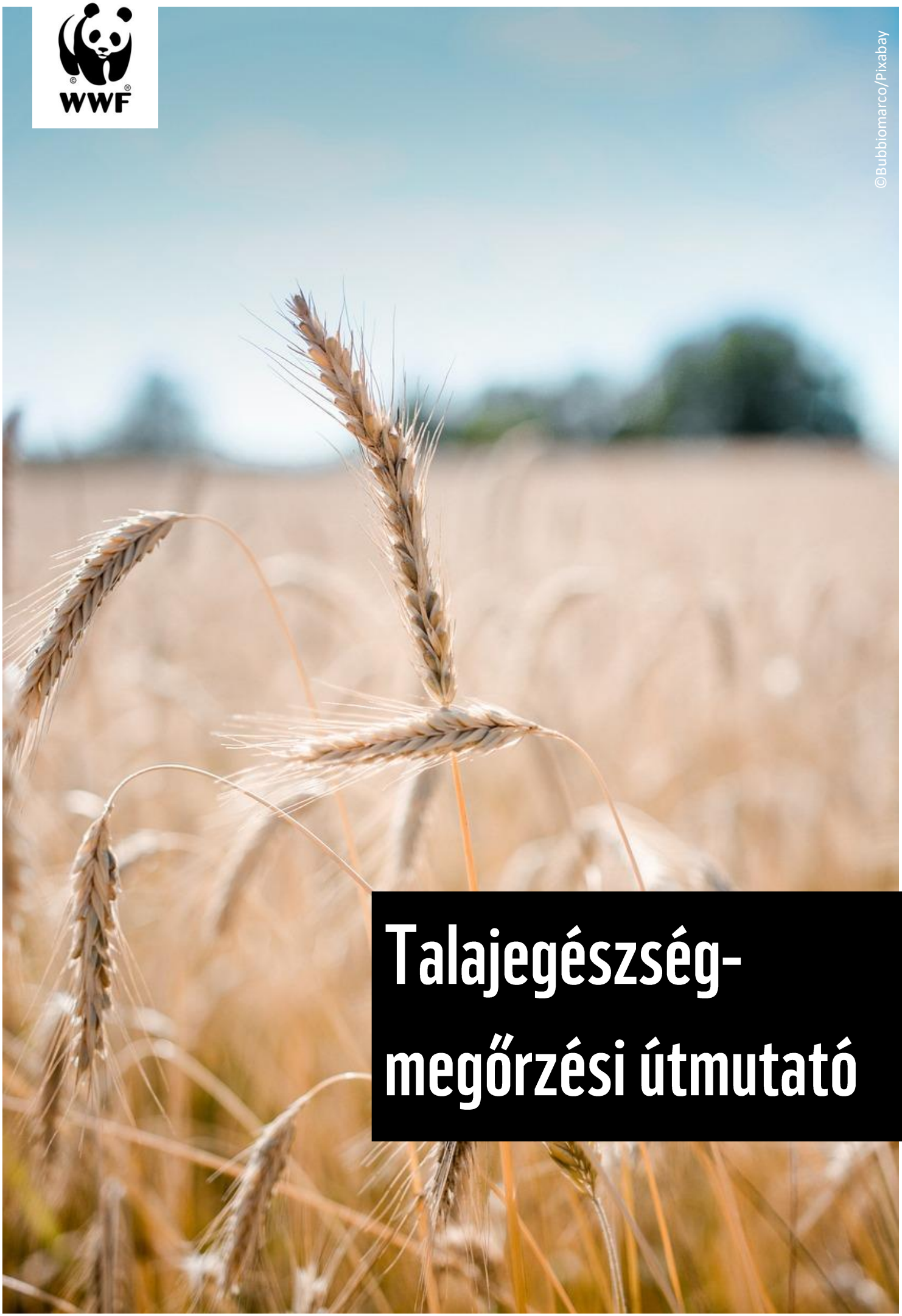

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Talajegészség-megőrzési útmutató

A talajegészség fontossága – Magyar nyelvű összefoglaló

A talaj a fenntartható élelmiszer-termelés alapja. Az egészséges talaj felső rétegében nagy tömegű élő szervezet – baktérium, gomba, rovar, féreg, stb. – található, ezen kívül sok szerves anyagot tartalmaz, és szerkezete lehetővé teszi, hogy a csapadék beleszivárogjon és tározódjon benne. Magyarország területének közel fele (46,29%) intenzíven művelt mezőgazdasági terület, amelyeken a talajok állapota kétségbeejtővé vált. A tartós, intenzív művelés – gyakori forgatás, gépi taposás, gombaölő, gyomirtó és rovarölő mérgek rendszeres használata, szervetlen nitrogén, foszfor és kálium-sókkal történő műtrágyázás – következtében élővilágának túlnyomó része elpusztult, szervesanyag, főként humusz tartalma szélsőséges szintre csökkent, és szerkezete a tömörödés („eketalp") és porosodás miatt leromlott, kémhatása savasabbá vált. Lejtős területeken felgyorsult a vízerózió, és a szél is könnyebben elhordja a poros felszíni réteget. Mindez a termőképességet számottevő mértékben csökkenti, és kitettebbé tesz bennünket a klímaváltozás hatásainak, mert a legyengült talajok nem képesek ellenállni és regenerálódni az egyre szélsőségesebb időjárási viszonyok között.

A talajképződés nagyon lassú folyamat, ennek ellenére egészsége javítható, helyreállítható megfelelő műveléssel. Ezért tartjuk fontosnak, hogy útmutatást adjunk azokról az elvekről és módszerekről, amelyekkel hatékonyan regenerálhatók a szokványos mezőgazdasági műveléssel tönkretett talajok. Ennek érdekében a talajt művelő gazdáknak a következő lépésekre van szükségük:

1. meg kell tanulniuk megítélni, hogy a talaj, amin gazdálkodnak jó állapotban van-e;
2. fel kell ismerniük és meg kell érteniük a talajaikat érintő pusztulási folyamatokat;
3. meg kell tudniuk ítélni, hogy az eddig folytatott tápanyag-gazdálkodás jót tesz-e a talajaiknak;
4. meg kell ismerniük a talaj egészségét és vízháztartását javító lehetőségeket.

1. Honnan tudhatom, hogy van a talajom?

Ennek megítéléséhez csak egy ásóra van szükségünk. Az egészséges talajra jellemző, hogy:

- felszínén növénymaradványok vannak;
- nincsenek víz mosta járatok, összegyűlt üledékfoltok, repedések, vízállások a felszínén;
- a talajban is szerves maradványok (növényi részek, gyökerek, giliszták és más élőlények, valamint ezek nyomai, járatok, stb.) találhatók;
- a talaj morzsás szerkezetű;
- a talaj porózus, levegőt is tartalmaz;
- a felső réteg legalább 25 cm mély;
- egy hegyes tárgy könnyen és mélyen beleszúrható;
- képes a víz megtartására.

2. Tapasztalhatók-e vízzel és széllel összefüggő talajpusztulási folyamatok, vagy tömörödés a területen?

A termőterület különösen kitett a csapadékvíz elfolyása által okozott talajveszteségnek (erózió), amit főként a csapadék intenzitása és a terület lejtése befolyásol, de fontos tényező a növényi borítás, a szervesanyag-tartalom és a művelés módja, amelyek révén hatékonyan csökkenthető. Minél tartósabb növényi borítással, a talaj szervesanyagtartalmát növelő és szerkezetét javító művelési módokkal, valamint a csapadékvíz összegyülekezését, elfolyását lassító, visszatartó kisebb beavatkozásokkal, növénysávok, árkok, kisebb táblaméretek, stb. létrehozásával sokat tehetünk.

A tartósan vízállásos termőterületek esetében a leghelyesebb, ha felhagyunk a művelésével és állandó, vagy időszakos vizesélőhelyet alakítunk ki, így a víz tájban való megtartásával kedvezően befolyásoljuk a mikroklímát, és támogatjuk a biodiverzitást.

A szél okozta talajpusztulás (defláció) akkor jelentkezhet, ha talajunk szerkezete leromlott, porosodó és a termőterület kitettsége a tábla nagysága miatt és a szelet megtörő növénysávok, fasorok hiányában nagy. Ennek megfelelően ez a megfelelő táblaméret kialakításával, a talajszerkezetet regeneráló műveléssel, minél teljesebb növényborítással és növényszegélyek, fasorok létrehozásával csökkenthető.

A nehéz gépek taposása, hasonló művelési mélysége, vagy akár az intenzív legeltetés tömörödést okozhat, ami nagymértékben rontja a csapadékvíz beszivárgását és tározódását a talajban, ennek következtében a talajélet is csökken. A taposás csökkentésén, elkerülésén túl a helyzet mélyen gyökerező, az „eketalpat" átfúró gyökérzetű növénykultúrákkal, szervestrágyázással javítható.

3. Megfelelő-e a tápanyaggazdálkodásunk?

A leggyakoribb hibák között van a vízkészleteinket szervetlen nitrogén és foszforvegyületekkel terhelő túlzott műtrágya használat, és ezzel párhuzamosan a szerves trágyázás hiánya, vagy elégtelensége. Emellett a talajban történő normális lebontási folyamatokhoz szükséges szén-nitrogén arány (25-30:1) sem mindig biztosított. A trágyázás, vagyis a tápanyagok pótlása során figyelembe kell venni a talaj tápanyagszintjét, a termesztett növény igényeit és állapotát, valamint a kijuttatást a hatékony hasznosulás érdekében megfelelő időjárási és talajviszonyok között kell elvégezni, és a további műveletek során el kell kerülni a tömörödést okozó gyakorlatokat. Hatékony módszer a levéltrágyázás, a vetéssel egy menetben történő mikroműtrágyázás, a zöldtrágya, illetve köztes kultúrák, valamint a talajmikroorganizmus-készítmények alkalmazása. Kálium pótlásnál, különösen savanyúbb talajokon, fontos a megfelelő magnéziumszint biztosítása a növények számára.

4. Hogyan válasszunk megfelelő talaj- és vízgazdálkodási beavatkozásokat?

Az észlelt talajpusztulási és vízháztartási viszonyok szerint kell gondolkodnunk, de figyelembe kell vennünk a területünkről lefolyó és ott beszivárgó vizet befogadó víztestek védelmi szempontjait, valamint a környezet- és természetvédelem, tájvédelem szempontjait. Leghelyesebb, ha egy adott kisvízgyűjtő területen gazdálkodók együttműködve tervezik meg termelési rendszereiket. Az ismert, pozitív hatású beavatkozási lehetőségeken, pl. növénysávok, fasorok létesítése, szintvonalas művelés, minimum vagy no-till, köztes kultúrák, antieróziós intézkedések, stb. túl, természeti erőforrásaink romló állapota és a globális környezeti kihívások elkerülhetetlenné teszik a gazdaságok átfogó „újratervezését" a termőhelyi viszonyokhoz igazodóan a talajok, a vízkészletek és a biológiai sokféleség helyreállítása és megőrzése érdekében. Ennek ki kell terjednie a táblaméretek kialakítására, puffersávok és élőhelyek létrehozására és a regeneratív termelési módok alkalmazására.

Végezetül fontos, hogy ismerjük meg és kísérjük figyelemmel a talajra és a vízkészletekre, valamint a biodiverzitásra vonatkozó, egyre nagyobb hangsúlyt kapó jogszabályi környezetet. Emellett a gazdasági szféra is rákényszerül, hogy termelési folyamatainak szénlábnyomát csökkentse, vagy ellensúlyozza, ami további lehetőséget teremt a gazdáknak, hiszen a talajban megfelelő műveléssel történő szénmegkötés a CO2 kibocsátók számára egyre inkább keresett kompenzációs lehetőséggé válik a közeljövőben.

The Soil Care Manual
Not only for farmers
January 2024

Introduction

High quality organic matter is essential

The health of soil depends first and foremost on the availability of good quality organic matter. That is the basis of good soil structure and evidence of the presence of rich soil communities. Earthworms, mycorrhizal fungi, soil bacteria, and other soil organisms co-create the conditions for proper crop growth. Optimal soil structure also promotes the retention of more water. That ensures sufficient moisture for crops and increased retention of rainwater. Good soil condition increases the resilience of the agricultural landscape to the expected impacts of climate change (drought, floods). Soil care is a key factor in the production and economic success of a farm.

Soil health can be restored

Soil is a slowly renewable resource; it is estimated that 1 cm of soil takes 100 years or more to build up in its natural environment. The good news is that its health can be significantly improved by modifying management practices. That's why we are presenting you the 'Soil Care Guide.' It constitutes a comprehensive overview of approaches that can be used and combined appropriately in the management of conventionally farmed land. We know that the solutions are often not simple. Although many general approaches can be brought up, it is always important to apply the knowledge of local conditions and to consider specific soil characteristics.

About the manual

The manual is divided into six chapters. In the first three chapters you can find answers to questions about whether the soil on your farm is in good condition (Chapter 1), where the vulnerable spots in terms of soil are on your farm (Chapter 2), and whether the fertilization management you use can be improved in any way to benefit soil structure and or the environment in general (Chapter 3). Chapter 4 gives an overview of what measures can be used to promote good soil health and its water retention. Chapter 5 spots the need for tight cooperation on soil quality support between farmers and landowners. Chapter 6 gives a brief overview of forthcoming legislation concerning soil improvement and the important role soil care plays in supplier-customer relationships. We are pleased to be able to provide you with a practical tool for your challenging and vital work for society and nature.

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World Wide Fund for nature (WWF) is an international NGO that protects nature and seeks to help people live more sustainably. Most people know us as the organisation behind the panda symbol standing for our objective to conserve wildlife. But WWF is also dedicated to protecting the nature that is part of our everyday life. We look for practical approaches and inspiration in natural processes so that we can use natural resources and the environment sustainably to the benefit of people and the planet. More at: https://wwf.hu/.

WWF is working with TESCO in Central Europe towards developing sustainable food production and consumption.

All for Soil is a non-profit organisation that specialises in advising on soil conservation and sustainable farming. It prides itself on both a scientific approach and innovative technologies that enable comprehensive services in the fields of soil quality analysis, soil conservation, and agricultural landscape management, as well as collaboration.

National Institute for Integrated Landscape (NUIK – Czech abbreviation) is a non-profit organisation focused on transferring research results into practice, advice and education in the field of landscape adaptation to climate change, restoring the hydrological regime of the landscape and soil conservation.

Charles University Environment Centre (COŽP UK – Czech abbreviation) is a research institution that has been engaged in professional dialogue and interdisciplinary research on environmental issues and sustainable development for 30 years.

Beleco is a professional non-governmental, non-profit organisation working on nature and landscape conservation. In addition to implementing measures to promote biodiversity, it is dedicated to planning, advocating and implementing measures aimed at adapting landscapes to climate change. WWF Czech Republic operates in the Czech Republic through co-operation with Beleco.

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Chapter 1: Do you know your soil?

Healthy soil is the basis for good and stable yields and quality of harvested crops. A good soil structure is closely linked to the presence of sufficient organic matter and the life of soil organisms attached to it. Such soil provides crops with nutrients in the right form and a more balanced water supply even in less favorable rainfall periods. It is also significantly more resistant to erosion and compaction.

What does healthy soil look like?

- There are plant residues on the surface of the soil;
- There are organic residues in the soil (plant remains including roots, earthworms, and other soil organisms and their traces, e.g. corridors, etc.)
- Soil crumbles into rounded soil aggregates;
- There are pores/aeration in the soil;
- Topsoil is at least 25 cm deep;
- Soil is capable of retaining water;

How do I know that the soil is not healthy?

- Absence of organic residues on the surface and in the soil;
- There are few visible signs of the presence of soil organisms;
- The soil is hard and does not break up – it breaks into spiky (blocky) aggregates;
- There is an excessive amount of gravel or coarse material on the soil surface;
- Compacted subsoil – see spade test;
- Reduced topsoil strength, subsoil protrudes to the surface;
- Waterlogged areas – soil does not infiltrate/absorb water well;
- Occurrence of crust on the surface (thin dried layer that eventually cracks)
- Occurrence of erosion rills;
- Sites with sediment deposits.

What kind of soil contains your field? Try a spade test to find out. All you need is optimum moisture levels, a spade, taking the soil in your hand and seeing for yourself.

What to look for during a spade test:

- Focus on how much effort it takes to penetrate soil with a spade. If it is not too difficult, you are fine. If it takes a lot of effort, the soil is showing signs of compaction.
- Take a lump of soil and squeeze it to break it up into smaller pieces. Based on the size and shape of the aggregates you can determine the condition of the soil structure.

    - 1. Well-structured soil – is crumbly, with no large clods, easily breaks into small rounded aggregates, and is often very porous. Water is easily absorbed into the soil.
    - 2. Moderately structured soil – typically contains up to 50% of coarse particles and larger clods. The clods/aggregates are more or less spiky with few pores. Water is only partially absorbed into the soil.
    - 3. Poorly structured soil – large clods and coarse, sharp-edged aggregates predominate in the soil; soil does not crumble when squeezed between the fingers, but rather breaks apart. The soil is non-porous, sometimes forming cavities. Water is absorbed into the soil only with great difficulty. Waterlogged areas form on the surface.

- Focus your attention on the roots of the crop if you are spade testing at the time of vegetation growth.
    1. *Roots grow freely and deep* – well-structured soil*;*

2. *Roots are unable to penetrate deep due to compaction in the subsoil, a rain trap is formed, and water cannot infiltrate into the lower soil layers and runs away at an accelerated rate. Cause:* poorly structured soil *and lack of organic matter. (picture)*

Chapter 2: Where are vulnerable spots on my farmland and what to do about them?

Farmland is particularly vulnerable to erosive soil degradation. Through mapping and subsequent field verification, it is possible to identify where runoff flows across the field and where it is therefore vulnerable to water erosion. Soil and water conservation measures can be planned to prevent runoff and soil loss.

Is my land at risk of water erosion?

The slope and the length of the land along the gradient are the main factors influencing the occurrence of water erosion (both sheet and rill erosion), which are major factors in surface runoff. Other important factors are vegetation cover, the presence of organic matter in the topsoil and the overall management of soil as well as soil properties and its susceptibility to erosion and the frequency and intensity of rainfall. All these need to be considered in order to minimise the risks.

What measures will immediately minimise the risks associated with surface runoff?

- Grassing the waterway where surface runoff is concentrated
- Contour plowing (vulnerability to soil erosion can be reduced by up to half)
- Conservation agriculture
- Slowing down surface runoff through buffer strips
- Contour strip cropping
- Limiting the period when the soil is without vegetation cover

What technical measures reduce the risks associated with surface runoff over longer time scales?

- Preventing excessive runoff inflow from surrounding land
- Breaking up the length of the field and diverting surface runoff by technical measures (diversion channels, ditches and waterways)
- Retention of surface runoff and sediment (infiltration ditches, contour bunds, swales, landforms)
- Farm redesign (optimisation of field sizes and shapes with regard to erosion risks and agricultural machinery transfers)

Is my land at risk of wind erosion?

- Wind erosion is mainly determined by the condition of the soil structure, roughness of the soil surface, soil moisture, intensity and direction of the wind, and the absence of windbreaks, alleys and copses.

How to prevent wind erosion on my land?

- Arrange the shape and size of the plots / fields (as part of land consolidation and farm redesign) so that they are not situated on the long side following the prevailing wind direction;
- Introduce conservation tillage as much as possible, in particular leaving the land as little as possible without vegetation cover;
- Introduce contour strip cropping;
- Plant windbreaks;
- Use portable measures (mobile measures);
- Improve soil moisture regime → improve soil structure by supplying organic matter.

Is my land waterlogged and what can I do about it?

On your land, monitor areas that are permanently or regularly waterlogged. In permanent crops, these places can be distinguished by specific vegetation. There can be many causes of waterlogging. For example, it can be a result of compacted subsoil, a malfunctioning drainage system (hydromelioration), or a natural manifestation of the environment (former vernal pool, floodplain, etc.). In any case, however, it is an unsuitable environment for growing crops and the question of what to do with waterlogged sites is therefore relevant. In places where waterlogging is caused by inappropriate farming practices, attempts can be made to eliminate the causes (see How can soil compaction be prevented). When it occurs in areas of natural waterlogging, it is a good idea to consider realization of a permanent or temporary wetland.

Are there hydromelioration systems on my land?

- Hydromelioration systems can be seen under suitable conditions on available orthophoto images.
- If waterlogging of the land is caused by non-functioning drainage pipes, it is advisable to consider a) restoring the system or b) creating an area with a non-productive function (e.g. wetland). In both cases it is highly recommended to consult experts.

Why are wetlands needed in the landscape?

- They retain water in the landscape – they absorb rainwater and release it gradually.
- They help to buffer the effects of heavy rainfalls.
- They have a significant impact on the microclimate.
- They support the small water cycle in the landscape.
- They help to locally mitigate temperature extremes by cooling the surrounding area due to evaporation.
- They significantly support the biodiversity of the area.

Soil compaction on a farm and what to do about it

Soil compaction is a significant problem in Central Europe. It is caused particularly by the use of heavy agricultural machinery under inappropriate moisture conditions, inappropriate soil cultivation (e.g. repeated tillage to the same depth), crop rotation based on monocultures with little or no perennial forage crops, application of high doses of mineral fertilisers and insufficient fertilisation with calcium and organic fertilisers. Compaction also occurs in permanent grasslands as a result of, among other things, intensive grazing by cattle. Climate change also contributes to soil compaction. In the warmer winters of recent years, the soils do not freeze through, and the soil structure does not spontaneously break down (as it used to).

What are the consequences of soil compaction?

Compaction reduces the ability of soil to absorb water. It accelerates surface runoff and increases the risk of erosion.

- The ability of the soil to hold water is reduced and the soil has a lower water retention capacity.
- Periods of drought alternate with periods of waterlogging – water runs off in the surface layer of the soil and does not soak into the deeper layers.
- The capillarity of the soil is impaired which is why water from deeper layers cannot rise to the surface.

- Conditions for plant growth and development deteriorate.
- Biological activity of the soil decreases.

How can soil compaction be prevented?

- Minimise the transfers of agricultural machinery and, in particular, **do not drive on the field when it is wet**.
- Use varied cropping practices, including deep-rooting crops (oilseed radish, fiddleneck /phacelia tanacetifolia, vetch, clover, alfalfa, clover-grass mixtures, etc.)
- Incorporate intercrops in rotations to prevent soil compaction.
- Incorporate regular use of organic fertilisers.
- Reduce the use and transfer of agricultural machinery in vulnerable areas.

What to do when the soil profile is compacted?

- Significantly modify crop rotation in favour of deep-rooting crops and intercrops (fiddleneck, field pea, mustard, comfrey, etc.).
- Improve soil structure by adding organic matter (see Chapter 1).
- In case compaction is severe, deep tillage should be applied according to the depth of the compaction layer, sometimes to considerable depths, e.g. 70 cm. Implementation is difficult and correct timing is key.

Chapter 3: Are you using mineral and organic fertilisers correctly?

In farming conditions of Central Europe, the soil often does not receive sufficient organic fertilisers. These are essential for the availability of certain nutrients (especially organic phosphorus). If mineral fertilisers, especially N and P, are applied in excess or at inappropriate times when they cannot be absorbed by crops, they pose significant environmental risks, in particular by causing pollution of water sources. Mineral fertilisers cannot replace soil organic matter, which is closely linked to soil quality, the optimal state of soil structure and the soil's ability to retain water. In addition, changes in rainfall and temperature patterns in recent years have a significant impact on soil moisture availability, which directly affects crop yields. Adapting to these climatic trends often requires a revision of traditional farming practices, including adjustments to fertiliser application patterns.

Frequent mistakes in fertilisation and tillage practices

- **Excessive nitrogen fertilisation**
  - Especially in drier years, unused nitrogen (the so-called residual nitrogen) remains in the soil. Its presence must be factored in when fertilising.
  - In urban agglomerations, nitrogen emissions from road traffic should also be taken into account.
  - Nitrogen in the form of nitrate is easily leached from the soil and has a negative impact on the environment (water quality in particular).
- **Farmers adhere too strictly to agronomic standards**
  - Agronomic standards are based on the plants' uptake of individual nutrients, but do not count in all nutrient inputs released by natural or human-influenced soil processes.
- **The C:N ratio of the soil is not ideal**
  - Presence of organic matter sources is vital for soil health. However, decomposition of organic matter requires an appropriate carbon-to-nitrogen (C:N) ratio. The ideal C:N ratio for this purpose is about 25-30:1, which is the ratio found in compost. In soils, a

ratio in the range of 15-18:1 is common, and therefore it is often necessary to add N in order to promote decomposition of post-harvest residues. An inappropriate C:N ratio results in charring of the post-harvest residues, which subsequently ties up nutrients and makes them unavailable to crops.

- **When fertilising, the existing conditions are often disregarded**
    - Fertilisation practices need to be adapted to local soil conditions as well as moisture and temperature conditions. It is also necessary to factor in the growth stage of the crops and whether it is able to directly use the nutrients supplied at the time of application.
- **Incorrect tillage practices**
    - Incorrect tillage practices include in particular transfers of agricultural machinery under unsuitable moisture conditions – see Soil compaction.
    - Long-term use of conservation tillage to maintain natural soil processes (no-tillage, mulching cover crop or strip till) can cause compaction of the topsoil profile and limit the availability of low-mobility nutrients such as phosphorus.
    - To minimize the formation of compacted horizons, it is advisable to plough the soil in autumn (at least once every 4 years) or to work the soil vertically – this will result in a deeper incorporation of organic matter and a higher infiltration of spring moisture (or melting snow) into the soil profile.
    - Conversely, deep tillage in the summer months reduces soil fertility due to rapid mineralisation and associated loss of organic matter.
- **Application of liquid fertilisers with low nutrient content** (typically fugate, urea, etc.) without simultaneous incorporation is risky because of:
    - ammonia emissions to air (in summer months amounting up to 90%);
    - soil compaction caused by frequent transfers of agricultural machinery;
    - overfertilisation of fields in close proximity to biogas plants as it is uneconomical to transport fertiliser with high water content over longer distances.

How not to waste fertilisers

- Use available information (e.g. yield potentials, sampling, soil surveys) and above all your own knowledge and experience.
- Take into account the residual content of nutrients in the soil – for the sake of proper plant development it is important not to over-fertilise the soil or the plants.
- Do not fertilise winter crops with nitrogen until the outside temperature rises above 5 degrees Celsius (only then the plants are able to absorb it and use it) or use N inhibitors (although these interfere with the enzymatic conditions in the soil).
- Use intercropping to make use of residual N or reduce the recommended dosage of N significantly.
- Use modern technologies to manage inputs in order to make the right intervention in the right place, at the right time and in the right way (precision farming methods).

How to reduce the use of mineral fertilisers?

- Use organic fertilisers as much as possible, including green manure.
- Apply fertilisers in a way that allows the crops to make the best use of them.
- Consider introducing practices of regenerative agriculture, which uses plants (especially pre-crops and intercrops) and soil organisms to actively mobilise nutrients in the soil, rather than over-fertilising with mineral fertilisers.

What about nitrogen and potassium availability?

- Much more effective than the surface application of NPK is the application of liquid foliar fertilizers with added potassium, magnesium, and other micro-elements or the application of digestates/manure directly to the soil.
- NPK fertilisers should be applied directly to the soil upon sowing when the plant can use most of the nutrients.
- Autumn application of NPK is risky due to possible nutrient leaching.
- When fertilising with potassium, it is necessary to be mindful of the availability of magnesium in the soil, as potassium limits the absorption of magnesium by the plant. Magnesium availability decreases at a pH below 6.

Phosphorus balance/management

- Phosphorus availability is the limiting factor for most soils with alkaline but also acidic pH. Most of the phosphorus applied in industrial fertilisers is fixated in the soil in forms that are not available to plants.
- Therefore, it is essential to apply phosphorus in organic form (in autumn as manure, compost, separate, dried and treated sewage sludge, in spring as slurry and digestate).
- Spring application of slurry and digestate in dry climates significantly increases the presence of residual N.
- Unwanted accumulation of phosphorus in the soil can lead to leaching or surface washing and subsequent pollution of surface and groundwater with significant environmental impacts.
- Phosphorus is both critical and strategic raw material, 95% of it is used in agriculture in the EU. The need to improve the phosphorus balance has not yet been reflected in the agricultural subsidy policy. At the moment, an eco-payment for sustainable nutrient management (P and N) is foreseen. Knowledge of nutrient balance should become common practice in modern farming.

Chapter 4: How to select appropriate soil and water conservation measures

Soil and water conservation measures need to be selected with regard to the erosion hazard and runoff conditions of the area. The necessary protection of water sources, streams, and reservoirs, urban and rural areas, etc., must also be included in the considerations. Planning must be approached with respect for the needs of landowners and land users, but also concerning the interests of nature conservation, the environment, and the landscape, including knowledge of the problems and needs of the catchment area concerned. In most cases, it is appropriate to plan a whole complex of organisational, agrotechnical, and technical measures that complement each other and at the same time respect the requirements of agricultural production.

Simple measures that I can take myself (organisational, agrotechnical and biotechnical ones)

- Grassed waterways
- Erosion control grass strips / buffer strips within the field
- Contour tillage
- Establishment of grass buffer strips around watercourses
- Contour strip cropping rotation
- Conservation tillage (no-tillage, mulching cover crop, stip till)
- Intercropping
- Staggering of crops with low protective function to alternate with crops with medium and high protective function and with different lengths of growing season within an erosion control unit;
- Implementation of swales (e infiltration ditches);
- Planting group greenery in the landscape to slow surface runoff, e.g. windbreaks;

- Creation of. wetlands in areas of permanent or recurrent waterlogging;
- Optimisation of field's shape and size (taking into account erosion risk and surface runoff)

Technical measures requiring professional assistance (project)

- Erosion bunds
- Erosion swales and ditches
- Erosion control diversion ditches
- Revitalisation of waterlogged areas and setting up wetlands
- Revitalisation of small watercourses and hydromelioration on field
- Windbreaks, tree copses
- Roads with accompanying greenery
- Farm redesign

How to approach planning for erosion control on your farmland

- **Think in a wider context –** both erosion control and soil management are associated with the fulfilment of a number of cross compliance standards.
- **Plan for functional placement of buffer strips** (no grains) that slow surface runoff and meet the cross compliance standards.
- **Design landscape features to interrupt/slow surface runoff** (grassed waterways, ditches, swales with a limit, bunds, copses of trees, terraces).
- **Separate contiguous crop areas with regard to erosion control:**
    - Buffer strips or landscape features interrupting surface runoff
- **Make maximum use of the potential of non-productive areas within the cross compliance standards (GAEC) for soil conservation and water retention.**
    - Buffer strips (e.g. erosion control, water conservation, etc.)
    - Intercropping
    - Nitrogen-fixing crops
- **Establish agroforestry systems or alley cropping to slow surface runoff.**
- **Consider farm redesign** → modifying the distribution and use of land blocks to best support erosion control and meet GAEC standards.

<u>Methods for planning appropriate measures</u>

Farm redesign – changing the shape and size of the fields in terms of soil and water conservation

- The approach consists of optimising the size and shape of fields to accommodate the movement of agricultural machinery and erosion control. The optimum shape of fields in terms of their management is a rectangle with an aspect ratio of 1:2 to 1:4.
    - Optimising the use of fuel and transfers of agricultural machinery and equipment.
    - Tackling erosion risks, interrupting surface runoff, and retaining water – an optimal layout **allows for growing productive crops without restrictions, including those with low protective function**.
    - The option of incorporating technical erosion control measures to solve the erosion problem while, in the long term, promoting biodiversity.

Regenerative agriculture and soil conservation

Regenerative agriculture is an approach that seeks to minimise the negative impact of agricultural activities on the soil.

- It uses various principles and practices to improve soil health and conservation of aboveground and belowground biodiversity.
- It seeks appropriate agronomic practices to support natural carbon storage in the soil.

- It seeks to promote ecosystem services, i.e. the benefits that natural systems provide to people, such as water purification, crop pollination, etc.

Chapter 5: What should cooperation on soil conservation between farmers and landowners look like?

The common goal of landowners and land users (farmers) should be to achieve healthy soils that secure long-term fertility and are able to withstand weather extremes (drought and heavy rainfall). To design and implement the proper soil and water conservation measures, we need to find common ground and be sensitive to each other's issues and concerns. The landowners should allow the farmers to redesign fields and create landscape features with erosion-control and water-retention functions on their land.

What can I do for the implementation of landscape features?

Farmer

- Approach the landowner explaining the reasons for planned measures and the benefits they will bring.
- Come up with a suitable location for the landscape feature on the land so that it fulfils as many functions as possible at the same time (erosion protection, water retention in the landscape, biodiversity support, etc.).
- Get assistance from experts.

Landowner

- Grant your consent for the implementation of landscape features (to be included in the Lease Agreement).
- Grant your consent for the redesign of land blocks.

Don't be afraid of landscape features. They can be used to improve the quality of soil, benefiting thus both landowners and farmers.

Chapter 6: Soil conservation in legislation and supplier-customer relations

Cross-compliance standards are already targeted at improving the condition of farmland. However, further rules are being developed to encourage farmers to work more sustainably with soil. Soil conservation is an ever more frequent subject not only of legislative requirements but also of the supplier-customer relations.

Upcoming EU legislation

- Soil conservation is covered primarily by the forthcoming EU **Directive on Soil Monitoring and Resilience**, which seeks to establish general principles for sustainable soil management.
- The EU Member States have also agreed on a new **Regulation on Nature Restoration**, which is intended, among other things, to promote approaches increasing organic matter in soil.

Trading partners

The attitudes and requirements of trading partners – agricultural commodity traders, food producers or retail chains - are important in agribusiness. Many large and medium-sized companies are beginning to focus on the sustainability of their supply chains. There are two main reasons for this. They are beginning to realise that:

1) productivity, which is a prerequisite for their own prosperity, depends on good soil conservation and water retention in the landscape;
2) the standards introduced by new legislation – especially the so-called CSRD (Corporate Sustainability Reporting Directive) – require companies to measure the impact of their production and their suppliers on the landscape.

Food companies, as well as other economic sectors, are already increasingly engaged in assessing the carbon balance of their production processes. Soil conservation is also gradually becoming a parameter to be considered in this area, as the deposition of organic matter in the soil can be used to offset harmful emissions (the so-called carbon offsets). Also, some banks are already setting up lending programmes offering financial advantages to companies that take environmental concerns into account.