FOOD & BIODIVERSITY

Very Good Agricultural Practices

Guideline on Soil and Fertilization

Content

1 Introduction

The LIFE Food & Biodiversity project supports food standards and food companies to develop efficient biodiversity measures and to implement them in their pool of criteria or sourcing guidelines.

In this guideline, we provide information on the current situation of soil and fertilization in temperate climatic regions, as well as background for the measure of very good agricultural practice described in the "Recommendations to improve biodiversity protection in policy and criteria of food standards and sourcing requirements of food companies and retailers".

2 Soil and Fertilization

Soil is a fundamental and irreplaceable natural resource. It performs a number of functions essential for human life, e.g. producing food and fibre; interlinking earth, air and water; storing, filtering and transforming water, nitrogen and carbon. Soil is the most important carbon store in the world and it takes hundreds of year for a thin layer of soil to develop. It is classified as a "non-renewable resource". A resource, which is at risk.

Unsustainable practices in agriculture and forestry, contamination, urban sprawl and climate change threaten European soils at big scale, pushing forward soil degradation at an increasing rate in many parts of Europe.

A main threat to European soils is erosion. While it is a natural process, it is made worse by inappropriate cultivation techniques and cropping practices. Today, 12 % of Europe´s total land area (115 million ha) are affected by water erosion, while 42 million ha suffer from wind erosion. Erosion is supported by soil compaction, which mostly occurs due to excessive stocking rates and the inappropriate use of heavy machinery. Compaction reduces water retention capacity as well as the oxygen supply to plants and around 36 % of European soils are considered to be vulnerable to it. To feed the European population fruitful soils are essential. Thereby, soil fertility is strongly dependent on soil organic matter (SOM). Today, around 45% of soils in Europe have low or very low organic matter content (0-2% organic carbon) while 45% have a medium content (2-6% organic carbon). Especially in Southern Europe and parts of France, the United Kingdom, Germany, The Netherlands and Sweden a decline of SOM is an issue. Adding up on this, many parts of EU-28 face strong processes of salinization. While salt is a usual component of soils. Salinization occurs mostly due to human impacts reducing soil fertility and making soils unable to sustain plant growth. Mainly unsustainable irrigation practices and the use of mineral fertilizers drive this process. In Europe around 3.8 million ha are affected by salinization. The most affected areas are Campania in Italy, the Ebro Valley in Spain and the Great Alföld in Hungary. Just as bad as soil degradation is soil sealing through urban and industrial sprawl. Infrastructure has sealed around 9 % of the total area of the EU Member States and still the demand for new housing ground rises. These soils are irreversibly lost for agriculture. An irreversible loss of fertile soils is also caused by contamination. In Europe a history of two hundred years of industrialization, using dangerous substances in many production processes and poor or inadequate management practices has led to the situation that approximately 3.5 million sites in Europe are contaminated and are no longer available for the production of food.

All of these negative influences on soils also affect soil biodiversity and several of them are made worse by effects of climate change. In future, extreme weather events will push forward desertification while locally increased rainfalls will accelerate erosion. But also salinization is on the advance as the south will become more arid.

The European Commission addresses the threats to soil on several fronts trying to sustain the precious resource beneath out feet. However, there is no overarching, strategic framework on EU level, yet. This gap had been intended to be filled by the Soil Framework Directive proposal, which was withdrawn by the commission in 2014. In the absence of a common policy framework, soils are casually addressed in many policy instruments. The main instruments and directives linked to soil protection are:

- Water Framework Directive
- Soil Thematic Strategy
- Nitrates Directive
- Habitats and Birds Directive
- Environmental Impact Assessment Directive
- Common Agricultural Policy - Cross Compliance

- Common Agricultural Policy – Rural Development Programme
- Industrial Emissions Directive
- Sewage Sludge Directive
- Waste Framework Directive

Out of this list, the CAP is a rather unique structured instrument differing from many EU policies in scope and implementation. Member States enjoy a high level of freedom to design and target very specific support for soil protection in the second pillar, if they wish to do so. The first pillar embeds much less flexibility for Member States in implementation and includes strict cross compliance regulations. Cross Compliance uses standards of Good Agricultural and Environmental Conditions (GAEC) to target soil issues.

In practice, the implementation of the GAEC standards and thus the benefits gained for soils depend on how rigorously Member States define the farm-level requirements and the actual implementation of those requirements by farmers. This flexibility is important to accommodate the diversity of agricultural systems and the different environmental situations across the Union but it hinders concrete guidelines, which would be needed to sustain soils. Besides too flexible rules for crop rotations, the absence of a ban on the use of plant protection products and fertilizers on certain ecological structures (EFA types) limits the possible benefits for soil protection. Crop diversification requirements are obligatory for farmers but still the implementation differs strongly. Current rules aim to prevent the application of monoculture on a large part of EU arable land but a crop rotation is not prescribed. Yet they would have more potential for soil protection compared to the diversification of cultures on farm level.

Here Rural Development Programs (RDP) and specifically agri-environment-climate measures take a leading role. They are one of the most important policy instruments for achieving soil objectives on agriculture and forest land throughout the EU. They enable Member States to plan 7-year programs including measures aimed at soil protection, and to design sub-measures that address their specific soil threats and needs. These could include, for example, supporting specific soil management practices at farm or field level using targeted multi-annual environmental land management contracts for both agriculture and forestry.

3 Very Good Agricultural Practices for More Biodiversity

As described above, soil protection is punctually targeted by a diverse set of regulations and directives. Out of which many leave room for improvement while at the same time Member States have a high flexibility in choosing how to adapt the EU regulations, nationally. As a result, national regulations often fail to protect natural resources, as is shown in the case of Germany, where the EU is suing Berlin for its failure to clean up nitrate in the country´s groundwater. This showcases that the national good agricultural practices are not widely implemented yet and that there is a need for even more ambitious agricultural practices.

3.1 Nitrogen balances and limits

The protection of water and soils from nitrogen and other pollutants, nowadays, is a priority of the European Commission. Starting in 1975 and having the latest update in 2000, European water legislation (Water Framework Directive) evolved to a cornerstone of EU-legislation. It entails the Nitrates Directive, which aims at reducing water pollution caused by nitrates from agricultural sources and preventing of further such pollution. To reach these goals the directives promotes the implementation of good agricultural practices in the member states, which shall focus on:

- periods when the land application of fertilizer is inappropriate;
- the land application of fertilizer to steeply sloping ground;
- the land application of fertilizer to water-saturated, flooded, frozen or snow-covered ground;
- the conditions for land application of fertilizer near water courses;
- the capacity and construction of storage vessels for livestock manures, including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage;

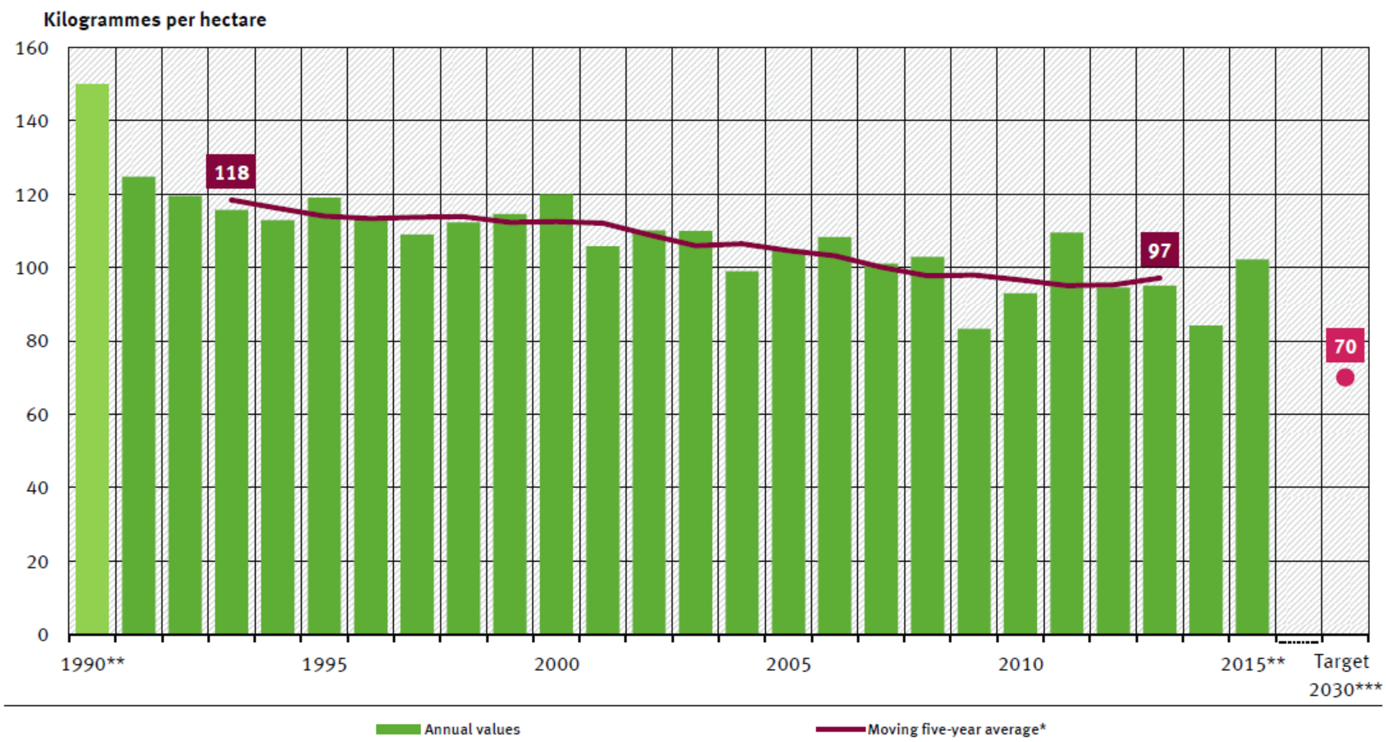
- procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that will maintain nutrient losses to water at an acceptable level.

Although, these guiding principles are established, all European countries exhibit a nitrogen surplus. Overall, however, these surpluses have declined since the mid-1980s, reducing the environmental pressures on soil, water and air. The adoption of nutrient management plans and environmental farm plans has had a key role in this reduction.

In Germany, nitrogen surpluses are decreasing over the last decades but are still far from the self-set sustainable development goal, showing that the optimal fertilization rates are not met, yet. Thus, a more ambitious demand for a decreased application of fertilizers, reduced in volumes and closer to the need of the plant will contribute to reduce this surplus.

Modern technology (machinery), nitrogen balances and nutrient demand determinations are but a few tool that farmers have at hand to adjust fertilization closer to plant needs.

Nitrogen surplus of the national farm-gate balance*



* Annual surplus referred to the middle year of the five-year-period
** 1990: data partially uncertain and of only limited comparability with the following years, 2015: preliminary data
*** Target of the German Sustainable Development Strategy, referred to the average of the five-year-period 2028 - 2032

Source: Federal Ministry of Food and Agriculture (BMEL) 2017, Statistischer Monatsbericht Kap. A Nährstoffbilanzen und Düngemittel, Nährstoffbilanz insgesamt von 1990 bis 2015 (MBT-0111260-0000) (in German only)

Today, common agricultural practices include the use of nitrogen balances as a planning tool for nutrient management prior to the use of fertilizer. Nitrogen balances compare nitrogen inputs (fertilizing, nitrogen fixation and nitrogen deposition among other things) and nitrogen outputs (denitrification and the emission of ammonia among other things) and thus reflect a major part of the nitrogen cycle and the impact of farm management on the hydrosphere and atmosphere.

Status-quo: What is the actual situation in European agriculture?

Among the methods to calculate the nitrogen balance, two types are in general use:

With the so called "Gross balance" a potential surplus of nitrogen on agricultural land is calculated. Therefore, all inputs of nitrogen to an agricultural system and outputs from nitrogen removed from the system are compared per hectare of agricultural land. The application of organic and mineral fertilizer, the atmospheric deposition of N and the biological nitrogen fixation are taken into account as inputs to the system. Harvested corps are seen as outputs. The data used for the calculations of the gross nutrient balance are partly based on expert's estimates of different physical relations. In reality, some of these data vary greatly from region to region. Also among Member States the N-coefficients used for the calculations differ. This creates a set of uncertainties that are carried through the total N-balance.

The Farm-gate nutrient balance treats the farm (or national agricultural industry) as an entity. Nitrogen recycled within the entity is ignored. This type of balance takes into account the amount of nitrogen imported into the farm or national agricultural industry (i.e. in fertilizers, feedstuffs, etc.) and exported from the farm or the national agricultural industry, i.e. in animal products (e.g. milk, eggs, meat) and crops, excluding fodder crops and grass which are consumed on the farm. The difference between imports and exports is the nitrogen surplus or deficit. In general, the farm-gate nutrient balance leaves less space for uncertainties as all inputs to the farm and all outputs are documented data, falling back on receipts and verifiable quantities of outputs and inputs. Thus, a farm gate nutrient balance should be preferred and carried out annually. Due to its high data quality (evidence of acquisitions and sales), farm gate nutrient balances provide reliable information and can be used to draw up farm comparisons and regional and national balances.

At all times, application of nutrients should be oriented at the nutrient demand of the crop. To verify this, a nutrient demand determination is a helpful tool. Aiming at reducing the amount of nutrient leaching the amount of needed fertilizer at plot-scale need to be calculated, setting the estimated yields in relation. The fertilizer requirement of a crop, focusing on nitrogen (N) and phosphorous (P) must be determined in writing according to a specified scheme. The nitrogen fertilizer requirement is the quantity of nutrients, which covers the requirement of the crop after deduction of other available quantities of nutrients and taking into account the nutrient supply of the soil. The calculated nitrogen fertilizer requirement is the site-related upper limit that applies to the crop throughout the vegetation. The requirement may be divided up into partial applications. A nutrient demand determination should be applied prior to the application of essential nutrient amounts (50 kg/N/ha or 30 Kg/P/ha). The determination of fertilizer requirements must be carried out in writing for each crop and for each management unit /field.

Table 1 Example of a nutrient demand determination

Farm information		**Nutrient demand determination**						
Crop	Field	Yield Average of 3 years	N-demand of the coming crop	Deduction N-min	Deduction Humus	Deduction organic fertilizer previous	Deduction cove crop	**Final N-Demand of the crop**
		dt/ha	Kg N/ha	Kg N/ha	Kg N/ha	Kg N/ha	Kg N/ha	**Kg N/ha**
Barley	Hohn	80	180	-29	0	-6	0	**145**

To further decrease the nitrogen surplus and the contamination of water and soils, food standards and companies are a key player to promote measure that go beyond legal requirements. The setting of more precise nutrient limits, adapted to regional conditions bear a chance to contribute.

To maintain and improve soil fertility, we recommend standards and companies to go beyond current legal requirements:

- **!** All fertilizer applications and nutrient values of the fertilizers (at least N and P) are documented in detail. (legal requirement)
- A 'farm-gate' nutrient balance is carried out annually.
- Soil testing for nutrient content is conducted with a reliable method and documented at least every three years.
- Post-harvest nutrient balances are performed with documented figures and by an approved and specified method. See OECD/EUROSTAT Gross Nitrogen Balance: https://circabc.europa.eu/webdav/CircaBC/ESTAT/agrienv/Library/nutrientsbalances/handbooks/NHB%2024%20Nov%2003_OECD.pdf
- **!** On agricultural land an annual humus balance is performed and backed up with a humus inspection every six years. The humus balance must never be negative and must follow a conventional approach.
- **!** Prior to the application of essential amounts of nutrients (N=50kg/ha, P=30kg/ha), the exact nutrient requirement of a crop must be assessed by a nutrient demand determination. (legal requirement)

- Each standard defines crop specific nutrient limits adjusted in accordance with the plant's requirement and – where necessary and applicable - site-related and with tolerance thresholds. Any thresholds must be based on scientific work and must be appropriate for the respective region.

The measures marked with a red exclamation mark (**!)** should be considered as a priority. Whenever possible those measure should be taken as mandatory.

3.2 Crop rotations to support biodiversity

Crop rotation is based on growing different crops in the same place in sequential seasons. Thereby, the rotation of one crop may vary from one growing season to a few years. Farmers choose the alternating crops based on their individual requirements, possibilities and the regional characteristics they are facing. Cultivating only one crop on the same plot consecutively leads to a depletion of some nutrients and thus to yield losses of the crop. On the other side, following a crop rotation prevents a loss of soil fertility, pest infestation and erosion. As many pests specialize in a certain crop, rotating them provides an unfavorable condition for them to strive, as their host organism are taken away and the annual life cycle of insects, diseases and weeds are disrupted. Different crops penetrate the soil at different extend, a diversified root system steadies the ground and reduces water and wind erosion. For crops having either tap or fibrous roots, the diversity in the root structure will enhance the chemical, physical and biological structure of the soil. Thereby creating macrospores, which in turn enables new root growth and benefit soil structure and the water-holding capacity of the soil.

Deciding on nitrogen management it is important to understand the relationship between crop rotation and plant nutrition. Crop rotation impacts nitrogen mineralization by modifying soil temperature, moisture, content of plant residues, pH and tillage practices. While more and more nitrogen is applied to foster high yields, crop rotations help to reduce nitrogen leaching in the surrounding environment by improving the availability of soil nitrogen and thus reducing the needed fertilizer application.

3.2.1 Status-quo: What is the actual situation?

The CAP, with its area based payments, has consistent effects on crop rotation, favoring high-input crops which are more harmful to the environment. Mandatory Cross-Compliance was one of the major changes to the CAP, linking full payments to the respect of requirements regarding environment, animal welfare, animal, plant and public health, as well as standards of Good Agricultural and Environmental Conditions (GAEC)

GAEC for crop rotation are to be defined by Member States according to local conditions. Focusing on soil organic matter levels. Various approaches are being taken by Member States (MS) in respecting soil organic matter and thus for the crop rotation standard.

France and Luxemburg promote crop diversification by growing "at least 3 crops on arable lands" in the same year. Finland and Austria defined standards limiting monocultures. In Germany, soil analysis on soil organic matter have to be done and humus balances are calculated. Incorporating organic matter in the soil, supplements crop rotations and provide a better soil structure, reducing erosion and enhancing water retention. In Sweden, cover crops are promoted.

The Greening, introduced by the European Commission in 2013, aims at making soil & ecosystems more resilient by growing a greater variety of crops, conserving soil carbon & grassland habitats associated with permanent grassland and protecting water & habitats by establishing ecological focus areas. Besides other, this means that the farmers with more than 10 ha of arable land have to follow a crop diversification, demanding:

- Up to 30 ha: farmers have to grow at least 2 crops and the main crop cannot cover more than 75% of the land
- Over 30 ha: farmers have to grow at least 3 crops, the main crop covering at most 75% of the land and the 2 main crops at most 95 %

The rules for the crop diversification measure are straightforward, with no flexibilities given to the Member States in terms of choosing how to implement it. They do not prescribe a crop rotation on plot level, but rather focuses on a farm scale.

More specific measures to foster a crop rotation are given by Agri-Environmental Measures (AEM). AEM focus on reducing environmental risk and negative pressure of farming practices, promoting sustainable farming activities. These measures are adapted to local situations and bind farmers for a time of five years. The environmental issues mainly concern biodiversity, landscape and natural resources.

To maintain and improve crop rotation effectively, we recommend standards and companies to go beyond current legal requirements:

- ! On the total utilized agricultural area (UAA) of the farm, a minimum of three different crops will be grown. The main crop is grown at a maximum of 75% of the total UAA of the farm. The first two main crops make up a maximum amount of 90% of the total UAA. Legumes and mixtures with legumes are grown on at least 10% of the farm´s UAA.
- ! Fields, plots and parts of the fields that can´t easily be accessed by machinery are used for nature conservation (e.g. fallow land).
- ! In temperate climatic regions, the farmer must follow a crop rotation of at least four years on the same plot. This includes the cultivation of four main crops as well as the cultivation of cover crops.
- ! In semi-arid regions, the farmer must follow a crop rotation of at least three years on the same plot. It includes the cultivation of three main crops as well as the cultivation of cover crops.
- ! Annual obligatory crop rotation of the main crop on the same plot. The main crops need to belong to different functional plant groups.
- ! Farm operations must integrate catch crops or intertillages such as grasses, oilseeds, or legumes in their crop rotation.
- A balanced crop rotation includes >10% grain legumes or other crops with recognized positive impacts.
- ! Semi-natural habitats must not be fertilized.

The measures marked with a red exclamation mark (**!)** should be considered as a priority. Whenever possible those measure should be taken as mandatory.

3.2.2 Challenges to implement these measures

Germany has a range of different geographical conditions. Each of them favorable to different crops and agricultural production systems. Traditionally, crop rotations developed according to local conditions, good agricultural practices and economical outputs. While a rotation of at least four main crops could be achieved, the economical aspects of it are challenging. For some crops market conditions are unfavorable and restrict their cultivation. Legumes are an example. It can be questioned whether even greater amounts of legumes could be marketed. However, it is anticipated that locally grown fodder, including legumes, will gain importance, in future.

3.2.3 Positive examples

In Germany the Agri-Environmental Measure “Cultivation of diverse cultures” (Anbau vielfältiger Kulturen im Ackerbau) promotes and supports the cultivation of at least 5 main crops on a farm. Being subsidized by the state for five years, every main crop must not exceed 30% of the total farm area, cereals are restricted to 66% of the agricultural area as a maximum, vegetables must not be cultivated on more than 30 % of the agricultural land and legumes must be considered with at least 10 % in the mixture of cultures on the farm.

3.3 Soil Damage: Erosion and Compaction

Soil erosion is a natural process essential for soil formation, which occurs over geological time. The concerns about erosion are related to its acceleration mostly as a result of human activity including land use and farming practices, but also as a result of climate change. By removing the most fertile topsoil, erosion reduces soil productivity and, where soils are shallow, may lead to an irreversible loss of natural farmland. Soil organic carbon is the major component of soil organic matter that improves the physical properties of soil, as it stores a great proportion of nutrients necessary for plant growth. The annual rate of loss of organic matter varies depending on natural factors (climate, soil parent material, land cover, vegetation and topography) and human activities (land use, management and degradation).

Soil compaction is a form of physical degradation resulting in the densification and distortion of the soil to the extent that biological activity, porosity and permeability are reduced and soil structure is partly destroyed. Compaction can reduce water infiltration capacity and thereby increase the risk of erosion through accelerated run-off. The compaction process can be initiated by wheels, tracks, rollers or by the passage of animals. In order to define appropriate soil use and cultivation techniques, it is necessary to identify which soil is susceptible to compaction.

3.3.1 Status-quo: What is the actual situation?

The Common Agricultural Policy (CAP) tries to protect soils from erosion and compaction. Since July 2010 the cross compliance linked plots that are prone to erosion to erosion control agricultural measures. Dividing into areas in danger of water or wind erosion and regulating tillage practices as well as promoting continuous crop cover of the plots.

Agri-environmental measures are another lever erosion control. In general, farmers have to subscribe voluntarily to agri-environmental measures and are bound for at least five years to the implementation of measures, which go beyond legal requirement. Examples of such measures are:

- extensification of farming;
- management of low-intensity pasture systems;
- integrated farm management and organic agriculture;
- preservation of landscape and historical features such as hedgerows, ditches and woods;
- conservation of high-value habitats and their associated biodiversity.

Also GAECs (good agricultural and environmental conditions) try to minder erosion and compaction effects on European scale. Member States shall define measures specific to the target area, taking into account soil and climatic condition, existing farming systems, land use, crop rotation, farming practices and farm structures. Examples of such measures are the maintenance of minimum soil cover, measures to limit erosion and the maintenance of soil organic matter.

As described in the introduction of this paper, there is not yet an overarching directive on soil protection. In 2006 the European Commission adopted a soil protection thematic strategy including a proposal for a Soil Framework Directive aiming at:

- preservation of soil functions,
- prevention of soil degradation
- restoration of degraded soils

The Strategy and the accompanying proposal for a Soil Framework Directive were sent in 2006 to the other European Institutions for the further steps in the decision-making process. In the Environment Council meeting of 20 December 2007, the Member States were not able to find a common position on the Commission proposal. Discussions are still on-going.

Unfortunately, existing EU legislation varies in scope and objective and does not sufficiently address significant soil problems as it does not cover all soils and does not address all soil threats. Moreover, since soil degradation continues and is even getting worse, all this legislation is simply not enough.

To counteract and reduce erosion and compaction effectively, we recommend standards and companies to go beyond current legal requirements:

- **!** Soils must be covered as long as possible, at the least during the periods prone to nutrient leaching

- ! European farmers are to use the official maps for erosion risks and conduct erosion risk assessments if they are located in an erosion risk area. Where no official erosion maps exist, the standards have to provide information on when specific soil types are prone to water erosion with regard to slopes.
- ! Where risk of erosion is high, soil protection measures must be implemented, i.e. reduced tillage, terracing, slope parallel crop cultivation, perennial vegetation. (legal requirement)

The measures marked with a red exclamation mark (**!)** should be considered as a priority. Whenever possible those measure should be taken as mandatory.

3.3.2 Challenges to implement these measures

In Germany, different systems for keeping the soil covered are established. Most commonly stubbles are left on the field as long as possible and the seedbed is prepared shortly before the seeding of the following crop. In between cereals (e.g. barely or wheat) and root crops or corn, catch crops are cultivated to cover the soil, enhance soil life and reduce erosion. More and more, new cultivation techniques pop up, like the direct sowing of corn into an established catch crop. This approach covers the soil on a long time basis and also protects the soil from erosion during the vegetation period of corn as it covers the ground evenly. However, such approaches need specific machinery, which often is the barrier for implementing it. Nowadays, the reduction of erosion is a day to day business of farming in Germany. Leaving the soil uncovered has become rare, but it always depends on the water availability, whether a catch crop can unfold its entire benefits for the soils.

3.3.3 Positive examples

Direct seeding uses specialized machinery that only disturbs narrow strips of soil, opens it and places the seed. Thus most of the established crops are left unchanged. This system provides environmental protection, the lowest soil disturbance and the greatest possible protection from erosion while maintaining or increasing soil fertility. It also helps to reduce production costs for the farmers once it is established.

However, transitioning from conventional tillage agriculture to the use of direct seeding can challenge the farm management. It alters management practices in general and breaks traditions passed on for generations. But the greatest barrier lies in the initial investment in new farming equipment.

If such machinery is at hand, direct seeding can be interesting for a range of crops. The strictest methods of direct seeding was developed in the USA and is called "Roller-crimper" method. In spring established cover crops are rolled and crimped, while a cash crop is seeded directly into the mulch. In this system, cover crops are not cut or chopped, but the whole plant is rolled to the ground, where it is left to cover the soil and to suppress weeds. More information on this system and a hand on example can be found here:

https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/awp2018-press-06-carbonstorage_final.pdf

3.4 Increase the share of organic fertilizer

Organic fertilizer bear a range of benefits compared to mineral fertilizer. Most inorganic fertilizer are designed to provide the three macronutrients nitrogen (N), Phosphorus (P) and potassium (K). While these macronutrients are required in greater quantity for plant growth, secondary nutrients (calcium, sulfur, magnesium) as well as trace nutrients (boron, chlorine, manganese, iron, zinc, copper, molybdenum) are essential, too. Organic fertilizer always contain a number of different macro- and micronutrients (secondary-, tracenutrients) and thus support plant growth on a wider scale.

The long-term use of inorganic fertilizer can lead to soil acidification, which reduces the soils ability to redeliver nutrients to the plant. Usually this is undone by the application of lime, but generally, this process is negative for soil organisms, like earthworms and microorganisms, which are crucial to keep up soil fertility. Populations of beneficial microorganism were found to be higher in soils with a history of organic production practices but also these populations had a greater capacity for growth. Organic fertilizers like manure or compost also improve the humus content of the soil.

Besides what happens on the field, inorganic fertilizer have a negative effect on the environment during their production process. Many are synthesized from oil or are based on other non-renewable resources, which have to be mined.

To improve more biodiversity oriented fertilization, we recommend standards and companies to go beyond current legal requirements:

- **!** The use of organic fertilizers instead of mineral fertilizers is to be preferred.
- **!** Nutrient content of the organic and mineral fertilizers must be determined and documented. (legal requirement)

The measures marked with a red exclamation mark (**!**) should be considered as a priority. Whenever possible those measure should be taken as mandatory.

3.4.1 Challenges to implement these measures

In Germany, the application of more organic fertilizers bears significant management challenges for the farmer. Technical and environmental challenges limit the use of organic fertilizers rather than the farmer's unwillingness to use them.

First and foremost the availability of organic fertilizers restricts its use. Many such substances originate in animal husbandry. Traditionally, but also due to geographical specifications, animal husbandry is not evenly distributed throughout the country. Hence, organic fertilizer must be transported to the farms, which apply them. Economic reasons limit the transport of manure to a specific radius around the regions of animal husbandry. As a result, Germany faces locally high levels of nitrate surpluses.

Secondly, farmers are restricted in the application of organic fertilizers. In autumn, fertilizers can only be applied if a demand of the crop can be proven. This strongly depends on the soil organic matter content of the plots. Mostly, there is no need for an autumn fertilization as the nutrients can be redelivered by the soil in adequate amounts. Even if, a demand is given, it is often very low and allows for the application of very little organic matter. Often modern machinery cannot apply such little amounts. Hence, farmers face a technical and legislative barrier here.

An environmental barrier is given to the application of organic fertilizers through wet conditions in spring. Manure could be applied after winter on established cereals or prior to the cultivation of sugar beets. This, however, depends on the weather conditions. A wet spring does not allow for heavy machinery to enter the field.

Often corn is the only crop where organic fertilizers can be used on a regular and wide basis. However, corn itself is grown widely and should not be further increased in its cultivation area.

3.4.2 Positive examples

At least the challenge of distances is overcome, due to legislative pressure and the urge to distribute manure on a greater scale. Nowadays, organic fertilizer is transported further than ever before.

Overview of the Project EU LIFE Food & Biodiversity

Food producers and retailers are highly dependent on biodiversity and ecosystem services but also have a huge environmental impact. This is a well-known fact in the food sector. Standards and sourcing requirements can help to reduce this negative impact with effective, transparent and verifiable criteria for the production process and the supply chain. They provide consumers with information about the quality of products, environmental and social footprints, the impact on nature caused by the product.

The LIFE Food & Biodiversity Project “Biodiversity in Standards and Labels for the Food Industry” aims at improving the biodiversity performance of standards and sourcing requirements within the food industry by:

A) Supporting standard-setting organisations to include efficient biodiversity criteria into existing schemes; and encouraging food processing companies and retailers to include biodiversity criteria into respective sourcing guidelines;
B) Training of advisors and certifiers of standards as well as product and quality manager of companies;
C) Implementation of a cross-standard monitoring system on biodiversity;
D) Establishment of a European-wide sector initiative.

Within the EU-LIFE Project Food & Biodiversity, a Knowledge-Pool with background information linked to agriculture and biodiversity is provided. You can access the Knowledge Pool under the following link:

www.business-biodiversity.eu/en/knowledge-pool

Editor: LIFE Food & Biodiversity; Global Nature Fund

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