BIODIVERSITY FACT SHEET

FOOD & BIODIVERSITY

Arable Cropping

Cultivation of Sugar Beet

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 Biodiversity Fact Sheet, we provide information on the impacts of the production of root crops in temperate climate regions of the EU on biodiversity, as well as junctions to very good practices and biodiversity management. Biodiversity friendly agriculture depends on two main pillars, as the graph below illustrates. Within this paper, the aspects of "very good agricultural practices" will be discussed in each chapter, while the aspect of biodiversity management is described in more detail in the fifth chapter.

BIODIVERSITY FRIENDLY AGRICULTURE

Reduction of negative impacts on biodiversity and ecosystems (e.g. reduction of pesticides) **VERY GOOD AGRICULTURAL PRACTICES for MORE BIODIVERSITY**	Creation, protection or enhancement of habitats (e.g. creation of semi-natural habitats and biotope corridors) **BIODIVERSITY MANAGEMENT**

The fact sheet targets people who assess the implementation of requirements regarding cultivation methods (standard advisors, co-operatives, suppliers) and people who take decisions on product quality, supply chain and sustainability aspects in food processing companies and retailers in the EU. We wish to raise understanding for the importance of biodiversity and related key ecosystem services as the fundamental basis for agricultural production. In this fact sheet, we focus on root crop production in temperate climate regions of the EU.

2. AGRICULTURE AND BIODIVERSITY

Biodiversity loss: time for action

The loss of biodiversity is one of the biggest challenges of our time. Species loss driven by human interventions happens around 1,000 times faster than under natural circumstances. Many ecosystems, which provide us with essential resources, are at the risk of collapsing. The conservation and sustainable use of biodiversity is not only an environmental issue. It is a key requirement for nutrition and other ecosystem services such as water, clean air and micro-climate, the basis for production processes and overall good quality of life of mankind.

Biodiversity is defined as the diversity within species (genetic diversity) between species and of ecosystems.

The main drivers of biodiversity loss are:

- **Habitat loss due to land use changes and fragmentation.** The conversion of grassland into arable land, land abandonment, urban sprawl, and rapidly expanding transport infrastructure and energy networks is causing large habitat losses. 70 % of species are threatened by the loss of their habitats. Particularly farmland fauna and flora has declined by up to 90 % due to more intensive land use, increased use of pesticides and over-fertilization.
- **Pollution.** 26 % of species are threatened by pollution from pesticides and fertilizers containing nitrates and phosphates.
- **Overexploitation of forests, oceans, rivers and soils.** 30 % of species are threatened by overexploitation of habitats and resources.
- **Invasive alien species.** The introduction of alien species has led to the extinction of an increasing number of species. Currently around 22 % of species are threatened by invasive alien species.
- **Climate change.** Shifts in habitats and species distribution due to climate change can be observed. Climate change interacts with and often exacerbates other threats.

Agriculture and biodiversity – A symbiosis

The main task of agriculture is to provide a secure food supply for a fast-growing world population in order to ensure stable livelihoods. Consumption patterns in industrialized and emerging economies have led to an intensification of agriculture and a more globalized food market, resulting in a vast exploitation of agricultural land, highly intensive production systems and a simplification of agricultural landscapes.

Agriculture depends on biodiversity and at the same time plays an important role in shaping it. Since the Neolithic Age until the start of the 20th century, agriculture significantly increased the diversity of landscapes and species within Europe. The European continent was previously covered with forest; new landscape features emerged with the expansion of agriculture; including fields, pastures, orchards and cultivated landscapes such as meadows. The conservation of biodiversity and habitats is closely linked to agro-systems ever since. Currently more than 210 million hectares of arable and grassland areas, which equates to almost half of the surface in Europe (EU-28), are used for agriculture. Consequently, 50 % of European species depend on agricultural habitats. This symbiotic and beneficial relationship between agriculture and biodiversity has altered fundamentally over the last decades towards a massive loss of biodiversity on agricultural land and its surroundings due to a non-sustainable agricultural production.

Standards and companies of the food sector play an important role for agricultural production. Therefore, they can substantially contribute to biodiversity conservation on the farm and its surroundings. The continuous propagation of standards and procurement guidelines shows the large scale of effect they have on production level. Appropriate integration of biodiversity as a sustainability and quality factor into sourcing strategies will recover and secure biodiversity within our agricultural landscapes. At the same time it facilitates the evaluation of risks for internal operations, brand management or legal and policy changes, improves the product quality, and helps to ensure a secure supply chain. A good strategy for biodiversity conservation, i.e. a positive biodiversity performance, creates opportunities regarding differentiation in the market, value proposition and meeting stakeholder expectations and consumers' demands.

Legal Framework for Agriculture in Europe – Common Agricultural Policy (CAP)

Since 1962, the EU-Common Agricultural Policy (CAP, Directive 1782/2003/EG and the 2013 amendments) presents the legal framework for agriculture in the European Union. It was based on the experience of hunger and starvation in Europa and targets on securing food supply for the population and the independence of European food supply from international markets. The CAP regulates subsidies to farmers, the market protection of agricultural goods and the development of rural regions in Europe. Farmers receive payments per hectare of cultivated land and get additional subsidies related to production and farm management.

The EU CAP references to a set of EU directives, which must be respected by farmers:

- **Directive 91/676/EEC –** "Nitrates Directive" regulates best practices for fertilisation of crops.
- **Directive 2009/128/EC –** "Pesticides Directive" regulates best practices for the use of insecticides, herbicides and fungicides.
- **Directives 92/43/EEC –** "Flora-Fauna-Habitats Directive" and 79/409/EEC – "Birds Directive" provide the legal framework for biodiversity conservation in Europe, which is ratified by all member states and directly transferred into national conservation laws.
- **Directive 2000/60/EC –** "Water Framework Directive" is targeted to improve the state of water bodies in Europe and relates closely to biodiversity.

Since 2003, Cross compliance (CC) regulations address shortcomings concerning environmental issues of the CAP-philosophy described above. CC represents a first step towards environmentally friendly farming, forming a principle of linking receipt of CAP support by farmers to basic rules related to the protection of the environment (besides others). These regulations target general measures to reduce severe impacts of agriculture on the environment like erosion, nitrification, pollution of water bodies, landscape change and others. Conservationists only see a small improvement, if any, to biodiversity protection by the cross compliance regulations.

Since 2012, the CAP promotes the implementation of voluntary agro-environment measures supported by payments per hectare that depend on the efforts and losses in yield due to the implementation of these measures. Member states, federal states and provinces define regionally adopted agro-environmental measures. Those encompass actions which directly focus on the protection and conservation of agro-biodiversity. Farmers can sow blooming stripes, set aside fields temporarily or permanently, organise buffer strips along open waters, plant hedgerows and others. Studies show positive effects of such measures on biodiversity (What Works in Conservation 2017).

The most recent CAP „REGULATIONS OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" (No. 1305/2013 - on support for rural development; No. 1306/2013 - on the financing, management and monitoring of the common agricultural policy; No. 1307/2013 - establishing rules for direct payments to farmers; No. 1308/2013 - establishing a common organisation of the markets for agricultural products), introduced in 2014, oblige farmers to implement "greening measures" when applying for direct payments. Hereby, biodiversity and clean water are explicitly targeted. Farmers have to fulfil criteria to diversify crops, maintain permanent pastures and preserve environmental reservoirs and landscapes. 30% of direct payments are tied to strengthening the environmental sustainability of agriculture and enhancing the efforts of farmers, especially to improve the use of natural resources. First assessments after two years indicate the necessity to adjust the current set of greening measures, as the effect on biodiversity is not apparent.

3. ROOT CROP FARMING IN EUROPE

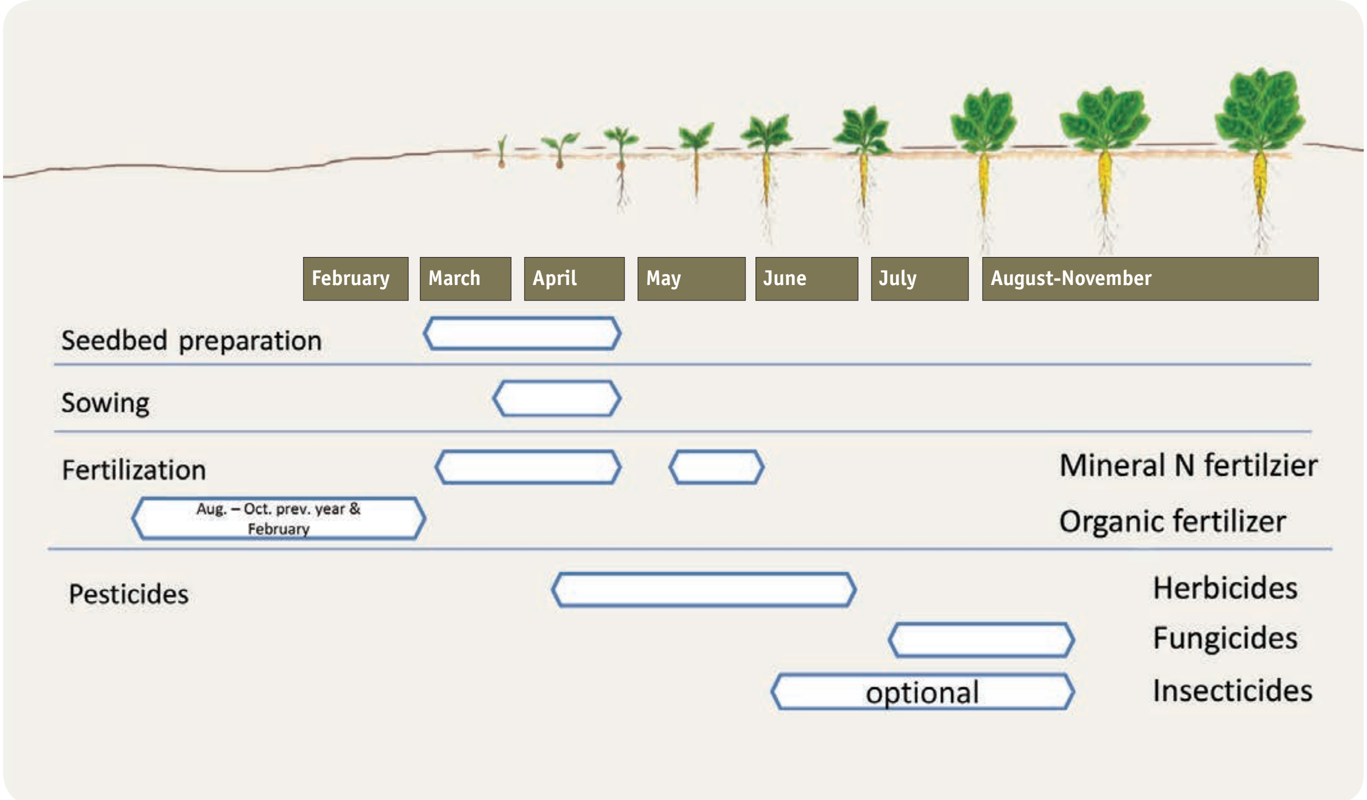
Root crop farming as production system includes different crop types, such as potatoes, sugar beet, maize, onions, carrots and other vegetables and herbs. Agricultural methods vary slightly from one crop to another, depending on the requirements of every plant species. In this document, we focus on the cultivation of conventional produced sugar beet. The production of sugar beet is part of a highly intensified production system. There is little space for biodiversity on the fields and additional negative impact on the surrounding nature.

Sugar beet can be grown on a wide range of soils with medium to slightly heavy texture. To achieve high yields and good product quality (i.e. a high sugar content) soils must show a high availability of nutrients, with high humus supplies and good water retention capacities. The ground should be plain and without soil wetness, thus most sugar beet crops are well drained. Key determinants are good rains in early autumn; dry weather in contrast will restrict growth. Frost and strong cold prior to the harvest also have major impact on the yield. The health of the crop is a result of the husbandry applied. In temperate regions, sugar beet has a growing season between 180 – 210 days/a, being seeded in spring and harvested in later autumn/beginning of winter.

According to Eurostat, the EU is the world's leading producer of sugar beet, with around 50 % of the global production. In 2016, the EU-28 produced 111.7 million tonnes of sugar beet. More than half of the EU-28 sugar beet was produced in France (31 %) and Germany (22.8 %) together. Poland (12.1 %) and the United Kingdom (5.1 %) were the next largest producers.

Over the las decades the yields of sugar beets more than doubled due to a more intensive production and achievements in the breeding of higher yielding varieties. Thereby, annual yields vary strongly, depending much on the weather conditions. Sugar beets contain about 20 % of sugar, which results in 16 % of crystal sugar after processing. The importance of sugar beet in the worldwide sugar production decreased from 43 % in the 1960s to 20 % today. Sugar cane today takes the larger portion, driven by ethanol production in Brazil and other South American countries, the production by area grew much faster in sugar cane than in sugar beet.

4. CULTIVATION OF SUGAR BEET AND IMPACTS ON BIODIVERSITY



Sugar beet calendar with major cultivation aspects

Sugar beets are seeded in spring (March/April), mineral fertilizer is applied before sugar beet is seeded and around the 4-leaf to 6-leaf stadium (May). Weed control occurs during the first growth stages, fungicides are used mostly in July until September. Insecticides are optional due to stained seeds and unregularly occurring pests.

4.1 Soil preparation and seeding

Sugar beets are seeded between Mid-March and Mid-April. Thereby, conventional seeding, mulch seeding and direct seeding technologies can be used. The conventional approach uses deep ploughing in autumn to loosen the soil before sugar beets are cultivated, to activate nutrient mineralization from organic matter and for soil hygiene purposes (reduction of weeds and soil born diseases). When mulch-seeding is applied, the ground is loosened with a grubber in spring before the farmer harrows the field to break down bigger soil clots. Thereafter, the sugar beets are seeded with a single-grain seed drill. When the needed machinery is present on the farm, direct seeding is possible, too. Mostly, sugar beets are placed in a distance of 20-22 cm from each other, having an inter-row space of 45-50 cm.

EFFECTS ON BIODIVERSITY

According to the German Federal Environment Agency, a gram of soil contains billions of microorganisms: bacteria, fungi, algae and protozoans. A mere one cubic meter of soil is home to anywhere from hundreds of thousands to millions of soil fauna such as nematodes, earthworms, mites, woodlice, springtail, and insect larvae. A hectare of soil rooting layers contains around 15 tons of live weight – the equivalent of around 20 cows. In other words, immeasurably more organisms live in the soil than on it. Soil ecology plays a key role in natural soil functions. The biological processes in soil ecosystems e.g. integrate plant residues into the soil, shred them, break them down and release fixed nutrients as minerals for plant growth. Soil organisms create favourable physical conditions in the soil: storing and mixing soil materials (bioturbation) with the cementing of soil particles through mucus secretion (revegetation), makes soil organisms instrumental for the formation of soil pore systems. Soil organisms form stable clay-humus complexes with high water and nutrient storage capacities, and create fine-grained, quasi erosion-resistant crumb structures. These organisms can, to some extent mitigate the harmful effects of organic substances on soil, groundwater, and the food chain.

In general, soil treatment affects biodiversity negatively, as it interrupts the natural processes described above. Oxygen, ultraviolet radiation and heat will strike the soil, particularly when turning the soil by ploughing and resulting furrows lead to severe edge effects for life in the soils. This hinders humification processes, which take place under exclusion of oxygen, and disrupts the natural soil pore system. Each treatment affects biological diversity within the soil and the fauna and flora above the ground to a different extent.

Farmland birds are affected by soil and seedbed preparations, as the breeding season starts after winter, where sugar beets are seeded and managed. Consequently, many ground breeding birds show decreases in population of up to 90 % in the last 20 years, e.g. lapwing (Vanellus vanellus), skylark (Alauda arvensis) and partridge (Perdix perdix).

4.1

Very good agricultural practices to ensure more biodiversity

Superficial treatments are usually less harmful than ploughing. It is thus a trade-off for the farmer between preventing soil-borne diseases and soil biodiversity. Earthworms, spiders and ground beetles are less affected by mulch-seeding and direct-seeding compared to conventional ploughing. Ground beetles are supported by conservational soil preparation, resulting in increasing species and population sizes. Avoiding ploughing the upper soil layer (0 to 30 cm) leads to a significant increase of small invertebrates, which form the basis for soil food chains. With increased biological activity on the field, the self-regulation of the soil ecosystems rises, leading to a faster decomposition of organic material. A diverse predator community will also reduce the risk of pests and diseases caused by prey-species.

4.2 Nutrient management and fertilization

Soil fertility, climate conditions and the characteristics of the cultivar have great influence on the nutrient demand of sugar beet and its yield. Sugar beet is demanding concerning the quality of the soils. Fertile clay soils with porous subsoil provide highest yields. The higher the portion of nutrients the soils can deliver, the better the yield and quality of the beet (sugar content). Up to two third of nitrogen might come from the soils, influencing the nutrient balance and fertilization strategy. In integrated crop management, soil analyses determine N-min values before seeding, and provide the basis for calculating the required nitrogen supply. Sugar beet needs up to 250 kg of N per hectare. In areas with lower yields, N intake is much less. Nitrogen provided by the soil (N-min values) is subtracted from that calculated intake. Applications of fertilizers should be divided in two applications if overall donation is above 120 kg/ha, according to region, soil type and precipitation. The first dose of 60 kg N and other fertilizer is applied in early spring before the vegetation period, the second dose close to the main vegetation period after around 45 days.

When organic fertilizer (compost, manure etc.) is used, it may be applied in autumn after the harvest of the previous crop or, in case of manure, can also be applied shortly before sugar beets are seeded. It complements the use of chemical and mineral fertilizers. Thereby, mineral fertilizers are applied in an optimized mixture of phosphorus, potassium and sulphur (macronutrients), usually applied in combination with nitrogen. Besides the macronutrients, some micronutrients are needed to sustain plant growth and crop health and will be applied to the mature crop by foliage spraying.

EFFECTS ON BIODIVERSITY

Two aspects need consideration concerning the effect of fertilization on biodiversity. The first is changes in the trophic state of plant communities, the second effects runoffs in the environment, including pollution with nitrogen and phosphorous. Plant communities are composed by biotic and abiotic factors such as soil quality, precipitation, competition with other vegetation etc. Crops are no naturally composed plant communities, so this concept cannot be applied here. The issue of excessive fertilization with pollution of soils and water bodies by nitrogen and phosphorus is not an issue of adopted fertilization methods along the regulations of integrated production. In integrated farming, as described above, the crop will consume applied fertilizers for plant growth; some remnants can be absorbed by the soil. Pollution caused by mist and slurry and the severe impacts on soils and water bodies is not that much a fertilizing issue, but an issue of disposing manure from intensive livestock farming and meet production outside the growing season. "Accidents" can easily destroy the entire life in a stream and it will take long time to re-establish that. Also moderate manure disposals lead to significant changes in limnic organisms, leading to a small set of species, tolerant to water pollution.

Hence, even with a good nutrient management on the field, plant communities of buffer stripes along pathways, hedges, and creeks are regularly influenced by nutrients from adjacent crops. This is indicated by nutrient-tolerant plants like stinging-nettle (Urtica dioica). In addition, alien invasive plants, e.g. Japanese knotweed (Fallopia japonica) and Himalayan balsam (Impatiens glandulifera) benefit from nutrient efflux and cover vast areas along riparian buffer stripes.

More nutrients lead to higher biomass production and therefore to a higher food supply for herbivorous arthropods at the first glance. Some more generalist species can benefit from this increase in biomass and show increasing populations. Biodiversity on the other hand is not driven by generalists, but by specialized species occupying a huge number of ecological niches. Long-term studies show a significant and strong decrease of many species typical for agricultural landscapes and ecological niches within these landscapes.

4.2

Very good agricultural practices to ensure more biodiversity

Diversified crop rotations improve soil biodiversity and soil fertility. Crop rotation fulfils the requirement for preventing soil damage, i.e. through erosion and compaction, which is essential to keep the soil in good conditions. EU Cross Compliance regulations give many, but not exhaustive regulations to prevent erosion and degradations of soils.

One way to improve the quality of soil and to increase the amount of humus in the long term is to regularly apply organic matter in form of manure, compost or cover crops. In general, it is recommended to use organic fertilizer instead of mineral fertilizers due to complexity of such substances and multiple positive effects on soil fertility and structure. It is important that these fertilizers are applied according to some basic rules, which aim at prohibiting the nutrient run-off in waterbodies. Manure is not applied on…

- …water saturated or flooded soils;
- … frozen soils;
- …soils, covered with snow.

To further decrease the possibility of run-offs, a minimum distance of one meter (with precision application machinery) and five meter with common application machinery towards water bodies must be ensured. Furthermore, farmers should be able to store their own manure for nine-month in order to avoid that manure is applied on the field due to a lack of storage facilities. In 2017, this situation arose in Northern-Germany after enduring rainfalls made it impossible to apply manure for over six month.

The sustainable use of soils is based on a balanced nutrient application and extraction. To achieve this, farmers have different farm management tools, such as the farm gate nutrient balance. Certified farms are often required to fulfil prescribed nutrient limits, given by the standard or procurement guideline, which go beyond the legal requirements. These are efficient tools to regulate the farming inputs. At best, the nutrient limits are crop-specific and adopted to regional circumstances.

4.3 Pest control and plant protection

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From an ecologist's point of view, crops like sugar beet are a monoculture poor in biodiversity, with comparably few species feeding on the crop, and consequently a very limited arthropod predators diversity (spiders, bugs, etc.). In such environment, pests and diseases can easily have a considerable impact on the economic output of a farm. Wild flowers compete with the farmed crops; insects harm plants, fungal, bacterial and viral infections decrease yields and can lead to a severe crop failure in humid periods during the summer.

Integrated Pest Management – Sugar beet farmers apply an integrated pest management of diseases, insects, and weeds. Thereby, close monitoring of the pest levels, cultural practices (e.g. crop rotation, tillage or non-tillage, water and nutrient management) and biological control tactics are combined with the judicious use of pesticides. Crop rotation e.g. focuses on the reduction of infections in the crop by reducing build-ups of insect pests, weeds, nematodes or other soil borne diseases. Pesticides must only be applied when pests and diseases exceed economic thresholds. The amount of active matter applied needs to be adjusted to the degree of infection. Preventive and calendar spraying, i.e. application of pesticides without signs of diseases or risk assessment, was common in the past and is now prohibited in Europe. Spot applications rather than comprehensive field treatments are recommended. Many growers employ preventive pest management strategies such as planting certified seed, using appropriate resistant varieties, manipulating planting date, modifying fertilization and irrigation. The most relevant pest for sugar beet are soil born nematodes (Heterodera schachtii), which are effectively reduced by a crop-rotation of at least five years. Other relevant pests are minimized by this rotation and appropriate soil preparation measures as well as. Often cereals are the crop prior to sugar beets. To reduce soil erosion, but also to reduce soil pathogens and nematodes, catch crops are a common measure.

Herbicides – For sugar beet, competition with wild flora in spring is the biggest issue in crop management and herbicides make up a high proportion of cost. The number of herbicide applications is defined by the product used and the efficiency of the applied mechanical methods to reduce weeds. While the amount of different herbicides seems great, they all base on only nine active ingredients, which can be divided into contact and residual, total and specific ones. Residual products seal the ground and inhibit development of wild plants; contact herbicides enter emerging plants and poison its metabolism. Total herbicides target any plant species (note that e.g. monocotyledonous like grass or maize and dicotyledonous plants, have slightly diverging metabolisms), specific herbicides only some. Herbicides are applied after germination of the beets. Depending on the active substance chosen, up to three treatments may be due later in spring.

Insecticides – The number of insect pests vary by region and production methods. Some diseases affect sugar beet and other related species, but the importance decreased in recent years, as a consequence of overall biodiversity loss. Insecticides are used to reduce pests if economically meaningful. The application of insecticides is bound to the annual population development of a given pest and might not be needed every year. Broadband insecticides target any arthropod/insect, ovicides, larvicides or acaricides only some stages or groups of species.

Fungicides, bactericides etc. – Fungal infections and the application of fungicides is ideally managed with monitoring systems and prediction models, which assesse the risk of infection and provide advice to farmers. According to the integrated pest management regulations, farmers have to monitor diseases and may only apply fungicides (and other pesticides) substances if the economic loss is outbalanced. The focus in sugar beet production lies on managing diseases, affecting the root system as well as those affecting the leaves. Targeting diseases inefficiently can lead to resistances, meaning that a disease becomes insensitive to a particular fungicide. Fungicides are commonly applied around July.

EFFECTS ON BIODIVERSITY

Despite the optimizations and regulations, the application of pesticides is common in conventional European agriculture. Fairly every conventional crop is treated several times with a combination of active substances, along with the criteria and regulations described above. The pesticides purpose in general is to erase biodiversity from the crops, preventing quick re-population and ideally keep the crop clean and sane until the harvest. Despite the efforts of the farmers, this is achieved to a very large extend and very efficiently. Fields are clean from wild flowers, butterflies are hardly ever seen in most of the summer. Statistically, out of 100 farmland birds breeding in 1995, only 20 are left on a given area.

Pesticides are a big environmental issue for water bodies and the environment in general and NGOs and some authorities thus criticize the extensive use. Water legislation restricts the application of some extensively used herbicides, and those with high risks of leaching due to their application times. In winter, drain flow is the main transport mechanism; herbicides attached to soil particles can be introduced into water bodies during heavy rains. Careful application of pesticides is the key to minimize such collateral damages. The efficiency of the herbicides is directly interlinked with the surface of the plant targeted. Small droplets sprayed have the highest impact, but fine sprays lead to the highest drifts. Drift is also a matter of the distance between sprayer and plants.

Herbicides – Wild flowers form the basis of food chains in arable landscapes. Many typical farmland species are almost extinct in many agricultural landscapes. Plants that once were common, like cornflower (Centaurea cyanus) and corn rose (Papaver rhoeas), declined by 75 % in species numbers and 95 % in population sizes. Herbicides, working either as contact or systematic toxin, which is taken up by any plant part and transported within the plant, are very effective in combating weeds. As an example Glyphosate, a total herbicide working as contact toxin, can be taken. Here, 0,1 ml/m² of active matter leads to the desired effect. Estimates by NGOs indicate that 75 % of arable land in Central Europe are treated once a year with glyphosate. Herbicides are mostly applied to combat already established weeds on the field, but some products are also used to seal the ground and to prevent the upcoming of unwanted weeds. However, these pre-emergence herbicides can mostly be substituted by mechanical weeding techniques.

Insecticides – the purpose of insecticides is to erase pests, arthropod biodiversity from arable countryside. As a current well-known example, neonicotinoides can be mentioned. This group of active substances targets the nervous system of insects. By far less effective, but still recognizable these substances also affect non-target groups like mammals, other animals and beneficial insects. Selectivity in pesticides does not mean exclusiveness, so the effect on a target group can be 100 % and only 10 % in others, but some impact will remain. In summary, the majority of land cultivated with sugar beet and other root crops is free from animal biodiversity for most of the year.

Fungicides, bactericides, etc. – The direct effect on biodiversity here is not as obvious as in other pesticides. The fungus etc. species targeted are often poisonous to arthropods, too and are not missing in the food chain per se. However, even very specific chemicals have an impact on other, non-targeted fungus species, and thus an impact on e.g. microflora and microfauna of decomposers in the soils.

4.3

Very good agricultural practices to ensure more biodiversity

Integrated pest management is a reference found in European legislation, which aims at preventing the use of pesticides by applying cultivation aspects to reduce pests and diseases in crops. These measures should always guide the farm management and should be implemented consequently. A basic set of agricultural practices to reduce the risk of pests and diseases in crops includes the following.

- Intercropping
- crop rotation
- adequate cultivation techniques e.g.
  - seedbed sanitation
  - sowing dates and densities
  - conservation tillage),
- use of pest resistant/tolerant cultivars adapted to the region of cultivation (traditional cultivars)
- certified seed and planting material
- optimal use of organic matter
- preventing the spreading of harmful organisms by field sanitation and hygiene measures e.g.
  - removal of affected plants or plant parts
  - regular cleansing of machinery and equipment
  - balanced soil fertility or water management,
- promotion of beneficial organisms

If these measures have been implemented and defined thresholds for pest and disease infections are exceeded, the use of pesticides can be part of an integrated pest management in non-organic farming. In order to protect open water bodies, buffer zones must be installed and maintained along the edges of waterways and waterbodies (minimum width: 10 meters). The best available spraying techniques, i.e. devices, which inhibit or reduce drift of pesticides to adjacent areas, should be used and spraying equipment should be calibrated at least every three years. Application of pesticides is limited to authorized employees, only. Mechanical weeding in early stages of crop growth is recommended to substitute pre emergence herbicides. The use of pesticides, which are dangerous to bees, pollinating insects, beneficial organisms, amphibians or fish should be prohibited, just as very harmful substances (e.g. Glyphosat, Diquat, Paraquat, Glufosinate ammonium, Indaziflam and the salt equivalent versions) should not be allowed.

4.4 Water management and irrigation

Sugar beet is grown as „rain fed crop" in Central Europe which means sugar beet is generally not irrigated due to favourable precipitation patterns. In some regions, temporary irrigation is used to in dry summers during sensitive stages of plant growth. However, the required investment amounts in (new) irrigation machinery and rights for the use of water often outweighs the increase in yield. Agricultural water extraction accounts for less than 1 % of total extraction in Belgium (0.1 %), Germany (0.5 %), and The Netherlands (0.8 %). However, the impact of irrigation might increase with a rise in global sugar prices and changing precipitation patterns following global warming. Droughts are expected to occur more frequently and will also affect Europe's temperate regions. This would lead to an increase in the demand for irrigation in many crops, including sugar beet. In drier climates, sugar beet crops are irrigated more regularly, leading to significantly better yields. Irrigation can be due mostly in summer, when water supply is scarce. Very often, yields are just much lower in drier climates. According to many climate models, rain fed sugar beet in semi-arid areas is more vulnerable to climate change. Water availability and efficiency will be a cornerstone for competitiveness in the coming years. According to Eurostat, irrigation is essential in southern European countries, making up a substantial proportion of total water use (e.g. Spain 64 %, Greece 88 %, Portugal 80 %). France, Greece, Italy, Portugal and Spain account for 70 % of the total area equipped with irrigation techniques in EU-28.

EFFECTS ON BIODIVERSITY

Irrigation is an essential driving force in water use management in many regions and has a huge impact on environment and biodiversity. Drawing water from groundwater, rivers, lakes or overland flow, irrigation systems redistribute this water, having numerus effects on biodiversity. First and foremost in Mediterranean areas. Building dams and channels reduces downstream river flows and changes the hydrology of an entire river system with impacts on all life in the watershed. Water habitats and limnic fauna can be altered by over-extraction of water for agriculture, from biodiverse communities to poor systems with only few species. Note that about half of the amphibian species in Europe are threatened!

Water tables may be altered as groundwater recharge in the area is increased on the irrigated areas, but may be reduced where the water is taken. With changing hydrology, ecologically important wetlands or flood forests dry out, change the character or disappear completely. Such wetlands are core-habitats in arid and semi-arid landscapes, providing drinking water for many species, taking important roles e.g. in bird migration, and have numerous other ecological functions. Rain-fed cereal areas in semi-arid areas are habitats for a diverse community of fauna and flora, including endangered steppe birds, rare plant species, with very high environmental value. Here, irrigation can cause another problem for biodiversity. Irrigated crops often grow more dense, quicker and higher. This has consequences for many species, e.g. in terms of breeding sites, movement inside the crops, bare grounds for foraging etc.

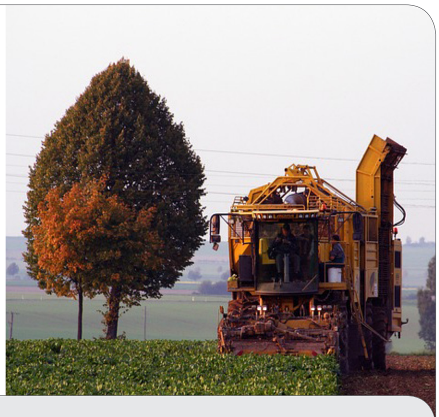
4.4

Very good agricultural practices to ensure more biodiversity

Agricultural cultivation must be adapted to the regional and climatic conditions. The goal is to safeguard protection of water resources, natural wetlands or protected areas from possible damages caused by overuse of water resources. The link between water source and water-use (ecosystem and ecosystem service) is critical. In general, water-use from open waters and groundwater bodies in Europe has to be in compliance with strict legal requirements. Regional governments and water authorities set withdrawal limits (legal compliance) and any withdrawal is subject of authorisation procedures. The quality and functioning of protected aquatic areas must be safeguarded in every scenario. Watershed management plans released by regional nature protection authorities need to consider the impact of climate change and the actual water needs of the agriculture in the area. These plans indicate the maximum sustainable water use per year as well as per certain times within the area. Use of water from illegal sources such as unauthorized wells or unauthorized water extraction from ponds, is not pursued in some parts of Europe, but does not follow legal compliance regulations, which are prescribed in any standard. Generally, farmers must follow legal requirements and should use the most efficient irrigation techniques available and applicable in the region (e.g. drip irrigation, reduced evaporation through evening irrigation).

4.5 Harvest

Sugar beets are harvested between September and January. The harvesting campaign is related to the processing of the sugar beets in the sugar factory and the idea to harvest only the amounts needed to keep up sugar production at a time. This ends up with a timeframe for the sugar beet harvest of around 120 days in favourable years. Harvesting losses account to 2.5 t/ha on average, which is 3 % of the yield. Harvest of sugar beet leaves the soil bare, being covered only by the beets leaves, which are chopped off the root. Sugar beet is thus an ideal pre-crop for many other crops, as the soil is already loosened and well prepared.



EFFECTS ON BIODIVERSITY

Harvest in general is a "catastrophic" event, seen from an ecological point of view: Landscape structure is altered on large areas; habitats are changed from monocultures to desert-like habitats. In the first decades of industrialized agriculture, this caused huge impacts on biodiversity. Since sugar beet is harvested over a long time period, the landscape effect of it is not as severe as it is for example in cereals. This is because the mosaic like harvesting leaves enough room for animals to withdraw to. Harvesting sugar beet leaves the soil bare and prone to erosion. Additionally, heavy harvesters cause soil compaction, having a negative effect on soil biodiversity. The first direct impact of soil compaction on biodiversity is the reduction of habitats for soil organisms, e.g. earthworms. Compaction damages earthworm tunnel structures and kills a great number of them. The abundance of micro-arthropods is higher in coarse soil than in fine-textured soil or compacted ones, too.

4.5

Very good agricultural practices to ensure more biodiversity

To reduce compaction, harvesting of sugar beets should happen when the soil is dry. This is also important for the loading of the piled beets. The ends of the fields, where sugar beet piles are established are more vulnerable to compactions since heavy machinery is used there twice. If a sugar beet pile is loaded late in December to January, the farmer is left with limited possibilities to seed a following crop on this area of the field. Here, flowering stripes can be established, which benefit insects, birds and smaller mammals in the coming year.

5. BIODIVERSITY MANAGEMENT

A tool proposed to improve biodiversity is the Biodiversity Action Plan (BAP). The BAP facilitates the management of biodiversity at farm level. Some food standards prescribe the implementation of a BAP without defining the content and the process to develop it. A good BAP should include:

1. Baseline assessment

The baseline assessment gathers information on sensitive and protected biodiversity areas, endangered and protected species and semi-natural habitats on or around the farm/collection area, including fallow/set aside land, cultivated and uncultivated areas as well as already existing biodiversity measures. These provide the information necessary to identify priorities, to define measurable goals, to assess the impact of implemented measures and if necessary, select approaches that are more appropriate.

2. Setting goals

Based on the baseline assessment the farmer sets goals for the improvement. The aim is to identify the main impacts the farming activities have on biodiversity, which should be avoided, and the main opportunities existing to protect/enhance biodiversity.

3. Selection, time line and implementation of measures for enhancing biodiversity

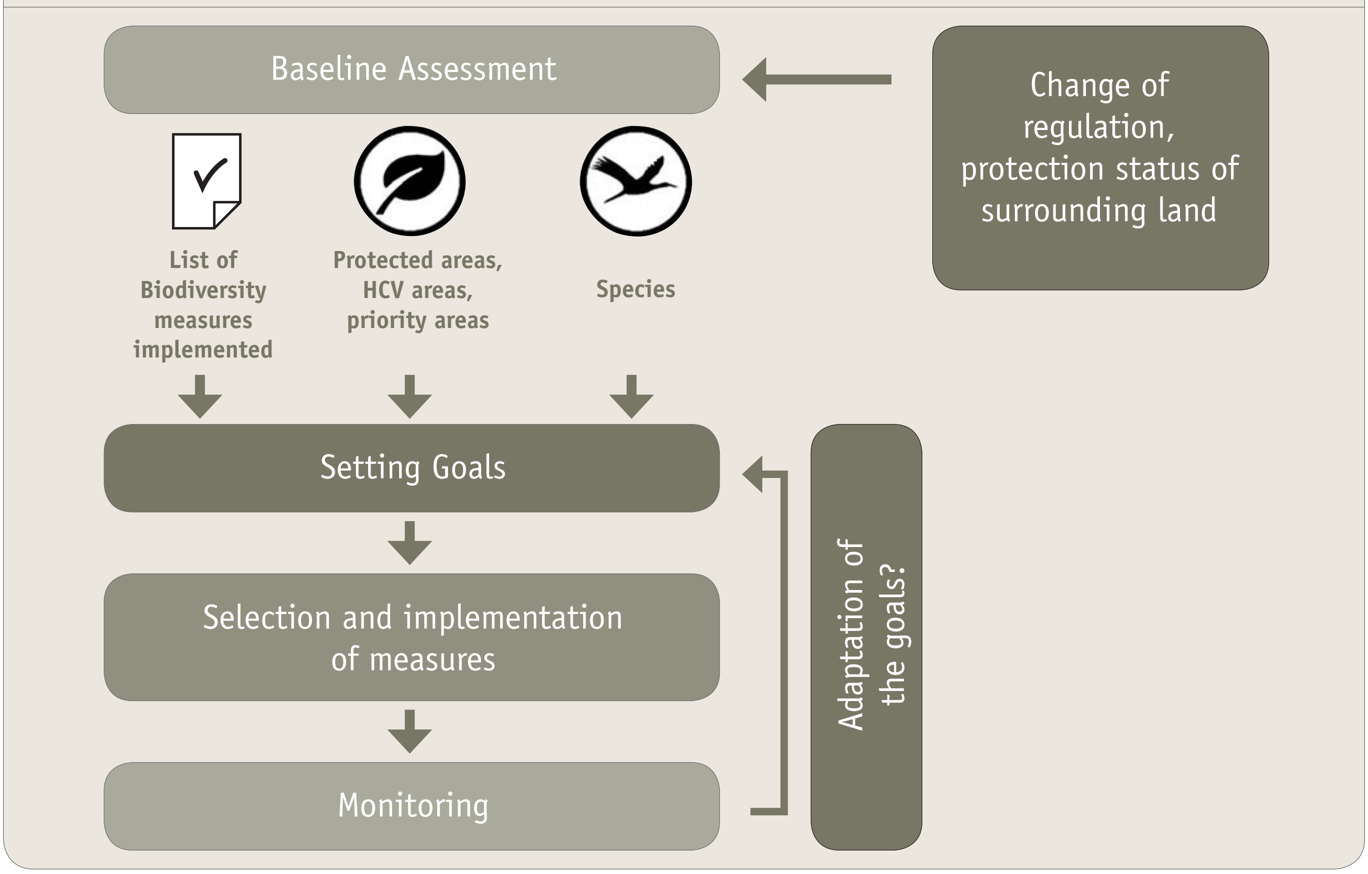
Some examples are:

- **Semi-natural habitats (trees, hedges, dry stones)/set aside areas:** Criteria will be set for type, size, and minimal quality of semi natural habitats and ecological infrastructures, for areas set aside or fallow land, and for newly acquired areas for agricultural production. A minimum of 10 % of the UAA (utilized agricultural area) is used to provide semi-natural habitats.
- **Establishment of Biotope corridors:** Specified areas for biodiversity on the farm will be connected with habitat corridors like hedges and buffer strips.
- **Grassland conservation:** Grassland is not transferred into other kinds of agriculturally used land; grazing densities are kept in a sustainable range and regeneration rate of grassland is respected in the grassland management.

The whole catalogue of measures was published within the Recommendations of the EU LIFE project: www.business-biodiversity.eu/en/recommendations-biodiversity-in-standards

4. Monitoring and evaluation

BIODIVERSITY ACTION PLAN AT FARM LEVEL



6. OVERVIEW OF THE EU LIFE PROJECT

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

The project has been endorsed as "Core Initiative" of the Programme on Sustainable Food Systems of the 10-Year Framework of Programmes on Sustainable Consumption and Production (UNEP/FAO).

European Project Team:

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