Factsheet

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# Agriculture and biodiversity

Impacts of different farming systems on biodiversity

FiBL

**Biodiversity is part of the organic farming system. The promotion of species diversity on farms is integral to organic production. With biodiversity areas, extensively farmed areas and site-adapted management, organic farms provide more space and resources for the diverse needs of a multitude of species.**

**Farmers benefit from the enhanced ecosystem services provided by greater biodiversity, as this enables them to reduce interventions (e.g. the use of insecticides) in their cropping systems. Functional groups such as pollinators, beneficial insects and decomposers benefit from organic farming methods.**

**Species diversity varies between farming systems (organic, conventional, etc.). However, there can also be significant differences between enterprises within the same system: annual arable crops, viticulture and orchards or permanent grassland offer different potential for promoting species diversity.**

**With rich biodiversity, organic farming promotes stability and resilience in production systems, which is becoming increasingly important as disturbance events become more frequent and climatic changes more pronounced. In combination with nature conservation measures, organic agriculture can leverage additional synergies to promote biodiversity.**

**Content**

# Biodiversity and farming

Biodiversity encompasses the entire diversity of all life forms. Assessments of biodiversity include not only plants and animals but also bacteria and fungi. The diversity and quality of habitats and the connectivity between them have a significant influence on biological diversity.

Genetic diversity within a population is key to ensuring the continued existence of a particular species in a particular space. Genetic variability enables species to adapt to changes in environmental conditions and the climate. If semi-natural habitats of a species are located at significant distances from each other, the species' populations in question are at risk of isolation and loss of genetic exchange. It is therefore important for the conservation of biodiversity that habitats are maintained and connected. Semi-natural habitats that are optimally distributed in sufficient quantity and quality provide for long-term biological development opportunities of numerous species. The potential for effective biodiversity promotion rests upon the diversity and abundance of different habitats in the landscape.

### Benefit for farming

Biodiversity is a vital prerequisite for the healthy and natural development of all living organisms. Rich biodiversity promotes the optimal functioning of natural processes and supports ecosystem services that are highly significant for agriculture. These include, for example, natural pest regulation, pollination of cultivated and wild plants by insects, and the generation and breakdown of plant biomass.

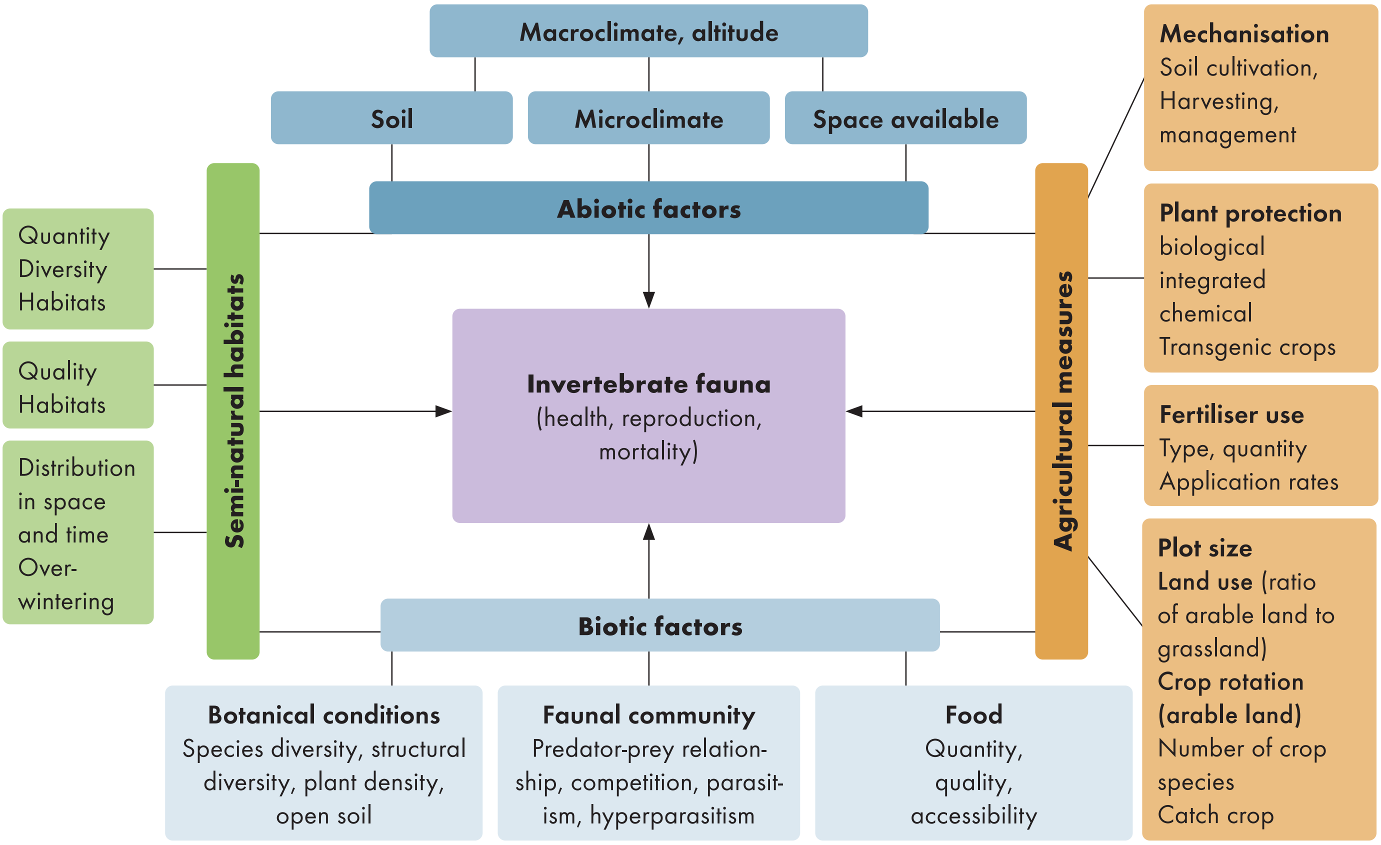
Agricultural policy increasingly promotes farming methods that preserve biodiversity and conserve natural resources[1]. Agroecological measures are intended to render farming systems more robust and efficient and help minimise the use of external auxiliary inputs. This can improve natural regulation processes and thus the functionality and sustainability of farming systems.

### Key factors for biodiversity in agriculture

In general, the diversity of flora and fauna at the local level is influenced by both anthropogenic factors (such as the type and intensity of agricultural practices) and non-anthropogenic factors (e.g. site conditions such as soil characteristics, altitude and microclimate). This is also true for the landscape level, where the quality of landscape infrastructure (e.g. the extent and diversity of semi-natural habitats) is particularly important. Biotic factors such as food resource availability and floral, structural diversity in cultivated and non-cultivated habitats impact on the diversity and abundance of animal organisms (see Figure 1 on p. 4).

Semi-natural areas offer habitat and hibernation areas for many species. Networked biodiversity areas and small-scale structures foster biodiversity at a high quality level and provide habitats for rare, endangered species.

**Figure 1: Factors influencing biodiversity – the example of small animal fauna**




Abiotic and biotic site factors strongly shape the conditions for small animal fauna. Anthropogenic activities such as agricultural cultivation measures and the retention and management of semi-natural habitats further influence the invertebrate fauna[2].

## Species loss and the role of agriculture

The intensification of land use associated with the increase in agricultural production over the decades has fundamentally changed the role of agriculture for biodiversity. The structurally rich cultivated land with fields, meadows, field margins, hedgerows, vineyards, copses and traditional orchards provided valuable habitats for many species of flora and fauna as well as soil organisms until the onset of the industrial farming revolution. Intensive agriculture, in contrast, is causing a massive decline in biodiversity. The main drivers of this decline include high levels of agrochemical use, loss of valuable semi-natural areas such as dry grasslands, hedgerows, floodplains and traditional orchards, the dissection and paving-over of habitats (landscape fragmentation), a large livestock population and the reduction in genetic diversity. Climate change, introduced non-native species, light pollution, and also the abandonment of meadows and pastures in mountainous areas further exacerbate the problem. As a result, the overall population of insects has declined significantly in recent decades: In Germany, for example, a 75 % decrease in insect biomass within three decades was recorded in 63 protected areas surrounded by agricultural land[3]. In grassland, too, a decline of 67 % in insect biomass was recorded over a 10-year period and a 34 % decrease in insect species[4]. A decline in insect biomass and species is particularly problematic given that many other species feed on insects, e.g. numerous species of amphibians, birds and bats. Changes in the food chain thus also put at risk many other species and ultimately many important functions in agriculture, such as natural pollination (cascade effect). Biodiversity loss in various sectors has also been analysed and documented for Switzerland[5,6]. The Red Lists of endangered species of flora and fauna identify intensive agriculture as one of the main drivers of species loss in the cultural landscape. Many populations are threatened because their size drops to below the minimum viable population size and their habitats are insufficient in size and quality (lack of genetic exchange). Intensive pesticide use, synthetic nitrogen fertilisers, land consolidation, drainage and the use of heavy machinery have contributed significantly to the drastic decline in biodiversity and to insect decline.

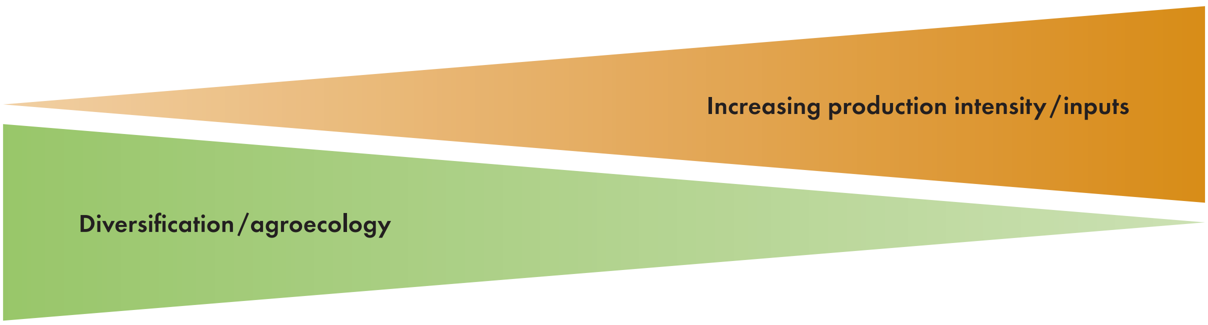
### Focus on farming systems

Whether a farming system can be characterised as intensive or extensive depends on the permitted use of auxiliary inputs on a given farm and on the farm's structure, mechanisation and land use (crop types, ecological infrastructure, etc.). There is a wide range of different farming systems, from conventional, integrated (IPM with agroecology) or high-input organic farming to low-input systems such as biodynamic or regenerative farming or farming systems informed by permaculture principles (Figure 2). Even within the individual farming systems, there is great variability of practices, especially in organic farming. This ranges from holistic biodynamic agriculture with diversity in cultivation and diverse semi-natural areas to intensive organic (arable) production in homogeneous landscapes (e.g. in southern Spain and eastern Europe). Moreover, there is a wide range of different farm types, from specialised farms (arable, vegetable, fruit or viticulture) to diversified mixed farms with significant differences in species diversity between lowlands, hilly areas and mountain regions.

Organically managed fields often harbour a rich flora containing rare and endangered plant species.

**Figure 2: Cropping systems between productivity and biodiversity promotion**

| Near-natural | Organic | Integrated | Conventional-industrial |
| --- | --- | --- | --- |
| Holistic systems approach<br>*Examples:*<br>Agroforestry, Demeter premium organic | Economically optimised systems approach<br>Agroecology<br>*Example:*<br>Bioland (intensive) | Pesticide reduction and agroecological measures<br>*Example:*<br>Integrated production (IP) | Large-scale monocultures<br>Yield maximisation<br>*Example:*<br>Factory livestock farming |




Increasing production intensity tends to go hand in hand with a decrease in the diversification of production and weaker support for and maintenance of diverse, semi-natural habitats.

## More biodiversity on organic farms

Numerous comparative studies of the impacts of conventional and organic farming systems have shown that organic agriculture has a more favourable effect on flora and fauna, both in individual plots and at farm level[7,8]. Global meta-studies show that organically farmed areas have on average 30 % higher species richness and a 50 % higher abundance of organisms[9]. The differences observed have held steady over the last 30 years[10]. The effects differ by organism group and also vary with the abundance or otherwise of landscape features, cropping systems and cropping intensity. The strongest effects of organic practices can be seen in annual arable crops, followed by specialty crops (viticulture, fruit production). The weakest effects have been observed in grassland. Important groups such as pollinators, beneficial insects and decomposers are promoted by organic practices in various cropping systems[9,10,11] (see Table 1 on p. 7). The positive effects are not only evident locally, but also at the landscape level[12,13,14].

Various groups of flora and fauna are supported in the process. Soil organisms, diverse groups of insects, spiders, birds and mammals benefit above average from organic management, depending on the crop produced (see Table 1 on p. 7). In contrast, similar levels of animal pest infestation tend to occur in the different farming systems[15]. A global meta-study on microorganisms confirmed that indicators of microbial biomass activity are on average increased by 32–85 % in organic systems[16].

There is as yet a dearth of comparative studies in mountain areas.

### Opportunities for rare and endangered species

A global meta-study has moreover shown that organic farming can support rare insects and spiders (abundance +55 %, diversity +27 % compared to conventional farming)[17]. Endangered species conservation usually requires tailor-made species protection programmes. The customary agri-environmental programmes in cultural landscapes are not sufficient in this regard. Organic farming can however make an important contribution to species protection, especially on farms hosting an abundance of high nature value and semi-natural areas[18]. The skylark, a characteristic species of the open cultural landscape, which has been strongly marginalised by the intensification of agriculture, as well as the now rare lapwings and grey partridges, can occur at higher densities under organic management[19,20]. Rare plant species of arable land[21,22] and more specialised species of ground beetle (carabids) have also been found at higher diversities and densities on organic farms[18].

### Promotion of functional groups

Diverse functional groups at high abundances are fundamental for the functioning of many ecological processes in cropping systems. Functional groups such as pollinators, beneficial insects, detritivores and producers (diversity of plants) are favoured by organic practices.

Three global review studies have shown that organic agriculture has a positive impact on the diversity and abundance of pollinators, beneficial insects, detritivores (abundance only), herbivores (diversity only) and plants compared to conventional production[10,11]. In terms of abundance, pollinators (+90 %), beneficial insects (+38 %) and rare arthropods (+55 %) benefit the most (see Table 1 on p. 7)[17].

As do several other monolectic wild bee species, *Hoplitis adunca*, a member of the genus of leafcutter, mason and resin bees, collects pollen from only a single plant species *(Echium vulgare)*.

**Table 1: Effects of organic farming on the diversity and abundance of different species and functional groups compared to conventional farming**[9,10,16,23,24,25,26]

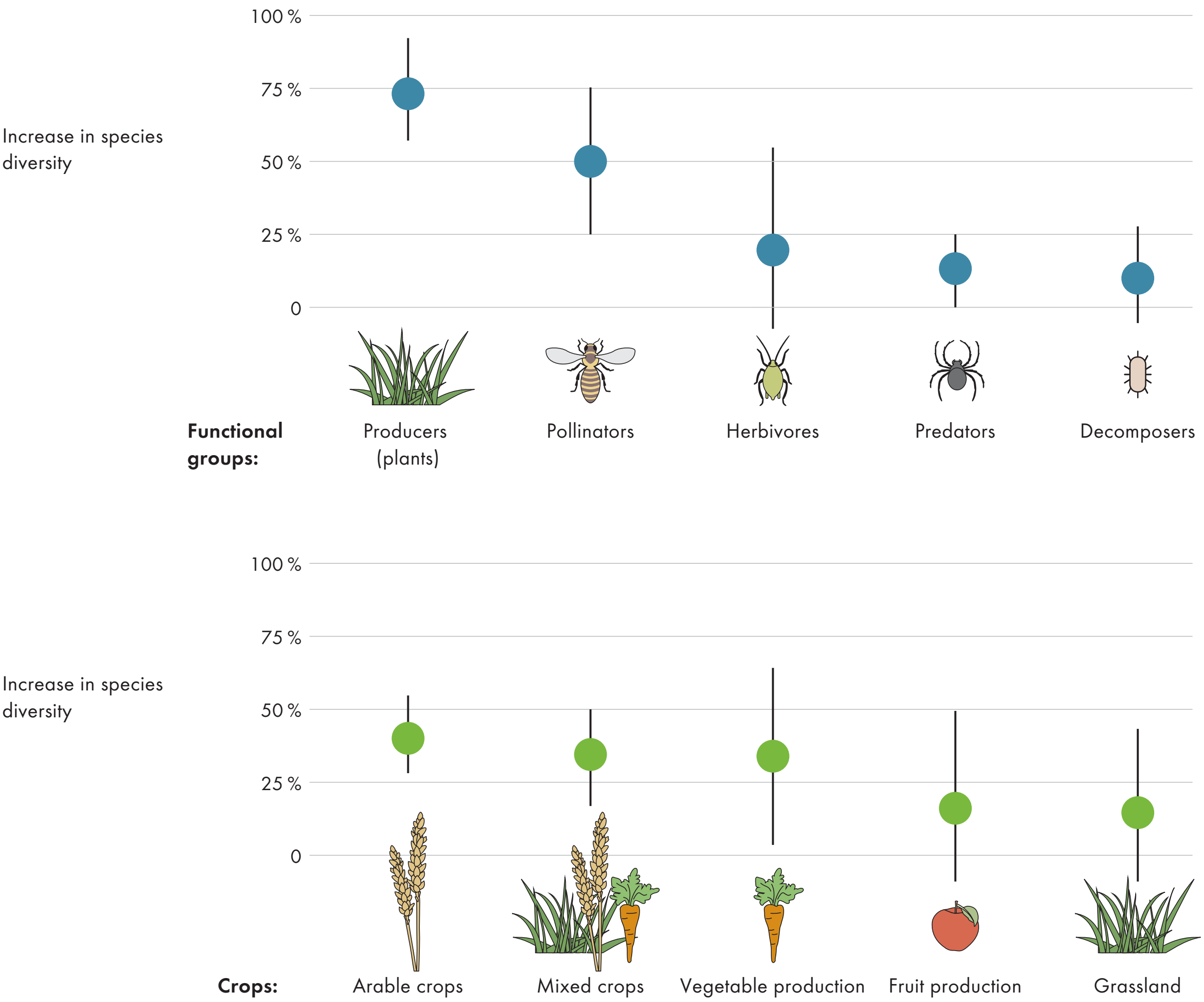
| Groups | Farm enterprise category | Abundance | Species diversity |
|---|---|---|---|
| **Plants** | Arable land | ++ | ++ |
| | Grassland | | + (=) |
| | Viticulture | + | + |
| **Birds** | Various enterprises | + (=) | + |
| **Mammals/bats** | Various enterprises | + | + |
| **Earthworms** | Arable land | + | = |
| | Viticulture | + (=) | = |
| **Spiders** | Arable land | + | + |
| | Viticulture and fruit production | + | + |
| **Beetles** | Various enterprises | = (+) | = (+) |
| **Wild bees** | Various enterprises | + (=) | + (=) |
| **Butterflies** | Various enterprises | + | + (=) |
| **Soil microbes** | Various enterprises | +* | |
| **Mycorrhizal fungi** | Arable land | + | + |
| **Pollinators (functional groups)** | Various enterprises | ++ | ++ |
| **Beneficial organisms (functional groups)** | Various enterprises | + | + |
| **Decomposers (functional groups)** | Various enterprises | + | + |

Positive '+', no difference '=', in some instances '()' compared to conventional farming.
*Microbial biomass

Ground-breeding birds such as the skylark can only survive in areas under extensive management.

Rare species such as the Scarce Copper butterfly *(Lycaena virgaureae)* benefit from species-rich grassland.

**Figure 3: Relative increase in species diversity on organic farms compared to conventional farms**




The differences in species diversity on organic farms compared to conventional farms (conv. ref. = 0) vary between functional groups (top) and crop systems (bottom). Plant species diversity is about 75 % higher on organic farms than on conventional farms. A meta-analysis found species richness to be only 20 % higher in permanent grasslands such as meadows and pastures under organic management[10].

**Biodiversity in fruit production**

Dessert fruit plantations are intensive production systems. Comparative studies of dessert fruit plantations in different European countries have shown that both abundance and diversity (+38 %) of a variety of groups of beneficial insects are higher in organically managed orchards than in IPM orchards[27,28]. Predatory beetles, bugs (Heteroptera) and spiders benefit particularly from organic management, which results in better natural pest control (aphids) in oganic apple orchards[29]. Such indirectly positive aspects can compensate for some of the yield differences. Sown wildflower strips and other cropland measures enhance the positive effects on beneficial insects and pest control[30]. In contrast, no differences were found in the natural pollination of fruit trees.

As perennial crops, vineyards produce stable, species-rich ecosystems when no synthetic pesticides and artificial fertilisers are used. High plant species diversity enhances the vineyard and makes the plots attractive for many species of fauna and other organisms.

**Biodiversity in vineyards**

Vineyards hold great potential for biodiversity. Their biological diversity is influenced by a variety of agricultural practices (soil cultivation, plant protection, soil management) and agronomic characteristics (soil and climatic conditions, flatter machinery-accessible terrain or terraced vineyard). Due to this significant heterogeneity, there are major differences in the extent to which viticulture contrasts with other farming systems. A number of systematic reviews show that organic management in vineyards has a positive effect on plant diversity, soil organisms (microbial biomass, respiration), bacterial diversity, soil fungi (mycorrhiza) and earthworms. Similarly, various arthropod groups such as spiders, ground beetles, wild bees and ants benefit, occurring in greater abundance and diversity[23,24,25,31]. In addition to species diversity, the composition of faunal communities in vineyards also changes significantly under organic management.

Intensive soil cultivation can cancel out positive local effects in organic vineyards. With intensive soil cultivation, earthworm abundance in organically managed vineyards is similar to that under conventional management[24].

Other important and welcome beneficial insects include predatory mites, as they are important antagonists of spider mites in vineyards. They also occur in greater diversity and abundance in organic vineyards. Their occurrence is strongly dependent on the intensity of plant protection measures.

At the landscape level, the diversity and abundance of bats[32] and farmland bird species (more insectivorous species) can be fostered by organic practices in vineyards, even more so in landscapes that are quite devoid of natural features[33]. In contrast, in structurally rich wine-growing areas (e.g. Tuscany), the occurrence of farmland birds does not differ with organic management, as any losses resulting from agricultural management are compensated for by residual semi-natural habitats in the vineyard matrix[34].

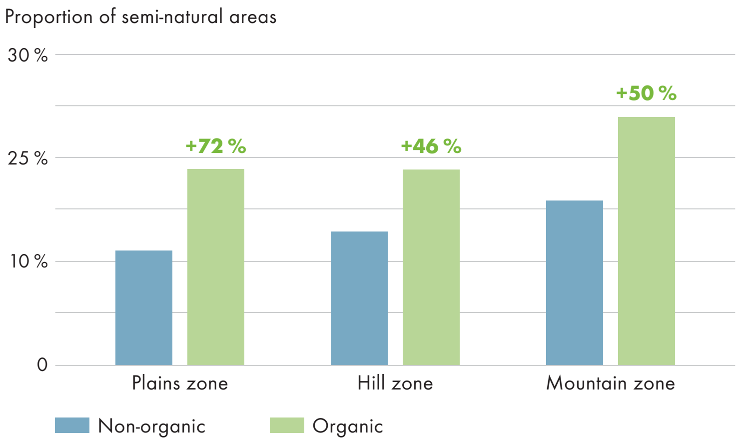
Ultimately, local effects on the various groups of fauna and other organisms are strongly dependent on cultivation intensity. The main causes of reduced biodiversity are intensive pesticide and herbicide use, excessive soil cultivation and lack of (permanent) green cover. Agroecological measures such as permanent green cover/species-rich cover crop sowings, careful soil management and the avoidance of herbicides can level out system differences for various groups of organisms. Moreover, faunal diversity in vineyards is significantly influenced by the proportion of semi-natural habitats in the vicinity.

An abundant supply of biodiversity areas such as sown wildflower strips is important for the survival of numerous species. Semi-natural habitats provide valuable food resources, safe refuges and hibernation sites.

## Greater habitat diversity on organic farms

In addition to the cultivation intensity on agricultural land, the proportion of semi-natural areas on farm holdings is crucial for the preservation of biodiversity. Hedgerows, species-rich and structurally rich meadows and pastures, wildflower strips, fallow land and small-scale structures constitute habitats, refuges and hibernation sites that are essential for the survival of many animal species[35].

**Figure 4: Proportion of semi-natural biodiversity areas on organic and non-organic farms**




The proportion of biodiversity areas is greater on organic farms in all topographic zones. The greatest difference is evident on organic farms in the intensively managed plains zone[36].

Comparison studies of organic and conventional farms in Switzerland[36], Denmark[37] and England[38] show that the proportion of semi-natural habitat on organic farms is higher than on their conventional counterparts. In many cases, organic farms are characterised by smaller plot sizes, greater plot diversity and more varied land use[39]. An analysis of all Swiss agricultural holdings showed that the declared semi-natural habitats constitute 22 % and 13 % of the agricultural area on organic and non-organic holdings respectively. Organic farms thus implement approximately two thirds more measures (Figure 4). The differences are greatest for extensively and less intensively used meadows as well as hedgerows and standard fruit trees in the plains and hill zones[36]. In highly productive favoured regions, however, there is also a significant deficit of valuable biodiversity areas on organic farms.

## Positive effects at the landscape level

Organic agriculture promotes biodiversity not only locally, but also at the landscape level. This positive landscape effect has been noted in annual crops and permanent crops for the arable weed flora [40], pollinators[17, 41] and various groups of beneficial insects[17,13,42]. In general, the positive effects of organic farming systems are most pronounced in landscapes of moderate complexity[22, 41, 43,44,45,46]. In contrast, homogenous featureless landscapes with a low proportion of land under organic management and where the organic land is isolated lack sufficient source areas of species diversity and areas for gene exchange. As a result, organic sites are unable to realise their potential.

The positive effects on species increase with a growing proportion of organic land in the landscape matrix. In the context of agri-environmental programmes, organic agriculture can thus play a complementary and synergistic role in promoting flora and fauna[40,42,47].

The effects of large-scale contiguous areas under organic management on the various groups of flora and fauna have not yet been investigated and are the subject of further research.

## Improved ecosystem services with organic management

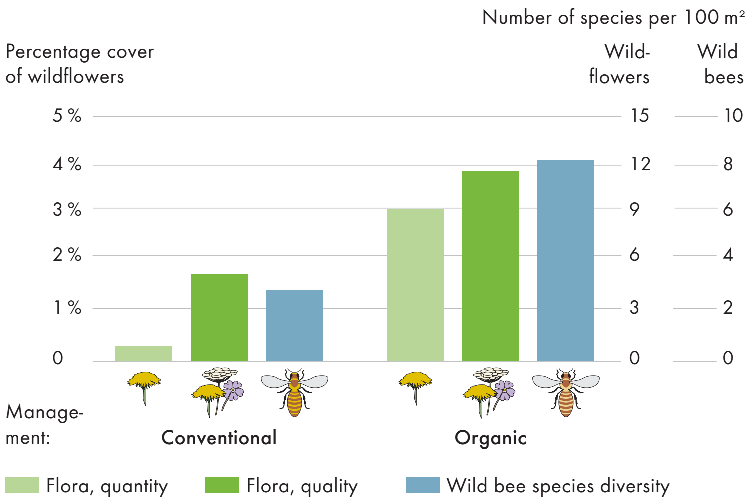
Rich species diversity is fundamental to the functioning of many processes in natural systems. Species-rich habitats are more productive and better able to adapt to environmental changes such as climate change. Species-rich meadows, for example, are less prone to soil erosion, produce more stable yields during periods of drought and have a longer growing season[48]. The higher species diversity and greater population densities of certain species that have been noted on organic farms impact important ecological processes. Evidence shows that organic farming can improve ecological functions such as:

### Natural pollination[22,41,45,46]

The higher cover and diversity of the companion flora in organic cereal plots supports flower-visiting insects such as honeybees and wild bees. There can be a three times higher species diversity and seven times higher abundance of bees in organic fields compared to their conventional counterparts[46]. With an increasing proportion of organic land in the arable landscape, the populations of wild bees including those of bumblebees in the surrounding semi-natural areas also increase strongly[41].

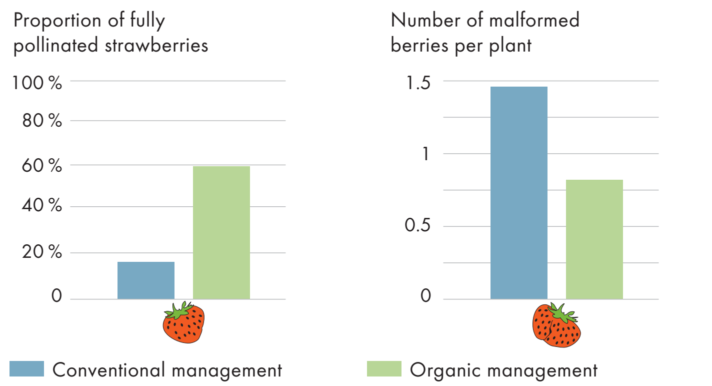
Wild bees play a key role in the pollination of crops and wild plants. Organic arable farming improves pollination of flowering plants even in noncrop habitats due to higher densities of wild bees being supported by organic crops[22,41]. Organic farming can promote wild bee diversity and abundance not only at farm level but also at the landscape level[41]. Several studies have shown that organic agriculture promotes species diversity, abundance and reproduction rates of wild bees (Figure 5). Crop pollination, especially of demanding crops such as strawberries and watermelons, can in part be better ensured on organic farms by wild bees. Pollination success is thus less dependent on cost-intensive pollinators such as bumblebees and honeybees[49,50].

**Figure 5: Effects of organic management on biodiversity in arable land**

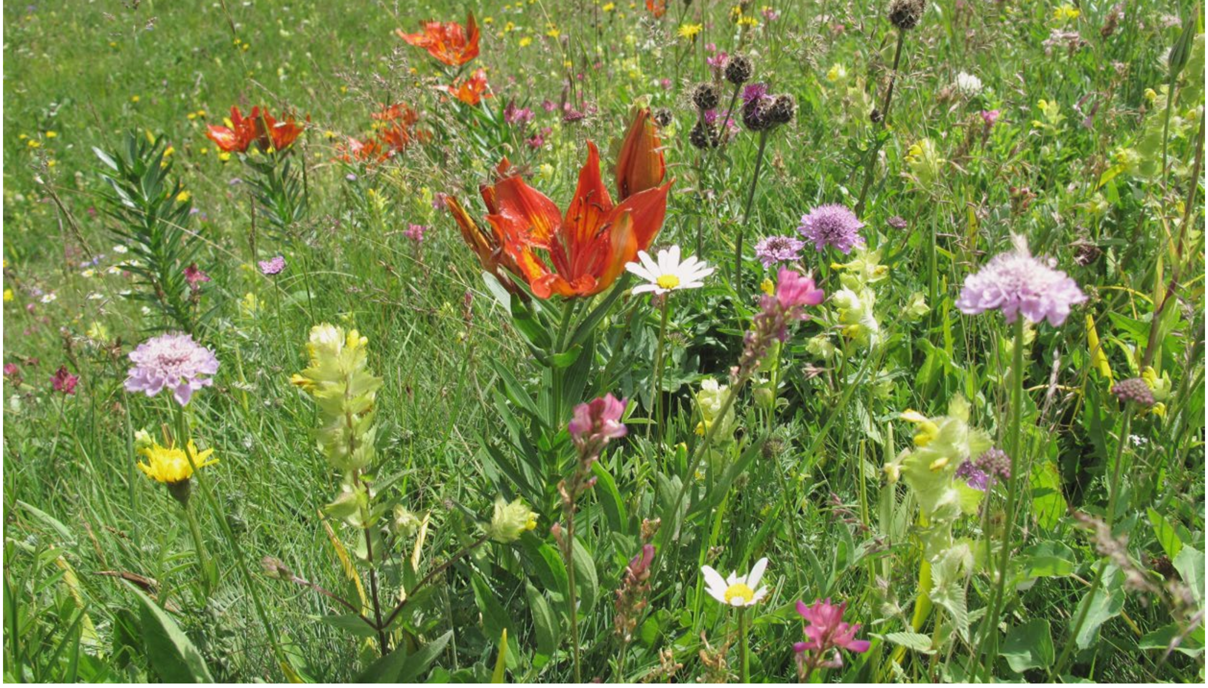



Organic management of arable land fosters wild bee diversity as a result of the greater flower cover and diversity of flowering plants[46].

**Figure 6: Effects of organic management on rop pollination**




There are fewer malformations overall on strawberries in organic crops due to higher pollination success[49].



Nutrient-poor sites host greater botanical diversity, a characteristic that greatly benefits populations of solitary wild bees.

The greater diversity and abundance of pollinators on organic farms gives rise to higher fruit yields and lower losses due to malformed and thus unmarketable berries. This difference is already evident 2 – 4 years after conversion to organic farming (see Figure 6 on p. 11).

## Natural pest reduction

The higher diversity of flora and fauna also promotes beneficial insects that naturally reduce pests[15,51]. In many cases, organic farming enhances natural pest control compared to conventional agriculture[15]. This has been verified for arable[52], viticulture[13] and fruit crops[29]. Effect strength is significantly influenced by cultivation measures and landscape features. The strongest natural pest control in organic annual crops was found in heterogeneous landscapes. It decreases with increasing clearance of landscape features and homogenisation of the agricultural landscape and with the intensity of plant protection measures. Insecticide use considerably reduces the potential of natural pest control[15, 53].

Weed seed predation by specific beetle species can be greater in organic than in conventional fields[54, 55].

Research from Norway shows that, compared to conventional arable soils, soil-borne pests are reduced to a greater extent in organic arable soils as a result of the higher occurrence therein of insect pathogenic fungi[56].

## Dung decomposition in pastures

A richer dung fauna has been found in organic pastures[57]. Compared to conventional pastures, the dung fauna in organic pastures is impacted to a lesser degree by veterinary drugs toxic to it. Dung beetles play an essential role in the breakdown of the dung and contribute significantly to the faster recycling of plant nutrients contained therein, thus positively impacting on forage quality.

## Effects of enhanced ecosystem services at local and landscape level

A higher diversity of a variety of functional groups (beneficials, saprophages, mycophages, phytophages) has also been found in organic vineyards[58], where the natural regulation of certain pest species (grape moths) can be stronger than in conventional viticulture crops, both at the local and landscape levels[13]. Moreover, an increasing proportion of organic vineyard acreage in a landscape dominated by viticulture (Bordeaux) has been shown to be a stronger driver of species abundance than the proportion of semi-natural habitats[47].

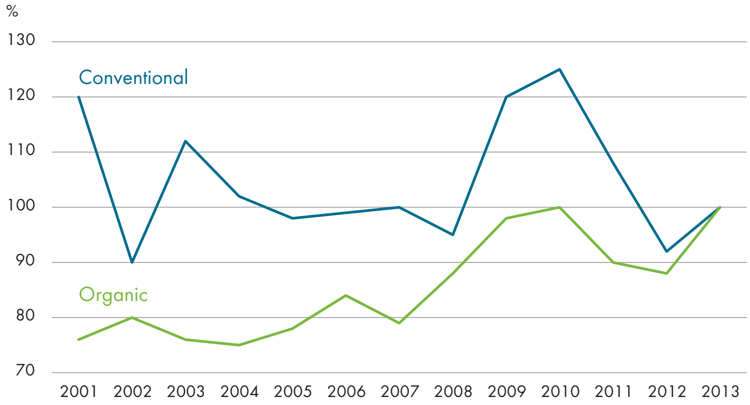
## Higher resilience of organic farmland

Species and habitat diversity make an important contribution to the resilience and adaptability of agricultural crops to environmental impacts. Structurally rich and heterogeneous landscapes promote the mobility and migration of fauna to new sites and thus favour the important exchange of genetic material. Beneficial insects also benefit from structural diversity, thereby strengthening system stability and resilience. In turn, the reduced dependence on external farm inputs, sustainable resource use, the diversification of cropping systems and the self-organisation and innovation of organic holdings all contribute to the socio-economic resilience of organic agriculture.

Crops in organically managed systems tend to produce higher yields under arid conditions than their conventional counterparts. For example, organic maize yields have been found to be 37 % and soybean yields 96 % higher than under conventional management in such conditions[59]. Another example are species-rich meadows, which produce more stable yields during periods of drought and have a longer growing season[48].

On average, organic yields per hectare are 20 % lower than conventional yields[60, 61]. However, this difference in yields varies greatly between crops and cultivation practices. Crop diversification and crop rotations that are optimised from an agroecological point of view in organically managed systems reduce the yield gap to around 10 % or less (Fig. 7 above)[60]. An additional factor capable of reducing the yield gap is the resilience of organically managed systems, for example to drought. The yield gap between organic and conventional farming will become smaller as a result of technical advances, especially in the areas of breeding, plant protection and cultivation techniques. Due to their higher biodiversity, organic systems may result in greater spatial stability of soil biotic and abiotic properties and soil processes, an essential prerequisite to long-term yield security[62].

**Figure 7: Development of yield differences between conventionally and organically farmed arable lands**




Average relative yield in conventional (blue) and organic (green) cropping, measured in a 6-year crop rotation over a period of 13 years.
Relative yield: 100 % = longer-term average yield per crop. Yields for all crops are aggregated per year[62]. In this long-term field trial from the Netherlands, organic yields converge with those of conventional farming over time.

## Organic agriculture as part of the solution

The biodiversity and climate crises are very much related to land use. In this respect, organic farming has gained a lot of experience with whole-farm approaches in recent decades. Such agroecologically oriented approaches can then be integrated into a variety of farming systems. In order to alleviate current environmental issues and strengthen agroecology, organic farming is increasingly being given greater consideration in agricultural policy. The EU Biodiversity Strategy 2030 aims for at least 25 % of agricultural land to be farmed organically by 2030 (EU 2020: Biodiversity Strategy for 2030; Farm to Fork Strategy). From an agroecological perspective, the development of entire organic regions (e.g. in arable-grassland landscapes) would be beneficial. This would likely yield considerable positive economies of scale for biodiversity and with respect to other environmental aspects (e.g. drinking water and the protection of environmental waters from pollution). These positive effects can reasonably be expected as a result of generally lower cultivation intensity (reduced use of auxiliary inputs), smaller plot sizes in crop production, more semi-natural and species-rich habitats, as well as potential changes in accompanying habitats.

## Risks of conventionalisation in organic agriculture

Organic farms, too, can find themselves facing trade-offs between agricultural land use and the conservation of natural habitats. Growing economic pressure and the high demand for organic products can push organic farmers to intensify and specialise their production. However, excessive intensification of organic production and specialisation on a limited number of crops put at risk the many benefits of organic management (risk of conventionalisation).

Cultivation with a focus purely on yield leads to a higher use of auxiliary inputs such as organic fertilisers and biological pesticides, simplified crop rotations, increased plot sizes, a reduction in biodiversity areas and intensive soil cultivation/management and weed control.

Diversified organic farming with a focus on optimum agroecological conditions and incorporating high-quality biodiversity areas has a sustained impact on biodiversity and enables numerous synergies between nature and production.

Whole farm consultancy plays an important role in this regard. It increases the proportion and fosters the quality of biodiversity areas and improves knowledge transfer for agroecological production[63]. Ecological and economic performance can be further improved through whole-farm consultancy with respect to agroecology and nature conservation, and through the refinement of organic standards regarding biodiversity and landscape design.

**Greater species diversity through an agroecological systems approach**

In organic farming, a variety of cultivation and landscape design measures are implemented that have a demonstrably positive impact on biodiversity. In particular, the following characteristic measures promote biodiversity:

- Refraining from herbicide use
- Refraining from the use of chemically-synthesized pesticides
- Measures aimed at supporting beneficials (functional biodiversity, preventive plant protection)
- Reduced fertiliser inputs (especially nitrogen) and refraining from the use of mineral nitrogen fertiliser
- Diverse crop rotations incorporating a high proportion of grass-clover leys and including catch crops
- Careful soil management (humus management)
- Limited livestock density and feed purchases
- Considerable proportion of semi-natural areas
- Diversity of farmland (mixed farms)
- Diverse farm structure and low level of specialisation in cropping

These factors not only foster biodiversity, but also strengthen natural cycles and thus increase the sustainability of organic farms. Ultimately, the effects of organic farming are highly dependent on the farm and landscape context[61]. They vary with the needs and mobility of different groups of organisms as well as with landscape characteristics and cultivation intensity.

**Strengthening ecosystem functions and conserving resources**

In order to maintain important ecosystem functions and reduce biodiversity loss, more resource-conserving crop cultivation (reductions in the use of pesticides and fertilisers) and a significantly higher proportion of biodiversity areas and organically managed areas in the landscape are needed[9,10,11]. Organic agriculture leverages synergies of existing ecosystems and exerts a complementary effect on biodiversity in the context of agri-environmental programmes. In addition to whole-farm expert advice, fair remuneration for ecological services and effective economic incentive systems for the targeted promotion of (functional) biodiversity are essential for the successful implementation of biodiversity measures on farms and in the wider agricultural landscape.

**For more information on services delivered by organic farming, please refer to:**
www.argumente.fibl.org
www.agrinatur.ch

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