, breeding, etc.) in the project. We should always remember that diversity of landscape elements leads to diversity of ecosystems.

4. Adaptation to climate change

The typical effects of climate change in continental conditions are:

- changes in precipitation patterns
- a higher probability of extreme hydrological conditions (droughts or floods)
- a higher probability of storms and extremely strong winds
- heatwaves in summer

Adaptation and mitigation – what is the difference?

Mitigation in terms of climate change means to limit emissions or increase the absorption (sequestration) of greenhouse gases.

Adaptation to climate change means to increase the resistance of the environment and society to the impacts of climate change.

Intensive agriculture and climate change

Many negative effects of intensive agriculture, such as erosion and soil degradation and loss of biodiversity and the water retention capacity of agricultural land, are in self-reinforcing feedback with the impacts of climate change, such as droughts, floods, storms, or even heatwaves (they make these impacts of climate change worse, and in turn are made worse by them). At the same time, the agricultural sector is an important source of greenhouse gases. Thus, the transformation of agriculture can contribute both to

mitigation and adaptation to climate change. The best solution may be to combine mitigation and adaptation effects in one package. Many of the measures described above have that effect too to some degree, but more prominent results can be achieved by the measures mentioned below.

5. Agroforestry

Agroforestry is a collective name for land use systems and technologies where trees and shrubs are deliberately used on the same land management units as agricultural crops and/or animals. In agroforestry systems there are both ecological and economic interactions between the different components. Agroforestry can also be defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic, and environmental benefits for land users at all levels. In particular, agroforestry is crucial to smallholder farmers and other rural people because it can enhance their food supply, income, and health. Agroforestry

Extensive orchard with pasture in the middle of agricultural land provides fruits and grass for farm animals.

systems are multifunctional systems that can provide a wide range of economic, socio-cultural, and environmental benefits.

Some of the benefits of agroforestry systems are:

Productivity: providing shelter for livestock can increase their daily live weight gain, and windbreaks in arable systems can reduce soil erosion. Trees can provide additional sources of on-farm revenue such as woodfuel, timber, fruit, or nuts.

Tackling climate change: trees can moderate the local climate and provide additional carbon sequestration (above-ground and below-ground).

Water management: including trees can help slow the flow of run-off from farms, thereby moderating downstream flood flows and reducing soil erosion. The deep roots of appropriately placed trees can help minimize the leaching of nitrates.

Biodiversity and landscape enhancement: agroforestry on farmland has been shown to significantly increase the diversity of species, and there is increasing evidence that many people favour mosaic landscapes.

Animal welfare: reduced temperature extremes and a greater variety of within-field habitats can reduce animal stress and allow more natural animal behaviour.

6. Biogas production

Currently, some countries subsidize crops suh as corn or rapeseed grown in conditions of intensive agriculture (with the use of heavy machinery, pesticides, and synthetic fertilizers) used for the production of biogas, which cannot be considered a sustainable practice.

On the other hand, biogas produced from biomass from landscape management (grass, wood, etc.) or organic waste can be considered as a renewable source of energy without a significant environmental impact.

7. Financing

Agriculture in the European Union is heavily subsidized. Unfortunately, a lot of these subsidies support exactly the wrong tendencies. On the other hand, the discussion of the greening of European agriculture has been going on for many years now, and some principles have also found a way not only into strategies and policies, but funding schemes as well. It is not a smooth or easy process, and it is opposed by powerful lobbying organizations that mostly represent big agricultural companies, which in many countries also have a decisive influence on the relevant authorities.

The European Union supports the greening of agriculture in several ways, first through the direct payments to farmers now required to comply with several basic requirements, called "cross-compliance", and 30% of these subsidies are also conditioned by respecting what are called "greening" requirements. This is a very powerful tool, but unfortunately the greening requirements are still rather weak.

The other form is subsidizing practices which go beyond these basic requirements, but generate some costs or reduce income. There are usually several funds to subsidize investments such as the restoration of wetlands or watercourses or the installation of anti-erosion structures. Good agricultural practices are also supported by agro-environmental schemes, where farmers are paid for longer periods (five to ten years) to adapt their agricultural methods to the needs of environmental and nature protection. Examples of supported practices can be mowing later to protect nesting birds, using fewer pesticides or fertilizers, extensive grazing instead of intensive, etc. Recently, forestry-environmental schemes have also been developed in many countries.

Conclusions and recommendations

- Modern intensive agriculture has severe negative impacts on the environment, especially soil quality, water regime, and biodiversity.
- There is a self-reinforcing relation between these impacts and effects of climate change.
- There are many known methods and measures that can be used to counteract these negative impacts and which are also compatible with intensive agriculture.
- The pioneers of the necessary transformation of agriculture are usually small, family-type farms, while big agricultural companies often oppose them because they can reduce their short-term economic gain.
- Policy and especially financial instruments are key factors in the promotion of necessary transformation; as a support for best practice, demonstration, and pilot projects, but also as requirements for direct payments. At the same time, toxic subsidies have to be transformed or eliminated.

Selected resources:

- Sustainable agriculture in the EU: https://ec.europa.eu/info/food-farming-fisheries/sustainability_en
- Sustainable Agriculture, OECD: https://www.oecd.org/greengrowth/sustainable-agriculture/
- What is Sustainable Agriculture? https://www.ucsusa.org/resources/what-sustainable-agriculture
- Integrated Pest Management: https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/ipm_en
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- The Agroforestry Handbook: Agroforestry for the UK, Soil Association Limited, Bristol, 2019
- The Instrument for Pre-Accession Assistance (IPA): https://ec.europa.eu/regional_policy/en/funding/ipa/

About us

ARNIKA

is uniting people seeking a better environment. We believe that natural wealth is not only a gift, but also an obligation to save it for the future. Since its foundation, Arnika has become one of the most important environmental organizations in the Czech Republic. We base our activities on three pillars: engaging the public, professional arguments, and communication. Since the beginning, we have led public campaigns both in the Czech Republic and internationally. The organization focuses on nature conservation, toxics and waste, access to information, and public participation in decision-making.
More information: www.english.arnika.org

Eco-Tiras

is the umbrella and unites 50+ environmental NGOs of Moldova and Ukraine, which care on the Dniester River. Our view is that only the involvement of all stakeholders, including the public, in the transboundary management of the river basin could improve the situation with regard to the river. We work on the basis of a scientific approach, the knowledge and initiatives of our NGOs' members, and the best international practices. Our dominant interests are: Integrated River Basin Management, international waters (the UNECE Water Convention), public participation, including the implementation of the Aarhus Convention, and environmental education.
more information: www.eco-tiras.org