BIODIVERSITY FACT SHEET

FOOD & BIODIVERSITY

Permanent Crops

Cultivation of Apples

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1. INTRODUCTION

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

In this Biodiversity Fact Sheet, we provide information on the impacts of the production of permanent crops on biodiversity in temperate climate regions of the EU, as well as ways to very good practices and biodiversity management. Biodiversity-friendly agriculture is based on two main pillars, shown in the graph below. Within this paper, the aspects of "very good agricultural practices" are discussed in each chapter. The aspect of biodiversity management, including a biodiversity action plan, 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 is aimed at everyone who takes decisions on product design and development, supply chain management, product quality, and sustainability aspects in food processing companies and food retailers in the EU. We wish to raise awareness on the importance of biodiversity in the field of providing key ecosystem services as the fundamental basis for agricultural production.

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 intervention occurs around 1,000 times faster than under natural circumstances. Many ecosystems that provide us with essential resources are at risk of collapsing.

Conservation and the sustainable use of biodiversity is an environmental issue and, at the same time, a key requirement for nutrition, production processes, ecosystem services and the overall good quality of life for 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 are causing large habitat losses. 70 % of species are threatened by the loss of their habitats. In particular, farmland flora and fauna has declined by up to 90 % due to more intensive land use, the high use of pesticides and over-fertilisation.
- **Pollution.** 26 % of species are threatened by pollution from pesticides and fertilisers 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.** 22 % of species are threatened by invasive alien species. The introduction of alien species has led to the extinction of several 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 industrialised and emerging economies have led to an intensification of agriculture and a more globalised food market, resulting in enormous changes in the use of agricultural land, grassland and pastures, highly intensive production systems and a simplification of agricultural landscapes.

Agriculture depends on biodiversity while also playing an important role in shaping biodiversity. Since the Neolithic age, agriculture has significantly increased the diversity of landscapes and species within Europe. The European continent used to be covered with forests; 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 has been closely linked to agro-systems ever since. Currently, European farmers use more than 47 % or 210 million hectares of arable and grassland areas, which equates to almost half of the surface in Europe (EU-27) for agriculture. Consequently, 50 % of European species depend on agricultural habitats. This symbiotic and beneficial relationship between agriculture and biodiversity has altered fundamentally since the 1950s.

The food sector can substantially contribute to biodiversity conservation. The appropriate integration of biodiversity as a factor into sourcing strategies allows the evaluation of risks for internal operations, brand management or legal and policy changes, improves product quality, and helps to ensure a secure supply to retailers and end customers. A good strategy for biodiversity conservation, i.e. a positive biodiversity performance, opens up opportunities in terms of differentiation in the market, value proposition, meeting consumers' demands and more efficient sourcing strategies.

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) has presented the legal framework for agriculture in the European Union. It was based on the experience of hunger and starvation in Europe and targets on securing the supply of food 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 as well as additional subsidies related to production and farm management.

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

- **Directive 91/676/EEC –** "Nitrates Directive" regulates best practices for the 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 has been ratified by all member states and directly transferred into national conservation laws.
- **Directive 2000/60/EC –** "Water Framework Directive" aims to improve the state of water bodies in Europe and relates closely to biodiversity.

Since 2003, cross-compliance (CC) regulations address any shortcomings in relation to environmental issues of the CAP philosophy described above. CC represents a first step towards environmentally-friendly farming, forming a principle for linking the receipt of CAP support by farmers with basic rules related to the protection of the environment (besides others). These regulations target general measures to reduce the severe impacts of agriculture on the environment such as 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 has promoted 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 measure, encompassing actions, which directly focus on the protection and conservation of agro-biodiversity. Farmers can sow flowering strips, 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. PERMANENT CROPS IN EUROPE

Permanent crops include a variety of different cultures. They are characterised by the fact that they are not included in crop rotation. Once planted, they remain on the land for at least five years and provide recurring yields.

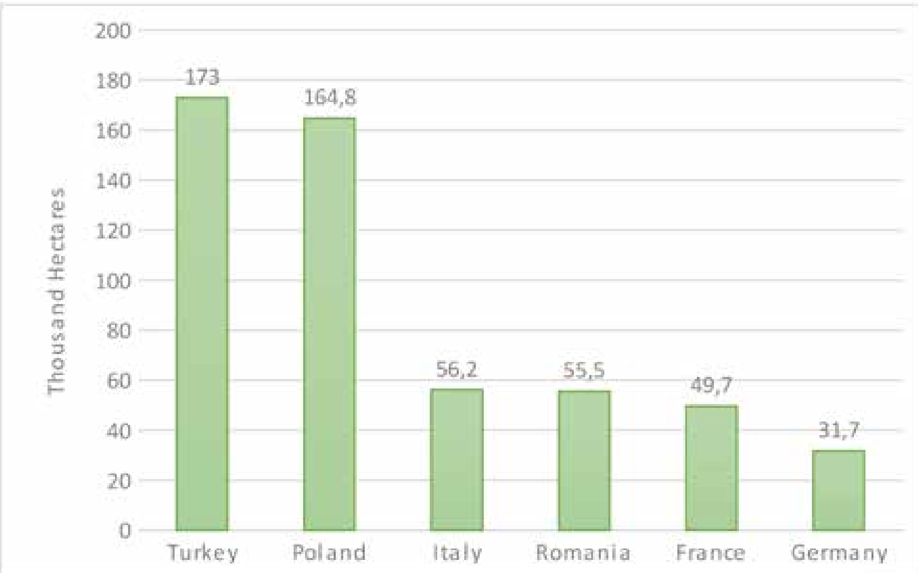
Permanent crops include, in particular, the following cultures:

- pome and stone fruit, vines, figs, kiwi, rhubarb
- berry bushes and shrubs (e.g. raspberries, gooseberries, elderberries)
- nuts (almonds, hazelnuts, walnuts, chestnuts)
- other permanent crops (asparagus, artichokes, hops, cut roses)
- certain perennial energy plants (Miscanthus, etc.)
- some approved species of short rotation forestry
- vine and tree nursery

Based on the wide range of crops, agricultural production methods are also very different. In this document, we try to include recommendations for all cultures, but the focus is on the cultivation of pome fruit.

According to Eurostat, about 7 % of the agricultural area utilised in Europe is planted with permanent crops. This corresponds to a planted area of around 11,386,000 hectares (as of 2016). There have been no significant changes over the past six years. Spain (4,724,120 hectares), Turkey (3,314,000 hectares) and Italy (2,384,380 hectares) are the most important EU member states in terms of permanent crops.

EU apple production, according to Eurostat, is concentrated in Turkey (173,000 hectares), Poland (164,760 hectares) and Italy (56,160 hectares). Overall, the EU acreage amounted to 523,100 hectares in 2016, a slight decline compared to 2011 with 548,360 hectares.



Most important apple cultivation areas in 2016, Source: Eurostat 2018

Apple cultivation is not only characterised by maximising the yield per hectare; the quality of the product is also important. Taste, marketable fruit sizes and the shelf life of the fruit are important considerations. Poor harvest years are mainly due to severe weather conditions (such as frost or hail events).

4. CULTIVATION OF PERMANENT CROPS AND IMPACTS ON BIODIVERSITY

The following pages describe the most important impacts on biodiversity and measures to prevent these impacts. For better understanding, the impacts have been divided into different categories (soil, water, fertiliser management, etc.) and for each section, recommendations for very good agricultural practices are given.

4.1 Soil preparation and seeding

Apple trees are planted between November and March. The planting itself depends on the type and condition of the soil, the proportion of stone in the soil, or the mechanical equipment of the farm. In order to build up humus some farmers are planting phacelia or clover within the planting strip. Apple trees can be planted with a spade, hoe, various earth drills or a planting machine. In contrast to annual crops, permanent crops are planted in rows next to each other with a minimum distance. This creates the arrangement of row – interrow – row. In the case of most permanent crops, tillage on an established area takes place only in the rows below the crops to avoid nutrient and water competition. In apple cultivation, keeping the area under the crop open also serves as a measure to reduce the mouse population. On the one hand, mice lack protection against natural predators (for example, birds of prey) when the soil is open and, on the other hand, regular cultivation interferes with the development of the mouse population. The number of apple plantations with ground cover below the trees, at least during seasonal change (crumbling/breaking in early spring, seeding with mowing in summer), is now increasing again.

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 for the natural soil functions. The biological processes in soil ecosystems, e.g. fulfil functions such as the integration of plant residues into the soil, by shredding, breaking them down and releasing the previously fixed nutrients as minerals for plant growth. Soil organisms create favourable physical conditions in the soil: by storing and mixing soil materials (bioturbation) as well as sticking the soil particles together through mucus secretion (revegetation), soil organisms play an instrumental role in the formation of soil pore systems. Soil organisms form stable clay-humus complexes with high water and nutrient storage capacity, and create a fine-grained, quasi erosion-resistant crumb structure. To some extent, these organisms can mitigate the harmful effects of organic substances on soil, groundwater, and the food chain.

In general, soil treatments affect biodiversity negatively, as the natural processes described above are interrupted. Oxygen, ultraviolet radiation and heat will come in contact with the soil, particularly after ploughing the resulting furrows and this will lead to severe edge effects for life in the soil. Humification processes, which take place under exclusion of oxygen, will be hindered; the natural soil pore system is disrupted. Each treatment affects biological diversity within the soil and the fauna and flora above the ground to a different extent and is fatal for many species.

4.1

Very good agricultural practices to ensure more biodiversity

Less compaction can be created by generally reducing soil treatments. Therefore, working steps can be combined, e.g. ground cover management and crop protection activities. Wildflower mixtures cultivated in the interrow help to further reduce compaction, but also contribute to the nourishment of pollinators and insects. Sowing the seed mixtures for the ground cover soil should be prepared with a milling machine or rotary harrow.

4.2 Nutrient management and fertilization

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The aim of fertilisation is balanced nutrition of the different cultures. In apples, good qualities and good yields can only be regularly achieved with well-nourished trees. It also makes the trees more resistant and more tolerant against stress. Thereby, fertilisation and soil management are closely linked. Fertilisation should cover the nutritional needs of permanent crops to the extent necessary to give the nutrients back to the soil that were absorbed for plant growth. Plants need different nutrients for the growth and development of the fruit. The main nutrients are nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca) and sulphur (S).

The basis for proper fertilisation is soil analysis, which should be repeated at intervals of no more than six years on soils at risk of leaching or in shorter periods of approx. 3–4 years on very heavy soils. The soil samples should be taken from the soil layer at least 0–30 cm from the surface, before fertilisation. The analysis will determine the pH value, lime requirement and levels of plant-available phosphate (P2O5), potassium (K2O), magnesium (Mg) and boron (B). The additional determination of humus content is an important decision aid to assess nitrogen fertilisation. In order to maintain soil fertility, liming may be necessary on acidic soils. The nutrients supplied with organic fertilisers (manure, compost) must also be taken into account. Location factors such as climate, water supply, soil type, root penetration and soil structure influence the actual nutrient utilisation and the actual supply level. For reasons of plant health and water protection, oversupply should be avoided. On the other hand, long-term nitrogen deficiency can seriously affect the performance of trees.

The nitrogen demand of pome and stone fruit crops and shrub berries is relatively low and the actual nitrogen export from the field via the fruits is minor. However, the supply of nitrogen should not be too high, as this often leads to strong-growing shoots and high leaf mass. Leaf fertilisation only makes sense in the case of acute nutrient deficiencies or stress situations, as well as in certain crops to promote fruit set and fruit quality.

EFFECTS ON BIODIVERSITY

Two aspects need to be considered with regard to the effect of fertilisation on biodiversity. The first concerns changes in the trophic state of plant communities, the latter affects run-offs into the environment, including pollution with nitrogen and phosphorous.

Plant communities are composed of biotic and abiotic factors such as soil quality, precipitation, competition with other vegetation, etc. Permanent crops are not naturally composed plant communities, so this concept cannot be applied here. Nutrient run-offs to water bodies result in a dramatic change in the conditions, which is known as eutrophication. This entails changes to the water chemistry and limnic organisms. Algae and aquatic plants can then grow excessively and overwhelm other plant species, and take away the nutrients required by other plant species, many microorganisms and animals.

Often, even with good nutrient management on the field, plant communities of buffer strips 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. fleece flower (*Fallopia japonica*) and bee-bums (*Impatiens glandulifera*) benefit from nutrient efflux and cover vast areas along riparian buffer strips.

More nutrients lead to higher biomass production and therefore to a higher food supply for herbivorous arthropods at 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 specialised 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

Important for good nutrient management is a nutrient cycle, which is as closed as possible, as well as a good humus layer, which supplies the plants with nutrients. One way to improve the quality of the soil and to increase the humus content in the long term is the regular use of organic matter in the form of compost, ground cover within the interrows or leaving behind trimmed timber. Much of the nutrients removed from the soil by the vegetative development of the plants are thereby preserved. The nutrients bound in the organic substance represent a slowly flowing nutrient source. Only the nutrients exported with the fruits have to be replaced in the longer term. Depending on the soil nutrient content, nutrient supplementation should be performed at shorter or longer intervals. Due to the complexity and the many positive effects on soil fertility and structure, it is generally recommended to use organic fertiliser instead of mineral fertiliser.

The nutrient requirements of the fruit are not distributed evenly throughout the growing season, but show focal points. Fertilisers should therefore be adapted to this process and the actual needs of the plant.

Ground cover prevents soil erosion, improves driveability and reduces nitrate leaching in periods of high rainfall. Soil management also affects fruit growth and the availability of nutrients. A stable soil structure (through humus supply and ground cover and avoiding compaction) enables the development of water and nutrient reserves through intensive rooting. In plantations with permanent ground cover but with low legume content, an additional nitrogen and water requirement of the ground cover and a temporary nutrient capture in the plant biomass must be considered depending on plant species, location, weather conditions and management.

In the case of nitrogen fertilisation, nitrogen redelivery of the soil has to be considered; this depends on the humus and total nitrogen content of the soil, the activity of the soil life, the weather and the soil management. Prior to the fertilisation of significant amounts of nitrogen (more than 50 kg N / ha / year), the nitrogen fertiliser requirement and the amount of nutrients available in the soil must be determined and documented at the time of fertilisation.

4.3 Pest control and plant protection

Maintaining the health of permanent crops to produce high-quality fruit and grapes is the key objective of farmers. To ensure this, variety characteristics, choice of rootstocks and crop-specific measures are combined with crop protection measures. Pests and diseases can have a considerable impact on the economic output of a farm. Insects harm plants and fungal, bacterial and viral infections decrease yields and can lead to a complete crop failure in humid periods during the summer. For plant health and targeted plant protection measures, various individual methods and combinations are possible.

Integrated Pest Management – Plant protection is based on several principles in integrated pest management (IPM). Pests, diseases and weeds are kept with gentle methods below a defined threshold and the necessary control measures are coordinated. The natural factors that can limit the pathogens are included in such a regulatory system (e.g. beneficials, susceptibility of the varieties, weather). Every farmer must be able to decide on the necessary measures on the basis of his own checks. Therefore, he should improve his knowledge of diseases, pests, beneficials and damage thresholds, e.g. by regular participation in training and advisor events. When using pesticides, the amount of active matter applied needs to be adjusted to the degree of infection. Preventive and calendar spraying, i.e. the application of pesticides without any reported 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.

Fungicides, bactericides, etc. – Fungal infections and the application of fungicides are the biggest challenge in permanent crops. They are ideally managed with monitoring systems and prediction models, which assess 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) if the economic loss is outbalanced. Targeting diseases inefficiently can lead to resistances, meaning that a disease becomes insensitive to a particular fungicide.

Apple scab is one of the most dangerous apple diseases worldwide. In humid and warm weather conditions and with susceptible varieties, infestation is hard to avoid and often difficult to combat. Without pesticides, it is usually not possible. Investigations into the use of chemical pesticides in fruit growing come to the conclusion that combating fungal diseases requires by far the most measures. Especially in the cooler areas rich in rainfall in the north of Germany and at Lake Constance, the control of apple scab is the focus of all crop protection activities. In the case of apples (dessert fruit), fungicides account for 70 – 80 % of all plant protection products used. According to surveys carried out under the National Action Plan for the Sustainable Use of Plant Protection Products, an average of 24 fungicide applications per farm were carried out in 2007 to 2011 at over 50 comparative farms. Even organic fruit growing is not without the use of pesticides. Here, especially copper and sulphur preparations are used.

Insecticides and acaricides – Permanent crops have a large number of insect pests and mites, varying by region and production methods. Most pests are of minor importance, causing insignificant yield losses. The most harmful pests occur annually and cause severe yield losses. Insecticides and acaricides are used to reduce such pests, in accordance with the processes described above. The application of insecticides and acaricides is bound to the annual population development of a given pest. Broadband insecticides target any arthropod/insect; ovicides, larvicides or acaricides only some stages or groups of species. Neonicotinoids are a group of highly effective insecticides whose active ingredients bind to receptors of nerve cells and thus interfere with the transmission of nerve stimuli in insects. They can act as contact or food poison. In contrast to other insecticide groups, neonicotinoids can be applied in many different ways. Most can be used for leaf treatment, pickling and soil treatment. Since spring 2018, the EU has banned the use of three active substances from the group of neonicotinoids outdoors.

Herbicides – The regulation of weed growth is also a major topic in fruit and wine growing. Unwanted wild flora competes with the crop and can reduce yield and quality, and increase the pressure of pathogens in the crop. The number of herbicide applications is defined by the product used and the efficiency of the applied mechanical methods to reduce weeds. Thereby, herbicides are divided into contact and residual, total and specific. Residual products seal the ground and inhibit the development of wild plants; contact herbicides enter emerging plants and poison its metabolism. Total herbicides target any plant species (N.B. monocotyledonous like grass or maize and dicotyledonous plants have slightly diverging metabolisms), specific herbicides only some. Currently, few herbicides from the group of active substances of glyphosate, glyphosinate, MCPA, propyzamide and flumioxazine are approved in apple cultivation in Germany.

EFFECTS ON BIODIVERSITY

Despite the optimisations and regulations, the application of pesticides is common in conventional European agriculture. Every conventional crop is treated several times with a combination of active substances. The general purpose of pesticides is to erase biodiversity from the cropped area, preventing quick re-population and ideally keep the crop clean and healthy until the harvest. The efforts of the farmers means this is achieved to a great extent and highly efficiently. Fields are free of wild flowers, and butterflies and bees are rarely seen for most of the summer.

Pesticides are a big environmental issue for water bodies and the environment in general and are thus criticised by NGOs and some authorities. 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 leach into water bodies during heavy rain. Careful application of pesticides is the key to minimising collateral damages. The efficiency of herbicides is directly linked to 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.

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

Insecticides and acaricides – The purpose of insecticides is to erase pests and arthropod biodiversity permanently from the arable land. One current well-known example is neonicotinoides. This group of active substances targets the nervous system of insects. Far less effective, but still recognisable, these substances also affect non-target groups such as mammals and other animals. Several means of application can limit the impact on species not targeted by a treatment, e.g. spraying in the evening when pollinators will be less affected, or application methods that limit drift to adjacent landscapes, buffer strips along habitat edges, etc. One main issue of insecticides is that they not only affect the targeted pests and disease vectors but also beneficial insects such as pollinators. Selectivity in pesticides does not mean exclusiveness, so there is always a side effect on non-target insects.

Herbicides – Wild flowers form the basis of food chains in cultural landscapes. Consequently, if this basis is absent in crops and disturbed in adjacent areas, there will be less food for arthropods and any birdlife depending on that. Many species are almost extinct. Herbicides, working either as contact or systematic toxin, which is taken up by any plant part and transported within the plant, are highly effective in combating weeds. Glyphosate is an example for a total herbicide working as contact toxin. 0.1 ml/m² of active matter leads to the desired effect. 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 appearance of unwanted weeds. However, these pre-emergence herbicides can mostly be substituted by mechanical weeding techniques.

4.3

Very good agricultural practices to ensure more biodiversity

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

- Choosing a variety suitable for the farming site
- Use of resistant and disease-resistant varieties and seed and seedlings allowed by the standards
- Balanced nutrient and water balance of the soil, improving the proportion of organic matter in the soil
- 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)
- Another and very important aspect is the protection and promotion of important beneficial organisms, e.g. by planting and maintaining ecological structures in and around the cultivated areas. Or by the fact that the soil cover is kept as diverse as possible and has the longest possible flowering period.
- Monitoring plans must be available for arthropods. Pests and beneficial populations must be monitored weekly in their corresponding high season. Farmers need to be able to identify pests and the effects of beneficial organisms and calculate the damage thresholds accordingly. For pathogens (fungal, bacterial pathogens, viruses), the appropriate prognosis and diagnostic methods must be used.

If these measures have been implemented and defined thresholds for pest and disease infections are exceeded, the use of pesticides can be part of integrated pest management in non-organic farming. In organic farming, the approved pesticides and other biological methods such as the use of pheromones, etc. can be used.

In order to protect open water bodies, buffer zones must be installed and maintained along the edges of waterways and waterbodies (minimum width: 10 metres). The best available spraying techniques, i.e. devices, which inhibit or reduce the 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 authorised employees only. The use of pesticides, which are dangerous to bees, pollinating insects, beneficial organisms, amphibians or fish should be prohibited. Furthermore, 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

Irrigation is essential for most agricultural production and agricultural water use accounts for a significant proportion of total water consumption (e.g. Spain 64 %, Greece 88 % and Portugal 80 %, according to Eurostat). France, Greece, Italy, Portugal and Spain account for 70 % of the total area equipped with irrigation technologies in the EU-27. Permanent crops are irrigated somewhat less than other crops. Irrigation currently takes place mainly in arid regions to increase growth and productivity.

In Central Europe, temporary irrigation is often used to increase yields in dry summers, during sensitive stages of plant growth. 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 will likely increase with 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 permanent cultures.

EFFECTS ON BIODIVERSITY

Irrigation is an essential driving force in water use management in many regions and has a huge impact on the environment and biodiversity. Drawing water from groundwater, rivers, lakes, irrigation systems redistribute this water, having numerous effects on biodiversity, foremost in Mediterranean areas. Building dams and channels reduces downstream river flows and changes the hydrology of entire river systems with impacts on all life in the watersheds. Over-extraction of water for agriculture can alter water habitats and limnic fauna 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 water is taken. With changing hydrology, ecologically important wetlands or flood forests dry out, change their 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. for bird migration, and having numerous other ecological functions. They represent habitats for a diverse fauna and flora and rare plant species with a very high environmental value.

4.4

Very good agricultural practices to ensure more biodiversity

Agricultural cultivation should be adapted to regional and climatic conditions so that local or regional water resources, natural wetlands or regional protected areas are not overused or damaged. The link between water source and water use (ecosystem and ecosystem service) is crucial. In general, water use from open waters as well as groundwater bodies in Europe must comply with strict legal requirements. Regional governments and water authorities set withdrawal limits (legal compliance) and any withdrawal is subject to 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 agriculture in the area. These plans indicate the maximum sustainable water use per year as well as at certain times within the area.

The use of water from illegal sources such as unauthorised wells or unauthorised 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).

5. BIODIVERSITY MANAGEMENT

A tool which is being proposed to tackle the issue of biodiversity at farm level 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 approach to develop it. Such a plan 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, define measurable goals, 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 improvement. The aim is to identify the main impacts of the farming activities on biodiversity, which should be avoided, and the main opportunities existing to protect/enhance biodiversity.

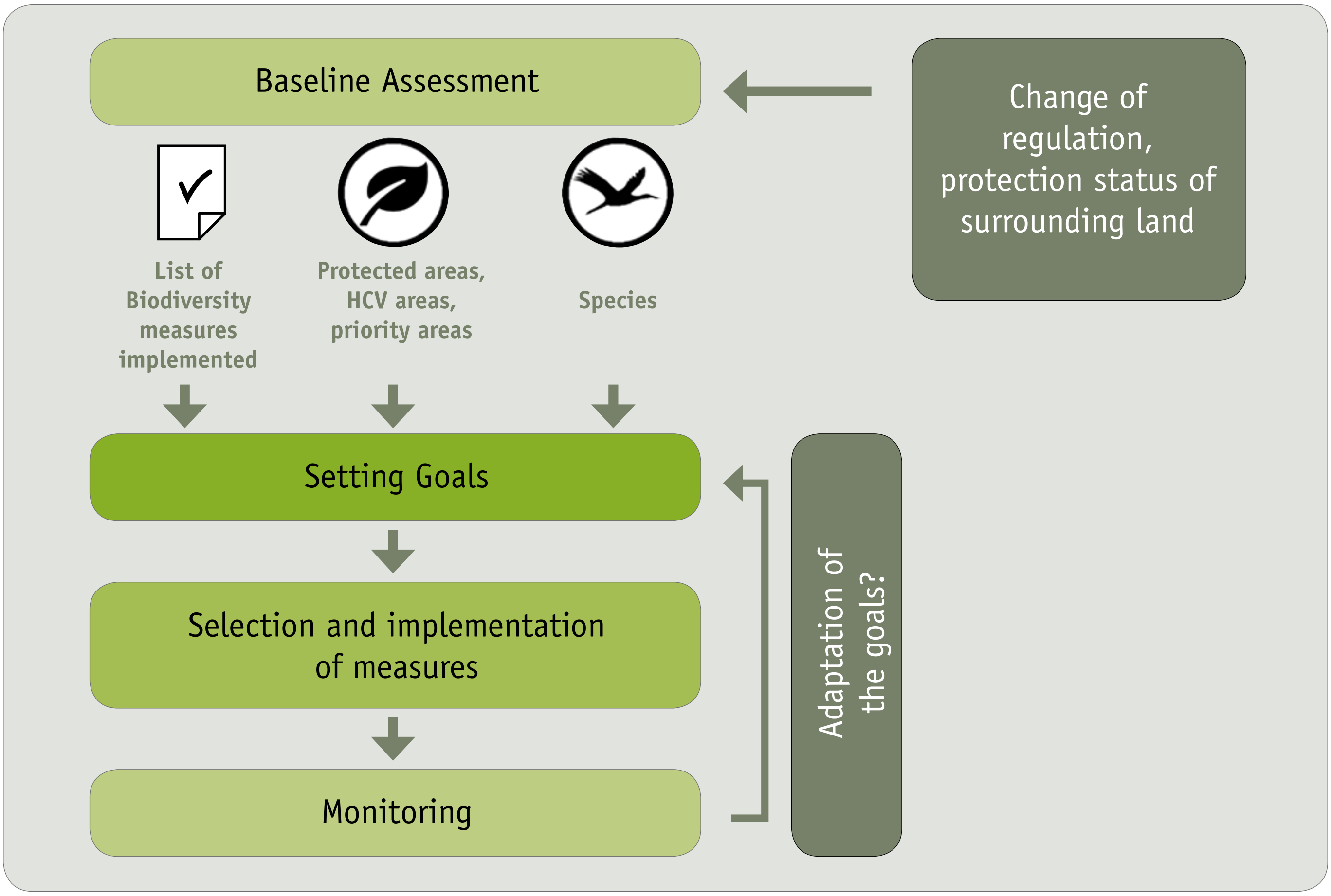
3. Selection, time line and implementation of measures for enhancing biodiversity

Some examples of measures 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 (utilised 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 such as 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 the regeneration rate of grassland is respected in 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



6. OVERVIEW OF THE EU LIFE PROJECT

Food producers and retailers are highly dependent on biodiversity and ecosystem services but they 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, and 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 advisors and certifiers of standards as well as product and quality managers of companies

C. Implementation of a cross-standard monitoring system on biodiversity

The project has been endorsed as a "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:

We appreciate the support of our partner standards and companies:

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