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RECOMMENDATIONS FOR MANAGING AND ENHANCING BIODIVERSITY IN FLORICULTURE PRODUCTION

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Stakeholder engagement

This publication is a result of a roundtable discussion with experts and stakeholders from the floriculture sector, in the context of the project “Unternehmen Biologische Vielfalt – Ubi” The goal of the roundtable was to analyze existing biodiversity-related criteria in the most used standards and certification schemes of the industry, in order to give recommendations for improval – in dialogue with standard setters, producers, customers etc.

The overall aim of the project is to support the implementation of the German National Biodiversity Strategy (NBS) and to mobilise companies for the topic of biodiversity. The project is funded by the Federal Agency for Nature Conservation (BfN) as part of the Federal Biological Diversity Programme with funds from the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV).

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This does not mean they identify with all recommendations or statements listed in this publication. However, this work would have been impossible without their expertise and engagement.

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Lidl International
Meo Carbon Solutions GmbH representing HORTICERT

MPS Group
REWE Group / toom Baumarkt
Rijnbeek & Zoon BV
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1 Introduction

1.1 Biodiversity and Its Role for the Floriculture Industry

According to the Convention on Biological Diversity (CBD), “biological diversity” or “biodiversity” means the variability of all living organisms of any origin.

Biodiversity comprises three levels:

- The **genetic diversity** within individual species as well as the diversity of all organisms in a habitat (genetic diversity)
- The **diversity among species**, such as plants, animals, fungi, microorganisms (species diversity)
- The **diversity of ecosystems** (including biotic communities, habitats and landscapes)

Figure 1: Biodiversity (c) Pixabay, own illustration

So why is biodiversity of utmost importance for the floriculture sector and its producers and businesses?

Biodiversity and ecosystems play a critical role in the floriculture industry by providing essential “goods and services” that underpin its success. The reliance of the industry on these benefits as well as the impacts of the industry on nature have been captured in the following figure, highlighting their complex connections.

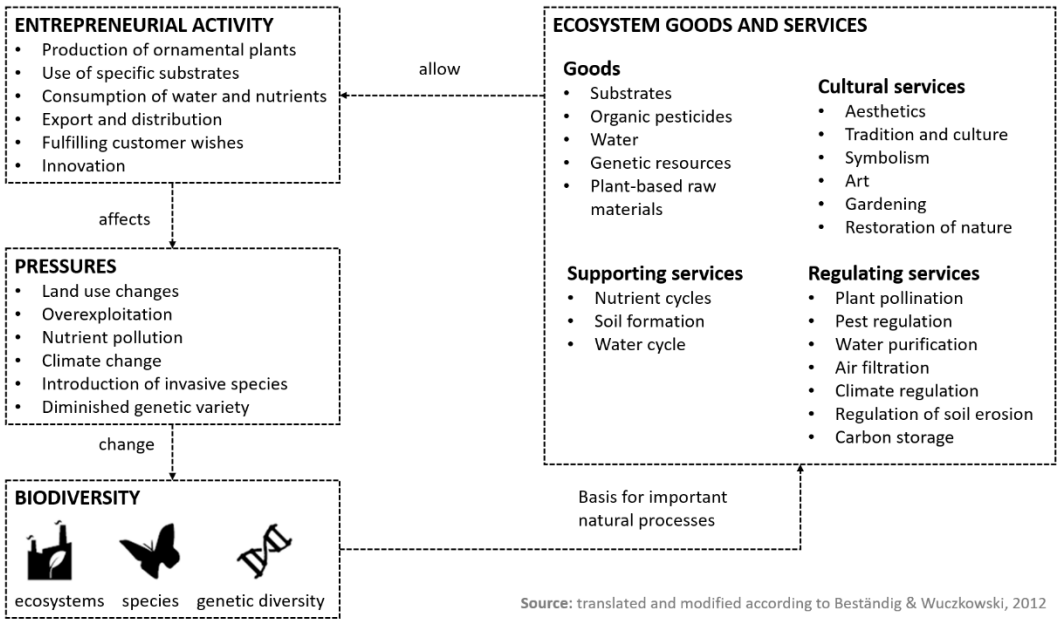


Figure 2: Relationship of biodiversity and ecosystem with the floriculture industry

The Impacts of Floriculture Production on Biodiversity and Ecosystems

The global flower and ornamental plant industry is estimated to be worth around 59 billion US dollars in 2023, with the market growing continuously, mainly due to high demand in Europe, the USA and increasingly also in Asia.[1] The largest importers of flowers are the EU (especially Germany and the UK) and the USA. The EU alone imports around 15 billion euros worth of flowers every year, making it the largest flower market in the world.[2] The flower industry provides hundreds of thousands of jobs worldwide, especially in countries such as Kenya, Colombia and Ecuador.[3] In Germany, approximately 130.000 people work in the floricultural sector.[4]

From a social perspective, **floriculture enhances quality of life** by providing beauty, improving mental well-being, and creating opportunities for leisure and cultural activities. Flowers and plants are used in a variety of social and cultural contexts, such as weddings, religious ceremonies, and celebrations.

Environmentally, floriculture also has the potential to play a role in conservation and biodiversity. Floriculture can become a pillar of "nature-based solutions", such as providing regional plants for rewilding spaces, promoting native species for climate adaptation, maintaining healthy ecosystems for pollinators, and helping to cultivate and conserve endangered species. However, demand and supply for this type of floriculture is still low.

However, besides these positive potentials for biodiversity, the floriculture industry also **has negative impacts on biodiversity**.

To sum up some of them:

- In the Northern Hemisphere, flower production requires a significant amount of **energy** to meet demand. In countries like the Netherlands, flowers are grown in greenhouses due to cold climates and cloud cover. Those greenhouses are often heated with non-renewable fuels, releasing substantial carbon dioxide. Additional CO_2 emissions result from transportation and storage. CO_2 emissions also come from the still very high use of peat in substrates.
- Unlike edible crops, flowers are not subject to the same regulatory standards, which results in significantly higher **pesticide use** in flower production. The combination of pesticides needed to create products that meet market demands and the amount of fertilizer required to sustain rapid and abundant growth leads to local environmental problems and – in terms of pesticides, to health issues along value chains. This excessive use of pesticides and fertilizers contaminates local soil, and subsequent leaching into groundwater promotes eutrophication.

[1] Market Research Future (MRFR, 2023): Floriculture Market Research Report, https://www.maximizemarketresearch.com/market-report/global-floriculture-market/23982/
[2] Centre for the Promotion of Imports (CBI, 2023): The European Market Potential for Cut Flowers and Foliage.
[3] International Labour Organization (ILO, 2020): Working Conditions in the Floriculture Sector.
[4] BMEL (2024): https://www.bmel-statistik.de/landwirtschaft/gartenbau/dienstleistungsgartenbau

- Flowers also have a **high-water demand.** The water footprint of a single rose is estimated to be between 7 and 13 liters. Water export is also a consequence of the energy-intensive flower export industry, which negatively impacts countries such as Kenya, where declining lake levels can be attributed to commercial farming in the region.[5]
- The floriculture industry contributes significantly to the spread of **invasive species**, as many exotic plant species are introduced and spread through global trade. It is estimated that around 50 to 80 % of invasive plant species were originally introduced as ornamental plants. These plants spread unintentionally into new regions and displace native species, which can have a significant negative impact on local biodiversity and ecosystems.[6][7]
- The increasing focus on a few particularly popular and high-yielding varieties is leading to the displacement of **traditional and wild varieties**. This trend is reinforced by intensive breeding concentration and the influence of globally active companies, which often focus on commercially successful varieties and thus drive a homogenization of the range. As a result, some of the genetic diversity is lost, which can lead to increased susceptibility to diseases and environmental changes.

1.2 Methodology

Aim of the UBi project team was to **develop recommendations on how to integrate effective criteria on biodiversity protection and conservation** into existing certification schemes in the floriculture sector.

In order to derive these best practices and recommendations for standards and certifications, the project team identified relevant certification schemes in a first step. As these standards often include **both cut and potted plants**, the recommendations in this document target both production systems, even though biodiversity impacts – and benefits! - may differ.

Drivers of biodiversity loss

Overall, ten standards were analyzed with a focus on drivers of biodiversity loss and recommendations compiled for various topics – based on the work of the certification systems and their good practices. The analysis focused on four of five drivers of biodiversity loss, defined by the Global Assessment Report on Biodiversity and Ecosystem Service by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in 2019[8]:

[5] Lanari N, Liniger HP, Kiteme BP (2016): Commercial Horticulture in Kenya: Adapting to Water Scarcity. CDE Policy Brief, No. 8. Bern, Switzerland: CDE.
[6] Vaz, A. S., et al. (2017): The progress of awareness raising efforts in invasive alien plant species across Europe: from easy-win campaigns to challenging communications. *Biological Invasions* 19.11 (2017): 3371-3388.
[7] IUCN (2024): Invasie Alien Species, https://iucn.org/our-work/topic/invasive-alien-species
[8] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

- **Land use**
- **Overexploitation of natural resources**
- **Pollution**
- **Invasive species**

Climate change was excluded from the analysis. Although high emissions, especially in greenhouse production and those resulting from transport and logistics, play a highly relevant role, it was assumed that these issues are already being thoroughly addressed in other forums.

To develop the recommendations, numerous industry experts were consulted and three roundtable discussions with 20–30 stakeholders held in both English and German languages (2023 and 2024). The recommendations were open to public consultation for feedback from August to November 2024. A fourth roundtable to discuss the results took place on 20 November 2024.

This process is not aimed at creating a new label or standard.

Rather, the recommendations are intended to inspire existing certifications to introduce or strengthen biodiversity criteria. The recommendations are also directed at retail companies, encouraging them to improve their sourcing practices by incorporating criteria into procurement guidelines.

Furthermore, it is an aim that the recommendations also help flower producers to identify means to further improve their biodiversity at production level and it was therefore very much appreciated that several floriculture businesses participated actively at the table to raise their feedback on feasibility.

One point of feedback led the project team to focus the recommendations primarily on **medium and large floriculture businesses.** For these companies, investments are needed to better protect biodiversity and adapt business models. This cannot be done alone or be the sole responsibility of the producers. Here, the entire value chain is needed to support this adaptation to the new reality of a world of climate change and biodiversity loss. Financing the transformation towards biodiversity (and social!) production remains the elephant in the room.

1.2 Structure of this document

This document follows the order of analysis, hence:

1. First, the main biodiversity criteria used for the analysis are briefly put into context where standards currently stand – in an aggregated way (“Baseline Report”).
2. In the second step, overarching issues – such as training, monitoring or financing – are addressed.
3. The Biodiversity Action Plan is highlighted as core concept of the recommendations.
4. The last chapters all follow the logic of the drivers of biodiversity loss and where main criteria for the analysis address ideas for improvement.
5. All thematic chapters first summarize where the sector faces challenges, to then give recommendations, which were developed in the roundtable process.

1.3 Outlook

Industry stakeholders emphasized the need for a level playing field to actively support biodiversity. This applies – among other issues - to the use of sustainable substrates, the preservation of genetic diversity, stricter regulation of pesticides and fertilizers, addressing water availability, and reducing plastic use.

Ideas for further collaboration:

- **Developing and exchanging knowledge and solutions:** Not all problems have ready-made solutions. Peat-substitution, criteria for good and feasible Biodiversity Action Plans and invasive species are three challenging topics, where all standards and producers in the floricultural sector could benefit from joint development of solutions and exchange of experience.
- **Training efforts:** Considerable resources could be spared, if the floriculture sector cooperated to develop biodiversity-related training for producers and retail jointly.
- **Fair compensation for biodiversity-friendlier floriculture production**: All involved parties recognize that biodiversity-friendlier production will often increase cost for producers. These have to be compensated. Standards, producers and retail should cooperate to increase the willingness of consumers to pay a higher price to compensate producers. Awareness-raising among consumers will play an important role.

In the discussions with stakeholders, it became clear that the floriculture industry is strongly motivated and committed to protecting biodiversity, even though this issue has not yet been a central focus. The project team considers the exchange of ideas and the many good practices already in place as an excellent foundation for future collaboration to develop industry solutions for biodiversity protection. Together, all actors can harness the industry's potential to not only improve production but to support and enhance biodiversity in gardens, parks, forests ...

2 Baseline Report

Biodiversity criteria in plant production standards

In the analysis, the project team compared a set of biodiversity criteria to the requirements formulated in different standards of the floriculture sector. These standards cover mainly both potted plants and cut flowers. Initially, the team conducted a screening of the most relevant standards and certifications for the German floriculture market. Criteria were checked and individual feedback on the analysis discussed with standard-setters. In this summary, the team tried to evaluate the overall performance of the evaluated standards with regards to the biodiversity criteria developed by the project team over the last years and aligned with concepts such as the "drivers of biodiversity loss". It has to be noted, that only a desktop analysis of the standard requirements and criteria was conducted, not an assessment of the actual implementation in the field.

Standards that have been analyzed in this assessment are[9]:

- Global G.A.P. IFA 6.0
- MPS ABC
- MPS GAP
- EU Organic
- SMK Planet Proof
- Fairtrade Hired Labour
- Fairtrade SPO
- QS Standards

Topic	Effectivity				Summary	Practices in place
	No coverage	Low	Medium	High		
Biodiversity Management & Biodiversity Action Plan					Approximately one third of the revised standards have a biodiversity management or even a Biodiversity Action Plan as part of their certification. In most certifications, this is however still a voluntary criterion. Challengingly, most standards that had a BAP in place could not display concrete BAP implementation practices. In the discussions it became clear, that certifiers currently do not have the capacities to help producers identify and implement biodiversity actions. Assessments and advice at farm level are needed. A collaboration among standards and brands is necessary, to provide the essential support and capacity development to producers.	FlorVerde proposes a structure for a "Biodiversity and Landscape Plan" (available in Spanish). This BAP is mandatory. Bioland has developed a point system in which companies must achieve at least 100 biodiversity points annually through various measures, which is mandatory for certification. SMK Planet Proof requires a mandatory BAP since 2025

[9] Some standards were not identified but have been included later in this summary for their approaches (e.g. FlorVerde, Bioland) or are mentioned in the recommendations (e.g. EU Ecolabel, Horticert, Demeter)

Biodiversity Monitoring					Monitoring of Biodiversity measures /management plans is not requested in 5 of 10 standards and two have a very basic requirement. Here lies a high potential for improvement.	SMK Planet Proof Standard requires monitoring of species (insects, birds and/or vegetation) by own observation. Furthermore, the standard requests a minimum number of observations: 60 (plants) and 20 (animals, such as insects, soil animals, birds, etc.) of which at least 40 different species. Furthermore, the implementation of the Biodiversity Management Plan needs to be monitored. FlorVerde demands a monitoring of activities / implementation of the BAP
Monitoring of inputs					Only 2 out of 10 standards monitor and track inputs such as fertilizers, pesticides, water and in parts even peat/substrate ingredients digitally as integral part of the certification scheme. This data is highly relevant to monitor the producer's performance and improvements over time (and in comparison to others).	MPS tracks inputs and can be used as a basis for other certification schemes (hence orange) FlorVerde
Soil management					Few standards refer to soil overexploitation and soil erosion and propose a proper soil management. This criterion is mainly relevant for outdoor production, not greenhouse production.	SMK Planet Proof, EU Organic, Fairtrade HL-Standard has erosion criteria: 5.3.5 Prevention and reduction of soil erosion, 5.3.6 NEW 2011 Application of ground cover.
Use of sustainable substrates					No standard provides comprehensive information on sustainability of substrates to its producers. On sustainable substrates there are very few criteria, referring to recycling of mineral inputs or one standard referring to CO_2 footprinting. Only 4 standards provide benchmarks for use of peat: the most ambitious is Bioland with 50 % precent of peat alternatives, one specifies that growing media should contain a maximum of 70 %peat and potting substrates should contain a maximum of 50 % peat. One standard states that substrates should not come from designated conservation areas. A reference is made 3 x to Responsibly Produced Peat (RPP) Certification, which is critically considered by scientists and can only be described as transition certification. Necessary support to producers to phase out peat is not (yet) provided. One reference is made to the EU Ecolabel.	Bioland states that: The peat content in substrates may not exceed 50 % by volume for nursery, perennial and ornamental plant cultures and 80 % by volume for young plant soils. Plants that require a low pH value for their cultivation may deviate from this regulation. Horticert standard would provide a very good basis for ensuring more sustainable substrates. It is not yet integrated in other standards.

Fertilizer management					All analyzed standards have criteria on the use and storage of fertilizers as well as its documentation. However, the promotion of alternatives to synthetic fertilizers, routes to reduction as well as the holistic management of fertilizer determination and the control of fertilizer application has potential for improvement.	Planet proof, Fairtrade HL, GlobalG.A.P. IFA include the basic criteria
Pesticide Management					All analyzed standards provided criteria on the use of pesticides, usually following the principles of Integrated Pest Management (IPM). However, there is a lack of control and of the impacts of pesticides on the environment, particularly the soil.	Organic labels Fairtrade HL 3.6.28 provides regular medical check-ups for all workers and a more ambitious list on pesticides
Water /Water sources					All analyzed standards display criteria on water resources, however, water in- and output is not always measured. Water sources often remain unclear to the producers. Standards should underline the relation between use of water and water sources and include criteria (see chapter water)	GlobalG.A.P. IFA 6.0, Fairtrade Hired Labour, Planet Proof
Waste					Most standards displayed criteria on the collection and proper waste disposal, recycling of waste and prohibition of sewage sludge. However, there is no conclusive strategy on circular economy and plastics.	GlobalG.A.P. IFA 6.0. on waste management
Plastic pollution					Though most standards referenced waste management, there is a lack of criteria on mitigating especially plastic and plastic waste, also including plastic soil covers or micro plastic.	
Waste water					Most analyzed standards display some criteria related to wastewater. However, there is hardly a strategy in place to filter water appropriately and avoid chemical discharges into the environment. Only Fairtrade SPO mentions a comprehensive criterion on handling wastewater from processing facilities. SMK Planet Proof recommends the purification of wastewater to save water in the production.	Fairtrade SPO
Light Pollution					Only two standards display criteria on lighting emissions in context of biodiversity conservation.	SMK on Prevention of light emissions
Invasive Alien species					Approximately half of the standards display some criteria related to invasive species.	
(Protected) species					Fairtrade SPO displays a criterion on “Raising awareness about rare or threatened species. You raise awareness among your members so that no collecting or hunting of rare or threatened species takes place.”	Fairtrade SPO
Training					Fairtrade and QS Standard request explicitly training on biodiversity. The other standards have criteria on training - especially fertilizer and pesticide management - which has also a positive influence on biodiversity. Here is potential for improvement. Because of the complexity, training on biodiversity should be requested by all standards.	QS Standard

Cooperation					Cooperation with NGOs, nature protection administration etc. is mentioned in two standards - and these criteria are not mandatory. Seven standards do not include references to cooperation. Here is potential for improvement. Criteria regarding cooperation can be optional in the beginning but should be highlighted as very important. Enhance the landscape approach is important for effective biodiversity protection, and this can be achieved if the producer participates actively in local /regional nature protection projects and maintains the contact with actors active in biodiversity protection.	
Financial support for producers					There is currently no standard that contains an incentive scheme for biodiversity measures. Encourage value chain players to recognize and reward biodiversity-responsible practices through i.e. premium pricing or payments for ecosystem services (PES).	FT premium is paid to workers (not to management) who can decide autonomously how to invest it SMK is currently developing a system

Table 1: Summary of the overall performance of the evaluated standards with regards to biodiversity criteria

3 Crosscutting Recommendations

The following recommendations were developed by the project team and discussed and opened for public consultation to all stakeholders – as all content of this publication. The following recommendations are directed at standards' management practices.

3.1 Training for Managers and Staff

In order to protect and enhance biodiversity in the floriculture industry, the farm manager or the person responsible for the farm / for the Biodiversity Management Plan should **attend a training event on biodiversity at least every year.** In this regard, **external specialist advice** (e.g., from the agricultural administration, nature protection administration, agriculture, private nature conservation organizations) or **participation in regional or local biodiversity programs** in which advisory services should be provided (e.g. through a community initiative) are also recognized.

The specialist advice should be provided by persons without any conflict of interest.[10]

The content of training events should always highlight the importance of biodiversity and provide information on how biodiversity performance can be improved. Examples of such topics are:

- Quality of biodiversity measures
- Promotion of beneficial organisms
- Full implementation of Integrated Pest Management
- Agroecological practices
- Supporting measures for protected species
- Management of invasive species

Biodiversity topics are included in the training for farm staff who should be motivated to provide ideas on biodiversity protection measures.

Training certificate(s) or other evidence of participation in past training(s) or confirmed participation in upcoming training(s) in the current year that the audit covers, are available.

Role of Standard Organizations

- The standard organization provides information on organizations offering training on biodiversity topics and/or offers their own training courses.
- The standard organization underlines that biodiversity is a cross-cutting topic and training on Integrated Pest Management, fertilizer management, reduction of GHG emissions, soil, erosion, or sustainable use of water is relevant and contributes to better knowledge on the impacts of biodiversity.

[10] E.g. staff from a pesticide producer would have a potential conflict of interest to sell more pesticides.

3.2 Landscape Approaches

Producers are encouraged to support protection and promotion of biodiversity efforts **beyond** their farms.

While recognizing that the legal scope of the producer is on-farm, off-farm opportunities are used to create or enhance positive effects for biodiversity. The producer participates in or conducts activities outside the farm to create synergies, communication, and collaboration promoting and protecting biodiversity on a landscape level. Examples can include:

- Informing the local or neighboring community or other interested groups about the biodiversity work of the producer.
- Cooperation with other producers or regionally active groups to protect and promote biodiversity or pass on or improve knowledge about biodiversity-promoting agricultural practices.
- Cooperation with partners of the supply chain to protect and restore ecosystems which have been negatively affected by the supply chain (insetting projects).
- Participating in joint projects or investments to implement and / or improve biodiversity management as an added value to the producer's business.

Role of Standard Organizations:

- The standard organization publishes and promotes positive examples of collaboration. Promotion could happen for example by organizing an award on sound biodiversity management.[11]

3.3 Potential Negative Impacts on Local Communities

Responsible Farm Management and Community Relations [12][13]

Assessment of Potential Negative Impacts: Potential negative impacts on local communities should be assessed, e.g., water abstraction, erosion, pesticide drift. The producer should demonstrate that preventive measures are in place to avoid or at least reduce those negative impacts.

In areas with traditional land users: Where rights have been relinquished by traditional land users, there should be documented evidence present showing that the affected communities are compensated subject to their **free, prior, informed, and documented consent (FPIC).** In the case of disputed use rights, a comprehensive, participatory, and documented community rights assessment should be carried out and the recommendations from this assessment should be followed.

[11] Adapted from GlobalG.A.P. Biodiversity Add-On
[12] Adapted from Europe Soy
[13] Standards should here also adapt their criteria to due diligence requirements of the CSDDD

Communication with Local Communities: As for communication with local communities, communication channels should be in place, that adequately enable communication between the producer and the community. Local communities should be made aware of the communication channels and language barriers should be avoided or at least reduced.

Complaint Management: The producer should deal with complaints and grievances from workers, neighbors, local communities, and traditional land users in an appropriate way and should maintain documented evidence. In case a relevant competent authority requires the producer to react to a complaint in a certain way, the producer will do so in a timely manner.

Transparent Complaint Mechanism: The complaint mechanism (e.g., appointed independent ombudsman; written complaint form, being accessible via email, telephone, or postal mail) is transparent, has been made known and is available to all workers, local communities, and traditional land users.

4 Biodiversity Monitoring

Sound biodiversity management requires monitoring of biodiversity on the farm and at supply chain level because:

1. Biodiversity management must be planned and implemented **in the long term.**
2. **More than one key figure and indicator are relevant**.
3. **Continuous improvement** is the objective. To prove this, a baseline and regular review of indicators are required.
4. Evaluation of the **effectiveness of measures is the aim**; identification of deficits; setting targets / activities / programmes more precisely.
5. It serves current and planned **reporting obligations** for companies.

4.1 Monitoring at Farm Level

Monitoring the diversity of species and their development on farm level can be costly, as the monitoring of species would have to be conducted regularly and by experts.

A good alternative is to monitor the development of the **potential created for biodiversity**. This includes the habitats and ecological structures that have been protected, restored or created. Quantitative indicators can be measured without bigger efforts, e.g. hectares of natural or semi-natural areas or metres of hedges. But also, some qualitative indicators could be considered, e.g. number of plant species.

Key Indicator Species: As a complementary activity it is recommendable to monitor the development of a few key indicator species. These plants or animals are indicators for the health of an ecosystem. Key indicator species should be selected and monitored with the support of an expert. Monitoring should be carried out according to a monitoring protocol (e.g. IUCN).

Monitoring Negative Effects: Furthermore, the development of negative effects on biodiversity should be monitored: the use of pesticides and chemical fertilisers, soil cultivation, use of water, etc. If these negative effects are reduced, the potential for biodiversity increases. Key figures for monitoring of agricultural practices are available.

Greenhouse Production: In case of greenhouse production, there are no ecosystems and related species “on the farm” to monitor. Producers should concentrate on monitoring negative impacts (e.g. contamination by pesticides and/or wastewater, volume of water used, volume of waste produced). Greenhouse producers should compensate for the conversion of ecosystems into agricultural greenhouses by the restoration and protection of ecosystems in the surroundings of the farm. The development of these ecosystems should be monitored by quantitative and few qualitative indicators.

4.2 Recommendations

The following recommendations aim to support standard organizations and companies in monitoring biodiversity effectively, with specific roles clarified where applicable:

Monitoring of Biodiversity Management Plan

A farm self-assessment on biodiversity is conducted annually to obtain a baseline on biodiversity. The self-assessment should follow the guidelines and should use the template or tool provided by the standard organisation.
Strengths and weaknesses of the farm regarding biodiversity should be assessed. The Baseline and the strengths and weaknesses assessment should be the basis for the Biodiversity Action Plan (BAP). Meaningful key data and indicators should be selected to define measurable targets and to monitor the implementation of the BAP.

The standard organisation should provide guidelines and a tool to determine the baseline by self-assessment. With this, the baseline would be structured and comparable. The guidelines / tool should include an obligatory basic set of key data / indicators for monitoring of the implementation of the BAP and reporting of results. Furthermore, the standard should provide a list with key data /indicators where the producer can choose the appropriate ones to monitor specific measures.[14]

The producer should monitor the implementation of the BAP every year using the basic set of key data / indicators plus specific indicators provided by the standard organisation. Monitoring results should be compared with the targets planned and should be evaluated. The BAP should be updated and/or adapted according to the monitoring results minimum every two years or earlier, if needed.

The standard organisation should provide guidelines and a tool to determine the baseline by self-assessment as well as the regular monitoring of the obligatory basic set of key data / indicators for monitoring of the implementation of the BAP and reporting of results. Furthermore, the standard should provide a list with key data / indicators where the producer can choose the appropriate ones to monitor specific measures.

The standard organisation should ask the producer for permission to use the key data / indicators as an input for yearly monitoring reports on the biodiversity performance of certain groups of certified farms. An overall monitoring report should be published by the standard organisation minimum every two years. Group specific monitoring reports should be made available for the business clients buying plants and flowers from certified farms.

Monitoring of Key Indicator Species

With the support of an expert, the producer should select a key indicator species (animal or plant) and monitor the development of this species every 2 – 3 years according to the corresponding monitoring protocol of IUCN or other international institutions. Monitoring should be carried out by an expert (institution, university, NGO etc.) and the evaluation of

[14] Adapted from GlobalG.A.P. Biodiversity Add-On, 2.1.1

the monitoring results should be taken into account in the adaptation of the current or the elaboration of the next Biodiversity Action Plan.[15]

Bird monitoring on cut flower farms in Colombia

Birds play a crucial role in ecosystem dynamics, aiding in natural pest control, pollination, and seed dispersal. They can also be key indicator species to assess the status quo of biodiversity. A recent Humboldt Institute study shows that 78% of Colombia's birds are threatened. For many years, flower growers in Colombia have implemented environmental programs to protect birdlife in their farms and communities. The second edition of the "Birds of the Flowers" study by Asocolflores, Florverde Sustainable Flowers and the Asociación Bogotana de Ornitología (ABO) aims to further this knowledge and protection.
The 2024 study evaluated bird populations on 28 flower farms in Bogotá and Antioquia, aiming to raise awareness and educate about bird conservation. Key actions include characterizing bird species, comparing current data with 2010 data, and communicating the importance of conservation to the community.

Further information: Florverde – Sustainable flowers

Gathering data at operational unit level

The German Centre for Business Administration in Horticulture / University of Hohenheim analyses around 800 annual financial statements from participating horticultural businesses per year.

This gives participating companies the opportunity to compare themselves objectively with other participants on a business management level free of charge.
At the same time, the submitted data is submitted in anonymised form, thus creating scientifically sound facts for assessing the economic situation in the horticultural sector.

The data shall be aligned with EU reporting requirements. The integration of more biodiversity-related data is planned.

Further information: Betriebsvergleich: Zentrum für Betriebswirtschaft im Gartenbau e.V.

[15] inspired by On the way to PlanetProof

Lifecycle assessments: Sustainability and traceability at product level with FloriPEFCR

The **FloriPEFCR method** (Floriculture Product Environmental Footprint Category Rules) is the new European standard for calculating the environmental footprint of ornamental plants, such as cut flowers and potted plants. Developed by organisations including Royal FloraHolland and Wageningen University & Research (WUR) primarily for the **European and African markets**, it is based on **Life Cycle Assessment (LCA)**, featuring clear calculation rules for 16 environmental impact categories across 8 product lifecycle phases. These include climate change (CO_2 emissions), water use, land use toxicity, and resource depletion. The method was officially approved by the **European Commission** in February 2024. FloriPEFCR enables standardized calculations of environmental footprints, even at the level of individual stems or pots, by assessing the entire lifecycle of products—from raw material sourcing to disposal. It aims to improve transparency and comparability while reducing the risk of greenwashing by requiring verifiable sustainability claims. To support adoption, the **Flori Footprint Tool** was developed, allowing businesses across the floriculture supply chain to analyse their environmental impacts and explore reduction strategies. The tool is aligned with FloriPEFCR requirements and provides immediate results across all impact categories. Next steps for implementation include completing the integration of FloriPEFCR rules into the tool. Additionally, ongoing work focuses on **data validation** to ensure reliable and comparable results. The method addresses growing demand for transparency regarding environmental impacts from both consumers and industry partners. By providing a consistent framework, FloriPEFCR supports the broader goal of reducing the environmental footprint of the floriculture sector and fostering sustainable practices.

Further information: FloriPEFCR Footprint Tool (https://florifootprinttool.com/en/#onze-tool)

5 Financing Biodiversity Measures and Pricing

5.1 Relevance for Biodiversity

Ambitious environmental and social standards **cannot be implemented for free** but come (initially) at a cost. Besides ideally covering living wages, this also includes the costs for measures to protect, enhance and restore biodiversity.

Protecting and restoring biodiversity is an investment, that ensures the preservation of essential ecosystem services, without which human wellbeing, agriculture, and floriculture would not be possible. In addition, environmentally and socially responsible production helps to reduce hidden environmental and social costs that are currently covered by society. These hidden costs include:

- The treatment of contaminated water for drinking water.
- Loss of healthy soils due to the depletion of soil biodiversity.
- Environmental and health costs resulting from the use of pesticides and fertilizers.
- The use of peat and the associated destruction of peatlands.
- The consequences of climate change, such as extreme weather events.

As long as subsidies harmful to biodiversity are still in place (see Kunming Montreal Agreement, Target 18 for reduction of these subsidies), producers - and especially smallholder producers – that act more sustainably lack a level playing field. They cannot wait until they are reap long-term benefits but need appropriate support from their customers/stakeholders in the supply chain who trade, process, or sell the products. Prices must be paid that cover higher costs for environmental and social standards, among other things. Furthermore, companies should participate in investments that are necessary to secure their supply chains. If workers on the farms are not paid a **living wage or income** in the long term, the already noticeable trend of workers withdrawing from agriculture and floriculture will intensify.

Financing biodiversity measures includes for example:

- **Avoidance and reduction of negative environmental impacts** (e.g., energy savings, reduced use of chemical pesticides and fertilizers can even save costs!)
- **Expansion of the potential for biodiversity** (e.g., creation of natural/semi-natural habitats, connection of habitats via biotope corridors, establishment of buffer zones) on available areas – this can save money in terms of creating a more resilient environment for production!
- **Natural climate adaptation measures** (e.g., ground cover, tree planting against heat, erosion control, protection of water sources and reservoirs)
- **Increasing labour costs and maintenance**
- **Living wages**: The costs of biodiversity measures and living wages must not be played off against each other. The costs of biodiversity measures must be considered as a factor in the calculation of living wages.

- **Biodiversity monitoring costs**

True Cost Accounting (TCA)

Taking into account the externalities typically excluded from economic assessments, TCA has emerged as a pioneering holistic framework to factor social, human, and environmental costs and benefits into food systems decision-making. In its TCA evaluation of global food systems, the 2023 edition of FAO's flagship report finds the expected hidden costs of food and agriculture in 2020 was USD $12.7 trillion — nearly 10 % of global GDP. FAO states: "the true strength of TCA is as a transparent tool for policymakers to assess the trade-offs and synergies of possible interventions and adopt the pathways that offer maximum value for both people and nature. "

Examples for TCA in floriculture are not broadly developed (yet). FloriPEFCR monitors inputs along the supply chain.

For agriculture, there's examples such as the RegionalWert AG "Sustainable Performance Accounting" as well as the True Cost Accounting Initiative.

In the following recommendations, criteria are presented that should be included in standards for floricultural production as well as plant and flower procurement specifications for companies. **However, it must be taken into account that companies producing cut flowers and ornamental and potted plants are already facing major challenges, including:**

- Meeting new legal requirements, for example, human rights and environmental due diligence obligations
- Rising costs of energy and fertilizers
- Labor shortages
- Adaptation to climate change

Many of these challenges are associated with considerable additional costs that also significantly restrict the financial scope of many companies. **The floriculture sector and its producers are under immense economic pressure.**

5.3 Recommendations

The following recommendations aim to support Standard Organizations and companies in financing the conservation and restoration of biodiversity, with specific roles clarified where applicable:

- **Advocate for Cost Integration in Pricing:** Push for measures that integrate social and environmental costs into product prices, ensuring fair competition across the supply chain and retail ("level playing field").
- **Analyze Costs and Benefits of Biodiversity Conservation and Restoration:** Collaborate with others to calculate and share standardized data on the costs and

benefits of biodiversity measures and ecosystem services, with input from companies.

- **Monitor and Study** positive effects of biodiversity conservation for production should be examined in collaboration with scientists and other experts to evaluate success factors. Standards can facilitate access to expert networks and research projects.
- **Enforce Shared Responsibility**: Ensure companies in the value chain cover biodiversity-related costs proportionally, aligning with legal frameworks like the EU CSDDD.
- **Promote Biodiversity and Ecosystem Premiums**: Encourage value chain players to recognize and reward biodiversity-responsible practices through i.e. premium pricing or payments for ecosystem services (PES).
- **Define and Enforce Living Wages**: Develop sector-wide standards for living wages in production countries to prevent wage dumping and ensure equitable cost distribution.
- **Educate and Engage Consumers**: Raise awareness of the ecological and social costs of floriculture, emphasizing the value of premium pricing that directly supports workers and environmental sustainability.

FSI Target: Reduction of the living wage gap of workers at farm level by 2025

The Floriculture Sustainability Initiative (FSI) is working to secure living wages through the IDH Roadmap on Living Wages. This platform works to strengthen international alignment and to build tangible solutions regarding living wage. Earning a living wage means workers receive sufficient wages to afford a decent standard of living for the worker and their family. Local context & circumstances are taken into account by selecting a regional benchmark.

Rainforest Alliance: Shared responsibility along the supply chain

Rainforest Alliance (RA) has decided in 2020: "To make sectors truly sustainable, we believe that both the value and the risks must be shared across the supply chain. Our shared responsibility approach aims to distribute benefits and costs of certification more evenly between producers and companies."

Aim of the approach:

- Producers' sustainability efforts are rewarded.
- Costs of investments in more sustainable farms and production are shared between producers and companies.

RA Agriculture Standard outlines two mandatory financial requirements for the buyers of Rainforest Alliance Certified commodities:

- A **Sustainability Differential** (SD), an additional monetary payment to individual certified producers, on top of the market price of the commodity. This is intended to reward producers for implementing more sustainable agricultural practices.
- **Sustainability Investments** (SI), a mandatory cash or in-kind investments from buyers of Rainforest Alliance Certified products to farm certificate holders to support the implementation of sustainable farming practices and reach and maintain compliance with the Sustainable Agriculture Standard.

In addition, all actors along the certified supply chain—not just producers—need to demonstrate their commitment to sustainable business practices. Certified companies must refer and commit to the human rights and environmental due diligence guidelines of international organizations including the OECD and the UN Guiding Principles on Business and Human Rights.

https://www.rainforest-alliance.org/business/certification/shared-responsibility-balancing-sustainability-values-and-costs-for-producers-and-companies/

6 Genetic Diversity

6.1 Relevance for Biodiversity

Genetic diversity is, besides the variety of ecosystems and the variety of species, the third aspect of biodiversity. It denotes the genetic variability between individuals within a species. A rich genetic variability is considered an important factor in the survivability of a species - or a given population.

A common example for the impoverishment of genetic variability on a local or regional level are populations of amphibians insulated due to landscape fragmentation. Such populations are threatened to expire at least partly due to an impoverished gene-pool reducing likelihood of reproduction and adaptability of the population. At some point, the decline of genetic diversity will increasingly contribute to the extinction-risk of an endangered species.

Part of genetic diversity of a species is the genetic make-up of the regional population compared to other regions. Simply said: The European beech in Italy differs from the beech in Germany or Rumania. This leads to an increased adaptation of the individuals of the species to the specific regional conditions (precipitation-patterns, seasonal changes…).
It can be argued, that breeding new varieties of ornamental plants has contributed to genetic diversity in many (or at least some) cases. However, many common practices of the industry can have detrimental effects on genetic diversity:

- **Vegetative reproduction** leads to genetically identical copies of the original plant. For the plant producer, this is beneficial since their product shares the habit or other desired properties of the original. However, this can lead to the wide propagation of a single genetic individual into the wild and thus impoverish the genetic pool of a given species.
- **Usage of non-regional seeds and seedlings** can lead to the adulteration of the specific regional genetic characteristics of species. To what extend this is problematic is a matter of ongoing discussion. Additionally, this seems to depend on the species in question. However, the consensus among nature conservationists is clear: regional seeds and seedlings should be preferred.At least in Germany, this ambition is backed up with regulations[16] prohibiting the use of non-regional seeds and seedlings in the free landscape. Further, Germany is divided into 22 areas of origin for regional native seeds and seedlings of herbaceous species, building the basis for their production and distribution[17].

Challenges for Standards and Companies

Addressing genetic diversity within existing business models poses significant challenges for companies and standards. For companies from a highly industrialized sector as well as standards, aforementioned topics are difficult to tackle within the context of existing business models However, there is a market segment of regional seeds and seedlings – including standards. In Germany, the VWW (“German Association of Producers of Wild-

[16] §40 BNatSchG
[17] See Bundesamt für Naturschutz (BfN) for further info on areas of origin

Seeds and Wild-Plants”) and RegioZert offer a certification scheme for regional seeds and seedlings.

The production and sale of purely regional seeds and seedlings however is a completely different business from the one addressed in this publication. Still, lessons learnt can be derived from this market segment.

6.2 Recommendations

The following recommendations aim to support standard organizations and companies in preserving genetic diversity, with specific roles clarified where applicable:

- **Promote Regional Seeds**: Encourage the use of certified regional seeds to maintain genetic diversity and comply with regulations, particularly in landscapes where regional genetic traits are essential for ecosystem health[18].
- **Monitor Impacts:** Collaborate with scientists and biodiversity experts to study the effects of industry practices, such as vegetative reproduction and the use of non-regional seeds, on genetic diversity. Standards can facilitate this exchange.
- **Raise Awareness:** Educate stakeholders, including producers, retailers, and consumers, on the importance of genetic diversity for resilience and long-term sustainability in agriculture and floriculture. Standards can provide the platform for training and awareness raising.

[18] In Germany, §40 BNatSchG must be considered

7 Biodiversity Action Plan

7.1 Definition and Purpose

A Biodiversity Action Plan (BAP) supports producers as well as consultants and advisors to improve the biodiversity performance of the farm. The BAP should provide an **overview of the current situation** on the farm (baseline on habitats, agricultural practices, approaches to protect biodiversity etc.). The evaluation of the baseline is the basis to **define aims for improvement** and the corresponding measures to achieve these aims. Furthermore, by defining a baseline, the BAP is a good basis for managers and consultants to give advice regarding the improvement of the quality and effectiveness of biodiversity measures.

7.2 Core Components of a Biodiversity Action Plan

A BAP has four components, which are visualized in figure 3. All components are equally important and need to build up on each other. Thus, those four components create a management cycle that improves the potential for biodiversity:

1. **Baseline Assessment:** Evaluate the current status of biodiversity, including habitats and agricultural practices.
2. **Setting SMART Goals:** Define **s**pecific, **m**easurable, **a**chievable, relevant, and time-bound objectives.
3. **Implementing Measures:** Establish and execute targeted actions to achieve the defined goals.
4. **Monitoring and Evaluation:** Assess the effectiveness of implemented measures and their impact on biodiversity.

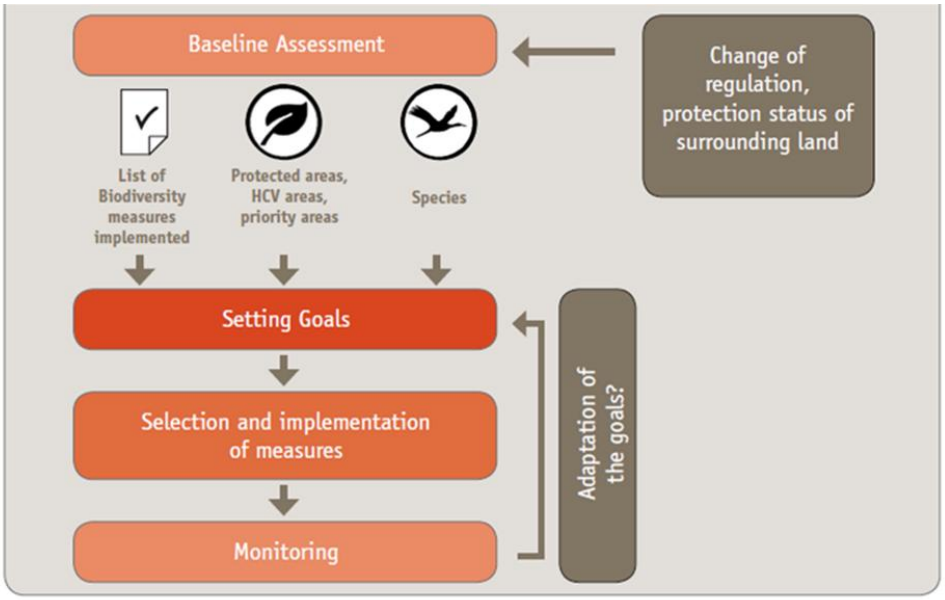


Figure 3: Elements of a Biodiversity Action Plan © GIZ/GNF/BMUV

7.3 Existing Templates and Guidelines

A template for a BAP in the floriculture production has been developed by Florverde Standard for Colombian cut-flower producers, Bioland also works with a BAP (see below). Additionally, there are guidance documents developed for the agricultural sector, which could be adapted by the standard-setters:

- Biodiversity Action Plans (BAP). Guidelines to set up and implement a BAP for farming activities (UEBT/GNF 2021)
- Manual on Biodiversity Action Plan in Chili Production (GIZ/GNF/BMUV 2019)
- Manual on Biodiversity Action Plan for Pepper, Cinnamon and Nutmeg (GIZ/GNF/BMUV 2019)
- Biodiversity Action Plan Monitor (Excel Sheet) (GNF 2019)

Sound biodiversity management is key for protecting and enhancing biodiversity. Therefore, the implementation of the BAPs should be **monitored by the standard organizations.** To do so, standards should provide a minimum structure for a BAP – ideally in an electronic format to facilitate monitoring. This structure should contain the minimum aspects to be considered. Additionally, there should be room for individual aims and measures.

Some of the analyzed standards already contain (elements of) a BAP. However, criteria referring to the BAP are usually an add-on, and not a must-have criterion. Further, often BAPs are not being implemented in practice. Here, additional capacity building and direct advice to farms is needed, in order to help them develop the right actions and performance indicators.

7.3.1 Examples of Biodiversity Action Plans

Florverde Sustainable Flowers Standard: Biodiversity and Landscaping Action Plan (2018)

Overview: Florverde® Sustainable Flowers (FSF) is an independent social and environmental standard from Colombia, focusing on cut flower production. Its **Biodiversity and Landscaping Action Plan** is a strategic framework aimed at improving landscapes and conserving biodiversity within production units. It aligns with company-specific goals and prioritizes environmental sustainability.

Key Components:

1. **Diagnosis**
    a. Identification of landscape units and mapping their location.
    b. Inventory of flora and fauna species, including any threatened species, to develop conservation strategies.
    c. Recognition of nearby protected areas and high ecological value zones to mitigate impacts and enhance their conditions.
2. **Objectives**
    a. Define a general objective.
    b. Set specific, measurable goals for short, medium, and long-term timeframes
3. **Essential Actions**
    a. **Landscape Management Tools**: Implement live fences and biological corridors.
    b. **Fauna Protection**: Introduce measures to safeguard identified wildlife.
    c. **Community Support**: Collaborate with local stakeholders (e.g., municipalities, schools, and neighbors) to promote biodiversity management.
    d. **Ecosystem Services**: Identify key ecosystem services on the farm.
4. **Action Plan and Timeline**
    a. Establish a detailed schedule specifying activities, responsible individuals, and timelines to ensure progress.
5. **Monitoring and Evaluation**
    a. Regular follow-up is crucial to assess progress, update strategies, and adjust actions as needed.

Focus:
The plan emphasizes the use of native species and the enhancement of habitats to balance environmental health with production goals.

Biodiversity Management in Organic Farming: The Bioland Approach

Overview: Bioland's Biodiversity Guideline features a points-based system designed to integrate biodiversity measures into organic farming, including horticulture and ornamental plant production. Certified farms are required to achieve at least 100 biodiversity points, encouraging a broad range of biodiversity-enhancing actions.

Key Components:

1. **Tailored Catalogs:** The points system is based on detailed catalogs for the entire farm, including a dedicated category for **potted plants and cut flowers**. Measures in this category include promoting plant species diversity, establishing fallow areas with greening mixtures, and using native plant species to enhance biodiversity. Producers can also propose individual measures, subject to Bioland's approval.
2. **Proportional Scoring:** Points are awarded relative to the total farm area or the specific land-use type, ensuring fairness across different farm sizes. All points are calculated proportionally to the total farm area.
3. **Digital Documentation:** Producers log their biodiversity measures in an app, which calculates their total points according to Bioland's guidelines.

Compliance is ensured through random annual inspections, where 5% of farms are checked. While the **ecological effects** of these measures are not directly measured, the system provides a flexible framework to enhance biodiversity within organic farming, including ornamental plant production.

Further information: Bioland Standards (in English, German, Italian), Catalogue for biodiversity measures including potted plants and cut flowers (only available in German)

7.4 Recommendations

The standard organization requires farms to develop a **Biodiversity Action Plan** (BAP) as a mandatory criterion. Key elements include:

1. **Baseline Assessment**: A description of the initial situation, existing natural and semi-natural habitats. The standard requires proof that the producer has obtained information about protected or endangered animal and plant species in the region as well as the main problems regarding biodiversity.
2. **Measurable Targets**: Quantitative and qualitative goals with meaningful indicators (e.g., ecological priority areas, biotope corridors, and monitoring of 2-3 indicator species).

3. **Biodiversity Information**: Producers must gather data on protected or endangered species and biodiversity challenges from reliable sources (NGOs, nature authorities, scientific bodies, or indigenous knowledge).
4. **Continuous Improvement**: Farms are expected to enhance biodiversity until a good performance level is achieved, after which the focus shifts to maintaining this standard.

The standard **supports producers** by providing training, guidelines, studies, and connections to relevant resources. It also **facilitates cooperation** with nature conservation bodies and NGOs, particularly in areas with high ecological value or severely degraded ecosystems. The plan is reviewed and updated at least every three years.

To minimize the additional work for the producer, the BAP can also be part of another management plan that is already required by the standard organization or company (e.g., environmental management plan). Demanding individual Biodiversity Action Plans from smallholders is neither practical nor effective. In this case, the producer organizations are called upon to develop a BAP for the affiliated producers in a region and to ensure that ambitious biodiversity goals are pursued overall without threatening the existence of individual smallholders.

It would also be beneficial for biodiversity, if producers of the same area and under the same certification scheme take a landscape approach and elaborate and implement a joint BAP. This BAP should have measures to be implemented in all farms as well as measures for specific aspects on farm level, e.g. protection of a river or other source of water. A joint landscape BAP would facilitate the creation of biotope corridors, the protection of rivers and streams and other activities to protect biodiversity.

7.5 Information About Protected Areas and Species – Tools and Data

- **EU Resources:** Information about protected areas, such as Natura 2000 and the Bern Convention's Emerald Network, is available on the European Environmental Agency's website. European protected sites | European Environment Agency's home page
- **Global Forest Watch:** Offers data on protected areas, biodiversity hotspots, global biodiversity significance, and deforestation. European protected sites | European Environment Agency's home page
- **IUCN Red List:** Provides data on threatened species. IUCN Red List of Threatened Species
- **Local and Regional Authorities:** Local and regional authorities can provide more information!

8 Land Use

8.1 Relevance for Biodiversity

A total of 735,500 ha land were used in floriculture industry in 2022, including cut flowers and potted plants, as estimated by the international Association of Horticultural Producers.[19] This may not seem relevant in comparison to the land use footprint of the food industry, but still the flower industry impacts land use, often leading to changes such as the conversion of natural habitats into agricultural land dedicated to flower cultivation. This highly affects biodiversity conservation.

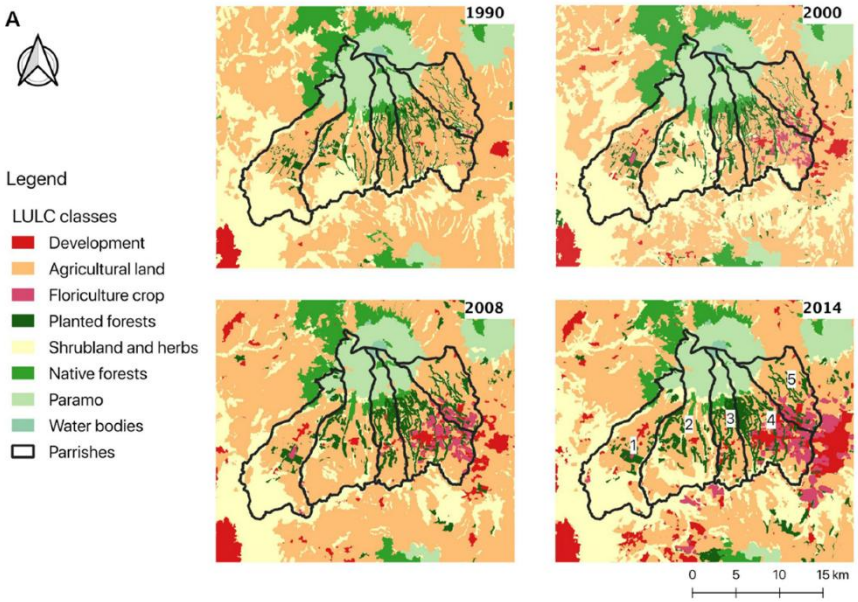
Land use for floriculture differs significantly between the geographical Global North and the Global South – due to different ecological, economic, and social conditions:

- **Monocultures and Land Conversion:** In the Global North, floriculture oftentimes takes place on already converted – and highly fragmented - agricultural lands. In the Global South, areas of natural ecosystems, such as forests, wetlands, and grasslands are still converted into agricultural land for flower cultivation – most often into monoculture flower farms. This conversion impacts local food security and causes land shortage.[20]
- **Smaller Cultivation Areas**: Due to higher production costs and other economic factors, flower production in the Global North often occurs on smaller, more intensively used areas.
- **Climate-Controlled Cultivation and Efficiency**: In the Global North, cultivation systems are often highly efficient in technical terms. Use of pesticides and fertilizers is regulated, but studies have shown that pesticides applied in greenhouses often escape into nature. Furthermore, more use of energy is required to achieve the needed temperatures and light to grow.[21] Greenhouses increase energy consumption.
- **Water Usage and Irrigation**: Flower cultivation in Southern regions often demands high water resources, which can be problematic, especially in water-scarce areas.

[19] Zhang, P., Zhou, J., He, D., Yang, Y., Lu, Z., Yang, C., ... & Wang, J. (2024). From Flourish to Nourish: Cultivating Soil Health for Sustainable Floriculture. *Plants*, *13*(21), 3055. https://doi.org/10.3390/plants13213055

[20] Kirigia, E., Betsema, G., van Westen, G., Zoomers, A. Flowers for Food? Scoping study on Dutch flower farms, land governance and local food security in Eastern Africa (2016) https://doi.org/10.13140/RG.2.2.25043.86567.

[21] PAN, It rains pesticides from greenhouses: The end of a myth, greenhouses are releasing pesticides into the environment (2022) https://www.pan-europe.info/sites/pan-europe.info/files/public/resources/reports/Greenhouse_Report%2012122023.pdfhttps://pan-germany.org/pestizide/pan-report-pestizide-koennen-aus-geschlossenen-gewaechshaeusern-entweichen/



This image shows how floriculture – among other uses – extends slowly in rural areas in Ecuador, thus leading to land use changes. Image: Land use land cover changes in Pedro Moncayo county/Ecuador through time A. LULC maps throughout the periods of study (1990, 2000, 2008 and 2014). B. Land extent changes through time in Pedro Moncayo county by administrative zones (parishes), including the expansion of the flower industry (in violet).[22]

8.2 Recommendations

The following recommendations aim to protect existing biodiversity at the farm level and its surroundings, create opportunities for increased biodiversity, and support standard organizations and companies in preserving land use, with specific roles clarified where applicable.

Scope and Extent of Certification

Usually, certification covers the operational unit **and ends at the farm gate.** However, the negative impacts of agricultural activity on ecosystems, fauna and flora **do not end there** but can affect the quality and quantity of the surrounding landscape, groundwater, and open water bodies: Fertilizer and other substances can disperse into surrounding areas and the farmed area itself can contribute to biotope fragmentation by posing a hindrance for species migration. While agricultural workers in the Global South might benefit economically from flower farms and find better infrastructure, there are also significant negative impacts, such as the loss of fertile land, potential exposure to agrochemicals and therefore significant health and safety risks as well as environmental degradation. These problems also include displacement, restricted fishing rights, abuse of workers' rights and unsustainable farming

[22] Guarderas, Paulina & Smith, Franz & Dufrene, Marc. (2022). Land use and land cover change in a tropical mountain landscape of northern Ecuador: Altitudinal patterns and driving forces. PLOS ONE. 17. e0260191. 10.1371/journal.pone.0260191.c

practices that harm local communities, such as death of livestock and fish populations and poor waste management.[23]

The standard organization/ company:

- Requires a risk analysis of the effects of land use changes on biodiversity prior to the establishment of new production areas and specifies a recognized method (see e.g. RSB Conservation Impact Assessment Guidelines, 2020). Environmental countermeasures for land sealing are taken, i.e. compensation measures.)
- Requires a risk analysis of the biodiversity impacts and ecosystem conditions on and around the farm (*see chapter Biodiversity Action Plan*)
- Has criteria and guidelines for the avoidance of negative impacts on ecosystems and biodiversity outside the boundaries of the farm.
- Requires the implementation of a core set of criteria on land use on the entire farm when partial certification of farms is possible (see the criteria marked as mandatory).
- Requires that **biodiversity sensitive areas** are identified and protected:
    - Requires that protected, HCV-areas, UNESCO and Ramsar Sites within and adjacent to the production areas (3 km) should be identified, e.g., with the use of databases / tools such as IUCN Key Biodiversity Areas, Natura 2000 Network, the Ramsar list, national databases and/or Global Safety Net Tool. These areas must be **conserved, restored, and properly managed.** (*See recommendations for baseline assessment and biodiversity management plan*).
    - Initiates or supports measures for the **sustainable use of water resources** beyond the farm level, focusing on regions with high water risks (*see chapter Water*).
    - Promotes a **landscape approach**, encouraging collaboration among neighboring producers to improve **habitat connectivity** (e.g., biotope corridors, semi-natural habitats, and protective measures for endangered species).
- Initiates and supports the identification and implementation of nature restoration measures in and around the production site. This included activities such as identification of degraded lands and rewetting / reforestation / introduction of native species etc.

Land Conversion and Ecosystem Protection

The standard organization/ company:

- **Prohibits illegal appropriation** of land, forests, and water.
- Aligns its regulations with **EUDR requirements** (cut-off date: **31.12.2020**).

[23] Socio-Economic Impact of Large Scale Commercial Farming on Rural People's Livelihoods: The Case of Flower Farming in Central Uganda (2024): https://doi.org/10.4236/jss.2024.129003.
Social and Environmental Concerns Witnessed by Nearby Inhabitants of Flower Farms in Central Ethiopia (https://ijoear.com/assets/articles_menuscripts/file/IJOEAR-DEC-2020-23.pdf)

- **Prohibits conversion** of natural or semi-natural ecosystems and areas with conservation value after the defined cut-off date. The chosen cut-off date should align **with international environmental standards and should be relevant to local contexts** (example: since 01.01.2014). This includes:
    - Natural ecosystems and habitats (e.g., forests, wetlands, mangroves, grasslands, peatlands, etc.)
    - Clearing natural ecosystems, especially through burning, for new production areas.
    - Areas where legal protection prevents such conversions (e.g., protected areas recognized by national or local legislation, areas with relevant categories of the International Union for Conservation of Nature (IUCN), or areas that are protected via other effective means.
    - High Conservation Value (HCV) areas.
    - Biotope corridors and landscape elements (e.g., trees, hedges, ponds).
- Requires evidence (maps, aerial photos, or official documentation) to demonstrate compliance since the cut-off date.
- Helps to create instruments to monitor land use change effectively.
- Mandates **Free, Prior, and Informed Consent (FPIC)** when land-use changes affect local or indigenous communities or traditional livelihoods.

Limited Exceptions

Conversion may only be allowed if:

- It was **legally permitted**.
- Damage resulted from **natural disasters**.
- Exceptions require sufficient documentation and restoration measures to compensate for ecosystem loss.

Sustainable Use of Protected Areas

The standard organization/ company

- Ensures due diligence.
- Requires that long-term **protection and viability** of ecosystems must be ensured within the framework of a **Biodiversity Management Plan (BMP)** or **Biodiversity Action Plan (BAP)** *(see chapter Biodiversity Action Plan).*
- Agricultural use in protected or HCV areas is only allowed if:
    - It does not conflict with **conservation goals**.
    - It complies with sustainable management plans and applicable restrictions.
- Documentation must include maps, geographical data, and input from stakeholders responsible for protected areas.

9 Exploitation of Natural Resources: Water

9.1 Relevance for Biodiversity

The IPBES 2019 report underlines the critical situation of aquatic ecosystems and relation between use of water in agriculture and the aquatic ecosystems as sources of water:

- Over 85 % of wetlands worldwide have been lost.
- Freshwater ecosystems face combined threats, including land-use change, water extraction, exploitation, pollution, climate change, and invasive species.
- Aquatic ecosystems are biodiversity hotspots that provide essential ecosystem services such as water, hydrological balance, fish habitats, and micro-climate regulation.
- Population sizes of wild vertebrate species have declined over the past 50 years across terrestrial, freshwater, and marine ecosystems.

Water is essential for agricultural production and food security and agriculture is both a major cause and casualty of water scarcity. Farming accounts for almost 70 % of all water withdrawals, and up to 95 % in some developing countries. According to the UNESCO World Water Development Report 2022[24], currently 70 % of global groundwater withdrawals, and even more in arid and semi-arid regions, are used in the agricultural production of food, fibres, livestock, and industrial crops, and an estimated 38 % of the lands equipped for irrigation is serviced by this resource. Experts are warning that the demand for water will exceed supply by 40 % in 2030 (World Economic Forum)[25]. Agriculture reorganises nutrient cycling on a massive scale using synthetic fertiliser and livestock manure. This leads to eutrophication of aquatic ecosystems generating toxic algae blooms, hypoxia, and even anoxic dead zones in freshwater and in marine ecosystems.
Impacts of climate change increase water scarcity. Many countries with the highest risk of water stress are in the Middle East, such as Kuwait and Qatar, but water scarcity and droughts are also increasingly frequent and widespread in Europe.

Urgent Actions Needed:

- Stopping the destruction and degradation of aquatic ecosystems
- Restoration of aquatic ecosystems
- Sustainable management of aquatic ecosystems and their watersheds

9.2 Recommendations

The following recommendations aim to support standard organizations and companies in preserving water resources, with specific roles clarified where applicable:

[24] The United Nations World Water Development Report (2022): Facts and Figures: Publikation_World_Water_Development_Report_2022_Facts_and_Figures.pdf
[25] WEF (2023): Freshwater demand will exceed supply 40% by 2030, say experts | World Economic Forum

Water Management

Sustainable use of water is a crucial aspect - especially taking into consideration the increasing impacts of climate change.

The producer should know the water sources which are supplying his farm and should have a map or sketch illustrating the location of the water sources.

There must be a documented risk assessment for water used for indoor and outdoor production and postharvest activities. At minimum, the assessment must identify environmental impacts on and of the following:

- Water sources
- Procedures to make efficient and rational use of water sources
- Distribution systems
- Irrigation methods
- Significant water uses for other activities on the farm
- Impact of own farming activities on off-farm environments

The risk assessment should be reviewed annually or whenever changes to risks occur.

Water Management Plan

The water management plan should include as a minimum:

- Compliance with restrictions indicated in water permits/licenses. It is not unusual for specific conditions to be set in the permits/licenses, such as hourly, daily, weekly, monthly, or yearly extraction volumes or usage rates. Equipment used for monitoring extraction volumes should be in the correct location to provide accurate readings. Records should be maintained and available to demonstrate that these conditions are being met.
- Application of methods to predict water needs and the amount of water lost by evaporation and transpiration – considering the impacts of climate change.
- Assessment of the need for maintenance of irrigation and other water delivery equipment. Application of an efficient, well maintained irrigation system.
- Identification of training for staff required to support maintenance and reparation, timetable for the implementation of training.
- Frequency and documentation of analysis of water quality. Implementation of corrective actions to improve water quality and documentation of results.
- Application of methods to recirculate, reuse and/or recycle water, e.g. compulsory usage of condensation water from greenhouse roofs, collection of rainwater, closed drain water collection system, use of treated grey water.

The producer ensures that agricultural cultivation and animal husbandry is adapted to the regional and climatic conditions, so that no overuse or damage to local or regional water resources, natural wetlands or regional protected areas occurs.

The plan should include documentation of:

- Records of actual irrigation
- Yearly reports on water consumption and discharge
- Quarterly analyses of water from sub-drainage pits
- Training of workers (what, when, number of participants)

It can be either an individual Water Management Plan or a Regional Plan if participation in a community irrigation system is documented. The plan should be reviewed at least annually, based on the reviewed risk assessments.

The Water Management Plan includes key data/indicators for monitoring. Monitoring results are analyzed yearly and are taken into consideration for the revision of the plan.

Guidelines: The standard organization provides sound guidelines on the content of a Water Management Plan with positive examples on saving water and protecting water sources. The guidelines include a minimum set of key data/indicators for monitoring.[26]

Accident Procedure Near Chemical and Fuel Storage

A procedure for accidents containing all appropriate information and emergency contact telephone numbers should be present and display the basic steps of primary accident care. The procedure should be accessible by all persons working near the plant protection product (PPP) / chemical storage(s), fuel storage(s), and designated mixing area(s).

The company must be equipped to handle accidents, spills, and potential accidents effectively in areas where pesticides or hazardous chemicals are prepared or mixed for use. In case a spill occurs, contamination into the soil or water supply is avoided. The company plans spraying in such a way as to have no or very little spray solution remaining.[27]

Flooding Risks

Storage rooms for plant protection products and for fuel are placed in locations without risks of flooding.

Wastewater Treatment

- **Identification of Wastewater Sources:** Producers must identify and document the different sources and types of wastewaters. The various management and prevention options including minimization need to be assessed.

  Tests for processing wastewater are conducted at all discharge points during the representative period(s) of operation, and results are documented.

  Human sewage sludge, and sewage water is not used for production and/or

[26] Adapted from Planet Proof, Global GAP Biodiversity Add-On FV-SMART 30.01.02, FV-SMART 30.01.03, Fairtrade Hired Labour 4.3.10
[27] Adapted from Naturland, 4.6.3, Global GAP Biodiversity Add-On FV-SMART 31.02

processing activities.

- **Sewage is not discharged into aquatic ecosystems and soil unless it has been treated.** Treated discharge is demonstrated to meet legal wastewater quality parameters or, in the absence of these, the wastewater parameters (not applicable to smallholders).

  For farm groups, tests for processing wastewater are done at all group-managed (collective) processing facilities* and at a representative sample of member processing operations including the different types of treatment systems. Wastewater from processing operations discharged into aquatic ecosystems and soil meets legal wastewater quality parameters. Wastewater from processing operations may not be mixed with clean water to meet the parameters.[28]

Note: For example, low-cost types of wastewater treatment (e.g., biological filters) are useful facilities providing good results.

Protection of Water Sources on the Farm

Riparian buffer zones must surround aquatic ecosystems, with specified widths based on watercourse size:

- 5 meters horizontal width along both sides of water courses between 1 - 5 m wide. For farms < 2 ha, the width of the buffer may be reduced to 2 meters at both sides
- 8 meters horizontal width along both sides of water courses between 5 - 10 m wide, and around springs, wetlands, and other water bodies
- 15 meters horizontal width along both sides of rivers wider than 10 m wide

Restoration of buffer zones should be realized with native species or allow regeneration of native vegetation. **No** pesticides, other hazardous chemicals and fertilizers are applied in the buffer zones, also not PFAS pesticides containing the metabolit TFA. It is also recommended that buffer zones, where feasible, are connected to create ecological corridors.

Note: The standard provides guidance on how to measure the width of the water course, examples for the creation of sound buffer zones etc.[29]

Protection of Water Sources Beyond the Farm
In case local environmental authorities or other entities consider that water sources are being depleted, are in a critical condition or under excessive usage, the producer engages in a dialogue with the authorities or local initiatives to be involved in finding solutions.
If the producer realized / realizes a negative impact on the water sources, she / he informs immediately the responsible authorities and / or other entities.

The producer participates in regular information exchange with regional experts who are concerned with ensuring good water quality and water equity of lakes, rivers, and other

[28] Adapted: GG, Spring 4.1.1
[29] Adapted from Rainforest Alliance, 6.3.3

water ecosystems. If possible, the producer cooperates in a monitoring system to guarantee the sustainable use of water resources.[30]

Sustainable Management of Water in Greenhouses

- A closed drain collection system in adequate dimensions is installed to collect drain water and reuse it for irrigation. The producer makes sure that the collection system is well maintained and does not have leaks or overflows to avoid drain losses.
- Drain water discharge should not pass the maximum of 10 % of irrigation volume and should be continuously reduced in comparison to the previous year.
- Rainwater collection is mandatory and should be collected from buildings and greenhouses.
- If possible, treated wastewater (grey water) and / or condensation water from heating installations, greenhouses etc. should be used.
- Nitrogen emissions are limited. The producer makes sure that there is no unconscious unallowed drain water discharge and undetected leakage from irrigation and drain collection systems.
- For discharge-on-purpose within the limits of drain water recycling obligations, only one discharge pipe is installed and connected to the sewer system or wastewater treatment system. The producer should make sure that nitrogen content is limited, and that discharge water is treated with methods that break down pesticides, if they have been applied in the last 3 months before discharge of drain water.

The standard organization provides sound guidelines on:

- Drain water discharge limits
- Drain water discharge continuous reduction
- Limits for nitrogen emissions

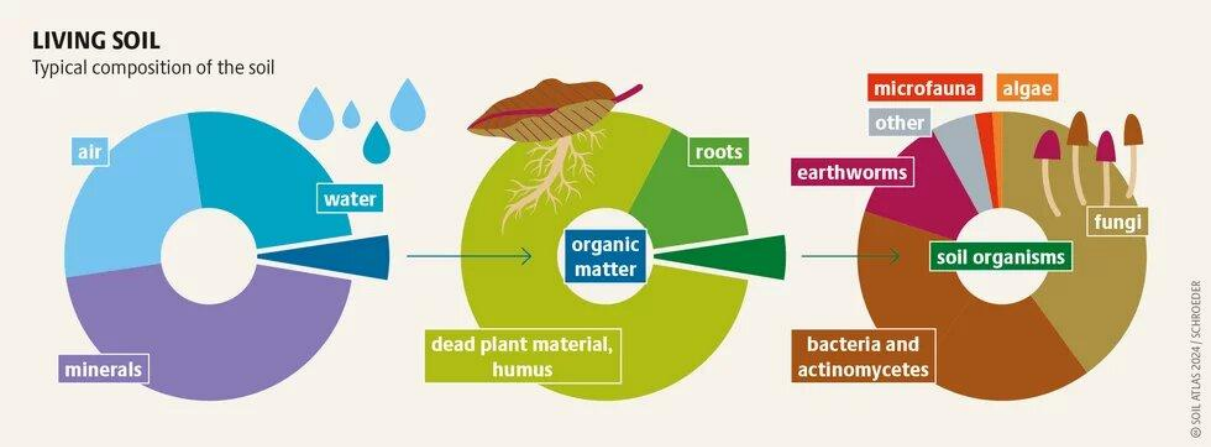
[30] Adapted from Fairtrade Hired Labour 4.3.11, Global GAP Biodiversity Add-On FV-SMART 30.02.02

10 Exploitation of Natural Resources: Soil

10.1 Relevance for Biodiversity Criteria

Soil harbors a great variety of organisms from micro to macro as well as from terrestrial to aquatic organisms - about 60 % of all known species worldwide[31]. But fertile and healthy soils are lost due to degradation processes such as erosion, salinization, and contamination. It is estimated that 20 - 25 % of the world's soil is already degraded. Soil degradation is a progressive process that affects an additional 5 -10 million hectares every year.

Soil is crucial for plant production. Therefore, in ornamental plants and flowers production, soils need to be managed in a sustainable way. Stopping degradation processes is urgently needed, and terrestrial ecosystems need to be restored.



Resource: Soil Atlas, 2024

Reference to Horticulture and Ornamental Plant Production

There are different types of soil degradation which might be caused by ornamental plants production on the one hand, and which affect ornamental plants' production on the other hand:

1. **Physical Degradation:**
    - Erosion: Loss of topsoil due to water or wind
    - Compaction: Reduced pore space and aeration due to soil particle compression
    - Crusting: Formation of a hard surface layer, restricting water infiltration
2. **Chemical Degradation:**
    - Nutrient Depletion: Loss of essential nutrients due to overuse
    - Salinization: Accumulation of salts from improper irrigation or natural processes

[31] Mark Anthony et al (2023): Enumerating soil biodiversity

- Acidification: Lowering of soil pH due to excessive use of chemical fertilizers or acid rain

3. **Biological Degradation:**
   - Loss of Organic Matter: Decrease in humus levels due to deforestation or overgrazing
   - Decline in Microbial Activity: Reduced biological processes affecting soil fertility

Production Systems

All degradation aspects should be considered when making decisions in the ornamental plant production industry. Voluntary standards address aspects of soil health, such as fertility and erosion prevention. Regarding soil biodiversity, criteria may still be improved or included in standards.
Ornamental and flower plant production takes place under very different conditions. These different ways of production systems need to be differentiated:

a. Outdoor production on the field.
b. Greenhouse production with open soils.
c. Greenhouse production with tables, lines, shelters, or hydroponic systems (refer to the chapter on recommendations for substrates).

10.2 Recommendations

The following recommendations aim to support standard organizations and companies in preserving soil resources, with specific roles clarified where applicable:

Soil Management:

Sustainable use and treatment of the soil is a crucial aspect. The grower must know about the soil characteristics and conduct a soil analysis on regular basis. The growers ensure that agricultural cultivation is adapted to the regional and climatic conditions, so that no overuse of resources or damage occurs.

A Soil Management Plan is Available:

The soil assessment must include at least the following:

- Soil structure
- Soil depth and soil horizons
- Erosion prone areas and slopes
- Densification of compaction areas
- Soil moisture and water level in the soil
- Drainage conditions
- Identification of areas with visual symptoms of nutrient deficiency in addition to the criteria on soil sampling and regularly analysis (see below).

A soil management plan should include the following as minimum in systems of outdoor production and partly for indoor greenhouse production with open soils:

- The plan should be based on analysis of humus content, nutrient balance, effective organic matter, soil biodiversity and up-dated soil erosion maps. A humus sampling to be conducted every 3 - 5 years. An analysis of soil biodiversity must be conducted every 4 - 6 years. Clear guidance on the sampling and analysis methods is required.
- A general organic matter calculation is performed over a period of one year. The average organic matter (OM) balance for all plots at company level is at least neutral. The producer aims at realizing a positive effective organic matter balance. In case of a perennial crop, the balance at plot level over the entire growing period is neutral.
- Protection and enhancement of soil biodiversity aiming at a positive effect on the humus balance.
- It is recommended to calculate the OM balance using a calculation tool, e.g., the NMI / SMK organic matter balance calculation tool[32] or other tools linked to a fertilisation plan.
- In case the OM balance is negative, the certificate holder prepares an action plan containing possible steps for achieving a positive balance in the next year. If this is not feasible in practice, e.g. due to manure legislation, this should be made plausible.
- In case the calculated decomposition of OM exceeds 2,500 kg / ha / year, an upper limit for the necessary organic matter supply of 2,500 kg / ha / year is applicable and a consequential negative balance is allowed.[33]
- Organic fertilizer should be preferred to mineral fertilizers, as it potentially improves soil health and decreases the dependency on synthetic fertilizers (further recommendations on fertilizers see in chapter on fertilization).
- Crop rotation system or mixed cropping systems is implemented.
- Measures against erosion are in place (see below).
- Reduction of soil disturbances (e.g., no-till farming, on land ploughing, tires with low ground pressure).
- Soil coverage is in place throughout the year (e.g. catch crops, undersowings, mulching), as long and much as possible.
- Legumes and mixtures with legumes to be included in the crop rotation.
- Other practices such as intercropping, agroforestry, the use of ground covers or incorporating compost or green manures into the soil.
- Promotion of rotting processes, e.g., by use of microorganisms (e.g. compost teas or other fermented products).
- For hired/leased land: it must be ensured that the balance sheet of the organic matter is positive. This must be also considered within rotation plans: the OM balance at rotation level should be positive.
- Monitoring of the soil quality must be also conducted every three years by a visual soil assessment of physical properties of the soil on different plots (in addition to the soil analysis mentioned above). The conditions must be recorded by means of a photograph of the profile pit in which the various soil layers are visible and a

[32] see e.g. http://om-balance.org
[33] Orientation taken from SMK Planet Proof

standardized form containing at least the chemical soil analysis and assessment of root formation, structure and interfering layers at three soil depths.
- As part of the soil relevant measures for the biodiversity action plan: unproductive areas (fields, plots, and parts of fields that can't easily be accessed by machinery are used for nature conservation) must be promoted as natural ruderal areas to promote biodiversity in the surroundings of the productive areas – inside and outside of the greenhouses. Stone bunds or sandy areas on the ground should be installed for insects.

The plan should be revised every year and take into consideration the impacts of climate change. The Soil Management Plan should aim for a continuous improvement of soil health and the reduction of negative impacts on (soil) biodiversity.
(The soil management plan could be integrated into a detailed biodiversity action plan.)

Preventing Soil Erosion

If the producer identifies land at risk of soil erosion with erosion maps or land has already eroded, the producer implements measures to avoid and/or reduce erosion such as
- Promoting stable soil aggregates through biological activity (e.g., by adding organic matter, liming)
- Growing ground cover and installing buffer zones (e.g. flower strips and cover crops with native species) throughout the year
- Use of deep-rooting green crops
- Mulching
- Drainage subsoiling
- Reduction of soil disturbance as much as possible (mulch/direct sowing processes), minimum tillage and light tillage after root crops. Use the technique of on-land ploughing.
- Use of low-pressure tires and other measures to avoid compaction.
- Infiltration strips
- Stone bunds
- Re-vegetation of steep areas and terracing to reduce erosion by water and wind.
- Placing wind breaks (trees / hedges on borders of sites)

Soil management in green houses / closed systems / soil sealing with plastic.

- Unsealing and restoring wherever feasible.
- Soil disinfection and sterilization: Disinfection must be carried out using sunlight. Field experience shows that bins can be sterilized between cycles. (In the EU, chemical disinfection is forbidden.)
- The use of methyl bromide as an alternative for disinfection of soil or other uses is not permitted.
- Contaminated soil must be treated to be reused.
- Many producers have land areas not under greenhouses. As biodiversity measures in the greenhouses can be challenging, it is essential to adopt biodiversity actions for

these areas around the high intensity land use, allocating the remaining space for near-natural areas as biodiversity-enhancing activity.

Soil management in permanent crops

- Utilizing interplanting for preventing erosion and shading.
- A minimum of 65% of the harvested land must be sown with green manure crops.
- The balance of OM at plot level over the entire growing period is neutral.

11. Exploitation of Natural Resources: Substrates

11.1 Relevance for Biodiversity Criteria

The impacts of substrates used in the ornamental plant industry on biodiversity can be diverse and depend on various factors, including the origin of the raw materials, their composition, their use, and their disposal. Currently, peat still presents the main input to substrates, in professional floriculture in Germany amounting to 73 %.[34] Other substrates are derived from renewable products such as coir, compost or wood fibers. Furthermore, mineral materials found in geological formations are of use as growing media. Such materials include sand, pumice, gravels, and volcanic porous gravels.

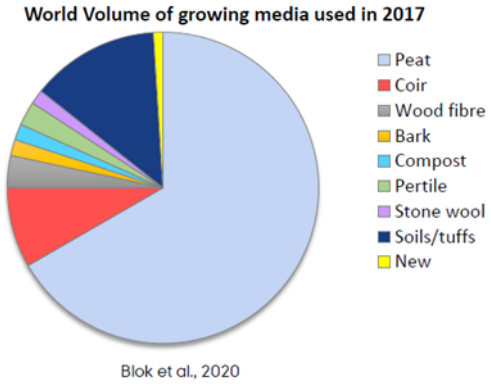


Figure 3 Growing media at global scale.[35]

Peat is a common component of potting soils due to its ability to bind water and its high acidity level, which insures sterility.[36] However, peat extraction can have various effects on the climate and on biodiversity. After drainage for forestry and agriculture, one of the main pressures has been the extraction of peat primarily for horticultural and energy fuel purposes. In the 2000s, approximately 25,000–30,000 kilo tonnes of peat have been extracted annually. Finland, Ireland, and Germany have been leading countries in peat extraction. Annually, in the 2000s, 50 – 70 % of the extracted peat has been used for energy production, 20 – 35 % for horticultural purposes, and 10 – 25 % for unspecified purpose.[37]

Peat extraction has major impacts on climate, hydrology, and biodiversity – **both in natural peatlands as well as on agricultural areas.** Peat extraction destroys the original peatland

[34] IVG (2024) : https://ivg.org/2024/04/11/gartenbau-macht-grossen-schritt-bei-der-torfreduktion-absatz-von-kultursubstraten-im-jahr-2023-mit-einbruch/

[35] Blok, C., Eveleens, B., & van Winkel, A. (2021). Growing media for food and quality of life in the period 2020-2050. *Acta Horticulturae*, *1305*, 341-355. https://doi.org/10.17660/ActaHortic.2021.1305.46

[36] BLE (2020): Torf und alternative Substratausgangsstoffe. https://www.ble-medienservice.de/0129-1-torf-und-alternative-substratausgangsstoffe.html

[37] Aleksi Räsänen, Eerika Albrecht, Mari Annala, Lasse Aro, Anna M. Laine, Liisa Maanavilja, Jyri Mustajoki, Anna-Kaisa Ronkanen, Niko Silvan, Oili Tarvainen, Anne Tolvanen (2023): After-use of peat extraction sites – A systematic review of biodiversity, climate, hydrological and social impacts, Science of The Total Environment, Volume 882. After-use of peat extraction sites – A systematic review of biodiversity, climate, hydrological and social impacts - ScienceDirect

ecosystem as the peat is totally or partially removed.[38] The extraction of peat from **natural peatlands** has detrimental impacts on a crucial refuge for numerous animal species and one of the most species-rich ecosystems. Peatlands disturbed by vacuum harvesting are often unable to naturally revegetate and regain their original ecosystem functions due to shifts in peat hydrophysical properties and as the viable seed bank is primarily removed during extraction.
Once degraded, restoration of peatlands needs a long timeframe and shows lower ecosystem quality.[39]

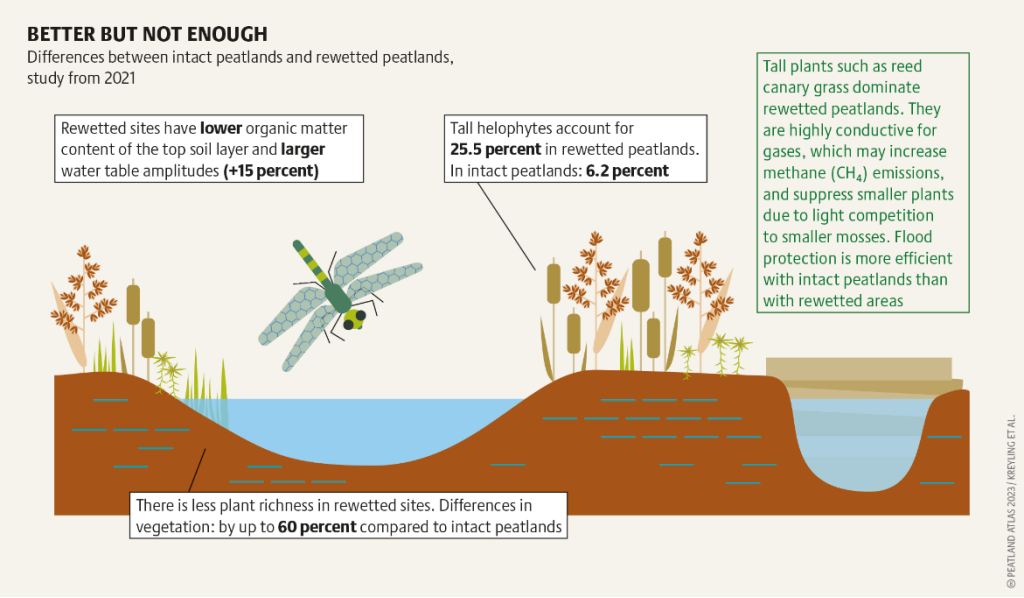
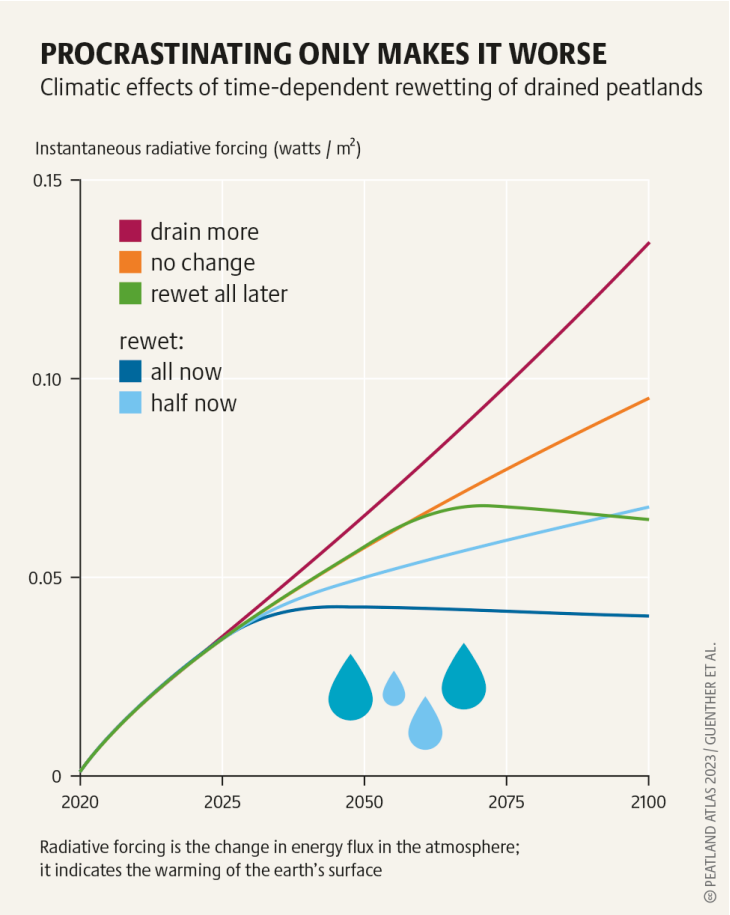


Figure 4 International trade in peat and peat products. © Peatland Atlas 2023[40]

Peat extraction on areas previously used for agriculture

[38] Räsanen et al. (2023)
[39] Heinrich Böll Foundation (2023): Peatland Atlas. https://eu.boell.org/en/PeatlandAtlas
[40] Heinrich Böll Foundation (2023)



In Germany, since the end of the 1980s, peat extraction is only permitted on areas previously used for agriculture.
Peat extraction is officially only possible after an extensive approval procedure that examines all impacts. As part of the environmental impact assessment and the species protection assessment, flora and fauna on the affected area are recorded over defined periods of time. In addition to hydrological investigations, reports on noise and dust emissions are also prepared if there are residents in the area of influence.
After extraction, the areas have to be restored.

Though restoration of the ecosystem is hence a valuable contribution of this industry, studies show that immediate rewetting of agricultural areas (without prior peat extraction) would sequester CO_2 emissions instead of releasing them into the atmosphere through peat use (see graph).[41]

Additional effects on biodiversity are (even on already degraded areas):

- Soil organisms and microbial diversity: Peat extraction leads to the release and destruction of soil structure, causing microorganisms and soil organisms that are adapted to peaty conditions to lose their habitats.
- No room for regeneration: Drained areas could theoretically be rewetted and renaturalized to partially restore biodiversity. However, peat extraction makes such measures impossible, as the soil is removed down to the mineral subsoil.
- Long-term effects on neighboring ecosystems: Peat extraction can exacerbate hydrological changes in neighboring areas and further endanger remaining biodiversity there due to drought or nutrient input.

It is expected that the incentives for producers to rewet their land will increase (at least in the EU with the Nature Restoration Law).

Peat in horticulture & floriculture

Peat for **horticultur**e is still the most important raw material for growing media (potting soil, professional substrates). Due to its physical and chemical characteristics, slightly

[41] Heinrich Böll Foundation (2023)

decomposed peat provides perfect conditions for the needs of seedlings, as well as many ornamental plants and vegetables.[42] Two thirds of the peat is used in commercial horticulture, while the rest is used by hobby gardeners.
Due to the complex properties of peat substitutes, especially when they are mixed, attention must be paid to the high quality of each individual raw material. However, these are – according to the industry – not yet available in sufficient quantities, continuity and in the required qualities at economic prices to completely avoid the use of peat. The availability of peat substitutes needs to be increased. However, Hirschler et al. indicate that the quantitative availability of alternative growing media would generally be detectable, with only a few regional exceptions in maximum demand scenarios.[43]
A peat reduction of 40 to 50 % can be achieved in many crops with reasonable effort.[44] However, depending on the type of plant and the general conditions of cultivation, further reductions are very complex and call into question crop safety.[45]

Responsibly Produced Peat

The RPP certification system (Responsibly Produced Peat) does not allow peat extraction from areas with a high conservation value. In line with the Strategy for Responsible Peatland Management of the International Peatland Society (2019), it requires peat mining in areas that are already heavily degraded and prescribes suitable subsequent use measures from a nature conservation perspective. This standard focuses on restoration of sites (not avoidance in the first place). It certifies sites, not suppliers.
The RPP program was set up in consultation with environmental organizations (e.g. Wetlands International), scientists and mining companies. RPP certification ensures the best possible development after completion of peat extraction with the aim of achieving environmental benefits, including climate protection. The option usually chosen is renaturation. This aims to restore peatlands damaged by drainage to a near-natural state by raising the water level in the moor.
In the Netherlands, the goal is to achieve 100 % RPP certified peat by 2025.
https://www.responsiblyproducedpeat.org/de/
https://www.wur.nl/en/research-results/research-institutes/plant-research/business-units/greenhouse-horticulture/show-greenhouse/parties-around-the-table-about-the-use-renewable-raw-materials-for-growing-media-in-2030.htm

[42] https://peatlands.org/peat-in-economy-and-society/
[43] Hirschler, Olivier; Osterburg, Bernhard; Weimar, Holger; Glasenapp, Sebastian; Ohmes, Marie-Friederike (2022) : Peat replacement in horticultural growing media: Availability of bio-based alternative materials, Thünen Working Paper, No. 190, Johann Heinrich von Thünen- Institut, Braunschweig, https://doi.org/10.3220/WP1648727744000
[44] https://projekt-terz.de/
[45] Renewable raw materials for growing media: Basic data for the environmental impact of potting soil and substrates agreement, Universität Wageningen, https://research.wur.nl/en/publications/renewable-raw-materials-for-growing-media-basic-data-for-the-envi

Biodiversity impacts of most common inputs for substrates (qualitative evaluation):

	Peat	Wood fibre	Coir	„Tuffs“ (volcanic rocks)	Compost
General remark	Non-renewable (short term), EU production	Renewable, local production possible, waste by-product	Renewable, production in Asia (biodiversity hotspots), waste by-product	Non-renewable, international production (biodiversity hotspots), recyclable	Renewable, local production possible, waste by-product
Production countries	i.e. Finland, Germany, Sweden, Latvia, Belarus, Canada[46]	i.e. regional Internationally: probably Vietnam, Thailand, and Malaysia	The main locations of the coconut industry are in India and Sri Lanka. Transport emissions are still lower than peat emissions.	Italy, Turkey, Greece, Indonesia, Island, Mexico, USA	Regional
Available sustainability certifications	Responsibly Produced Peat (RPP), Eco-peatland Code (UK)	FSC, PEFC, HORTICERT	HORTICERT, (Fairtrade, Organic, Rainforest Alliance)	/	HORTICERT
Land use change	Peat extraction disturbs i.e. the hydrological conditions.[47][48]	The impact depends on the forestry system: Monoculture leads to habitat losses.	Monocrop system, partly intercropping and/or livestock integration	Mining operations significantly alter the landscape	/
Climate change	Peat extraction leads to significant CO2 release.[49]	Wood decomposition leads to CO2 emissions (very low in comparison to peat)	Transportation emissions (very low in comparison to peat)		Greenhouse gas emissions in industrial composting can occur, but these are at least 95 % lower than emissions from landfilling biogenic waste if composting is carried out properly.[50]
Overexploitation of resources	Extraction of non-renewable resource; long-term changes in water supply possible	Depending on wood fibre technologies: High energy consumption, potentially high water consumption	A renewable resource and a by-product, but associated to high water consumption	Tuff is often used for 10-30 years before the cultivated material is replaced with new material, low prices; mining activities can destabilize the soil, leading to erosion	/
Invasive species	Ecosystem recovery after peat extraction can provide an opportunity for invasive species (if	Introduction of non-native tree species possible			Spread of invasive species possible if not composted and fermented properly[53]

[46] https://www.usgs.gov/centers/national-minerals-information-center/peat-statistics-and-information
[47] Clark, L., Strachan, I. B., Strack, M., Roulet, N. T., Knorr, K.-H., and Teickner, H. (2023): Duration of extraction determines CO_2 and CH_4 emissions from an actively extracted peatland in eastern Quebec, Canada, Biogeosciences, 20, 737–751, https://doi.org/10.5194/bg-20-737-2023
[48] Heinrich Böll Foundation (2023): https://www.boell.de/de/2023/01/10/moorzerstoerung-fuer-die-landwirtschaft
[49] Clark et al. (2023)
[50] Umweltbundesamt (Österreich)(2015): Praxis großer Kompostierungsanlagen und wesentliche Anforderungen an einen emissionsarmen Betrieb.
[53] https://www.kompost-biogas.info/invasive-neophyten-in-der-kompostierung/

	not properly managed)[51] [52]				
Pollution	Peat fires possible, extraction can cause eutrophic effects; light, noise and vibration pollution[54]	Depending on forestry regime: application of pesticides and fertilizer; light, noise and vibration pollution from harvesting; Solid waste disposal	Use of non-organic pesticides and fertilizers possible	Significant dust emissions can occur during the extraction and transportation of volcanic rock; extraction process can lead to chemicals used in the mining operations leaching into groundwater; noise	/

Sustainable management of peatlands and alternative raw materials

Peat moss cultures are an important component of **paludiculture**, an approach that combines rewetting and sustainable management of peatlands. Formerly drained moors, in particular heavily degraded agricultural areas, are rewetted. Bog-specific and typical plant species such as reeds, cattails and peat mosses are planted on these wet areas. These plants are then harvested and the biomass used as a **peat substitute**, which represents a sustainable alternative to conventional peat use. Management takes the form of mowing or grazing, which creates wet meadows or pastures. The targeted cultivation of **peat mosses** and other typical peatland species promotes the restoration of unique **peatland ecosystems and their biodiversity**. Studies on paludicultures show that **endangered species**, such as certain plants, birds and insects, have been reintroduced, leading to a significant improvement in moorland landscapes. Although the quality of the restored moors does not quite correspond to their near-natural state, this form of land use nevertheless represents a valuable habitat. The harvesting of peat mosses is gentle and has only temporary effects, which is why it is recommended every 3-5 years, according to Greifswald Mire Center. Others see peat moss extraction more critical, due to CO_2 emissions. Overall, paludiculture helps to protect peatlands in the long term while at the same time offering opportunities for agricultural use.

Further information: Greifswald Mire Center (https://update23.greifswaldmoor.de/news/new-information-paper-on-paludiculture-and-biodiversity.html)

[51] Heinrich Böll Foundation (2023): https://www.boell.de/de/2023/01/10/co2-schleudern-wie-entwaesserte-moore-unser-klima-schaedigen

[52] Example: During peat extraction and subsequent land use changes, the disturbed soil and altered water conditions created ideal environments for the spread of Rhododendron ponticum. Rhododendron ponticum is highly invasive and forms dense thickets that shade out native vegetation. This leads to a significant reduction in biodiversity as it prevents light from reaching the ground, stifling the growth of native plants. It also changes the soil chemistry, making it even more difficult for native species to re-establish. Furthermore, it harbors a fungal pathogen (*Phytophthora ramorum*), which can spread to and affect other plant species.

[54] Heinrich Böll Foundation (2023): https://www.boell.de/de/2023/01/10/co2-schleudern-wie-entwaesserte-moore-unser-klima-schaedigen

Standards / certifications should include transparent sustainability criteria on substrate ingredients (and in particular on peat).

Currently, very few standards display criteria for the sustainability of substrates, and even fewer regulate the use of peat. While Bioland, Naturland, and Demeter propose a minimum of 50% peat alternatives; three of the most commonly used certifications for floriculture (GlobalG.A.P., IFA, and Fairtrade) propose alternatives in the range of 10-20%. Another certification specifies that growing media should contain a maximum of 70% peat, and potting substrates should contain a maximum of 50% peat. One references the Responsibly Produced Peat (RPP) certification for 100% of the peat used.

It is crucial to include transparent criteria for peat and other ingredients so that customers understand how the standard regulates the composition of substrates and whether it includes sustainability criteria. The current criteria are insufficient.

Certifiers play an important role in demonstrating that voluntary standards can drive change. However, interviews with stakeholders indicate that beyond voluntary certification, stronger regulatory frameworks are also needed.[55]

Political context so far:
With the Dutch "Covenant on the Environmental Impact of Potting Soil and Substrates", fourteen Dutch organizations agreed in 2022 to **voluntarily** gradually increase the use of renewable raw materials and to only use certified peat. An inventory of renewable raw materials will be published, as well as substantiation to agree on percentages of renewable raw materials in the professional market in 2030.[22] In Germany, the Ministry of Agriculture (BMEL) has included in its "Peat Strategy" to largely ("weitestgehend") phase out peat in professional use by 2030. Net zero targets will likely lead to the phasing out of most peat production by 2045 in Germany and by 2050 in other countries.

EU goals	Netherlands - Covenant	Germany - BMEL
• **Climate-neutral by 2050** • **restore at least 20% of the EU's land and sea areas by 2030 and all ecosystems in need of restoration by 2050** • **restore 30% of drained peatlands by 2030 and 50% by 2050**	• 100% RPP by 2025 • 35% peat alternatives in commercial use by 2025 • 50% peat alternatives by 2030 • More than 90% peat alternatives by 2050	• Reduce peat in commercial use "largely" by 2030

[55] Hirschler, O.; Thrän, D. (2023): Peat Substitution in Horticulture: Interviews with German Growing Media Producers on the Transformation of the Resource Base. *Horticulturae*, *9*, 919.

11.2 Recommendations

- **Standards ensure that 50% + x peat alternatives are in use by 2030.**
  Standards should ensure that 50% **plus an additional percentage** of peat alternatives are in use by 2030, starting with an **ambitious** baseline that reflects current status quo. Harmonizing requirements for peat alternatives would help producers adapt to a changing political landscape. While 30% is a starting point for many floricultures, a pragmatic approach would be to achieve at least 50% at the production unit level by 2030.

- **Peat still in use should be produced under a certified / verified restoration regime (during timebound transition phase)**
  In the Netherlands, the industry "Covenant" proposes that 100% of the peat in use from 2025 onwards should be RPP certified.
  While RPP is not sufficient for a long-term strategy, it ensures minimum nature restoration requirements. Standards should hence require, that peat used during the transition phase by producers is at least extracted under the Responsibly Produced Peat (RPP) certification to ensure that restoration activities take place. **This phase should be time-limited and verified by the standard organization.**

  Standards should further require that producers can trace the peat substrates back to the origin of the harvesting/production area.

- **Standards require the producer to develop a transition plan for continuous increase of peat-alternatives.**
  The producer defines a transition plan (milestones and targets), to identify pragmatic approaches to increase the percentage of peat alternatives.

- **Standards include sustainability-criteria on other ingredients for substrates in their certification schemes.**
  Reducing peat implies a larger share of other types of ingredients and other production conditions. Here, a joint collaboration of the sector and substrate producers as well as research organizations is needed, to ensure, that alternatives are sustainable and do not create new ecological risks.
  - The producer should know the origin of the material and ensure traceability. Standards should deliver information and support substrate alternatives.
  - Substrate ingredients should not come from or be produced in biodiversity-sensitive areas (i.e., protected areas, Ramsar sites, buffer zones etc.)
  - Standards should provide environmental impact / LCA assessments on different ingredients together with recommendations on the use and the quality of the materials. This facilitates the sourcing of peat alternatives.
  - Producers should, where possible, determine the CO_2 footprint of substrate ingredients.
  - Producers should preferably use substrate ingredients that meet EU Ecolabel or similar equivalent. This means, that 70% of the waste is recycled and that the products themselves consist of at least 30% recycled material.
  - The producers ensured that the substrate does not contribute to deforestation.

  - Substrate ingredients should – where possible – be certified according to standards with ambitious biodiversity criteria (i.e. FSC for wood chips, HORTICERT for wood-based products, compost, coconut-based products). For a substrate ingredient certified by HORTICERT, most requirements listed above are met.

- **Knowledge provision & Training**
  - Standards should provide training and helpdesks/advisory support to help producers with the testing and increasing of peat alternatives.
  - Standards, substrate producers and brands should support joint projects, to provide their supplier with necessary knowledge on peat alternatives and implementation measures, to substitute peat in the medium term.
  - Projects for the restoration of bogs and other relevant ecosystems should be initiated along the supply chains.
  - The sector should provide information for stores and end-consumers on the proper care of plants based on peat-free/low-peat substrates.[56]
  - Customers are transparently informed about the composition of substrates of a (potted) plant, respectively the composition of substrates along the supply chain of the product.

[56] https://www.substrate-ev.org/pdf/Deutsch/Werbemittel%20GGS/Flyer/Flyer%20torffreie%20Substrate/Flyer_Tipps_Endverbraucher_ggs_A4_2024_03%20-%20lange%20Version.pdf

HORTICERT – An international certification system for sustainable peat substitutes and substrates

HORTICERT certifies sustainable peat substitutes for hobby and professional substrates and any company along the supply chain. In the long term, all volume-forming peat substitutes available on the market are to be certified; HORTICERT is currently concentrating on wood-based products, bark humus, green waste compost and coconut-based products. Companies wishing to obtain a certificate must have at least 25% of a product's ingredients certified using mass balancing. In addition, products bearing the HORTICERT logo may consist of a maximum of 30% (hobby soils) or 70% (professional soils) peat.

In September 2024, Erdenwerk Gebrüder Mayer, soil producer for toom Baumarkt, was the first company in Germany to successfully pass the HORTICERT audit and thus receive official HORTICERT certification.
Background: The "HORTICERT" project was launched as part of the German government's Climate Action Plan 2050 and peat reduction strategy. The strategy aims to end the use of peat in hobby horticulture markets by 2026 and to reduce it as far as possible in professional horticulture by 2030. To this end, the Federal Ministry of Food and Agriculture (BMEL) has commissioned Meo Carbon Solutions GmbH to develop a corresponding international certification system, which is being developed in a multi-stakeholder approach under the project sponsorship of the Agency for Renewable Resources (FNR).

NGO participation: Global Nature Fund, Lake Constance Foundation and Welthungerhilfe (WHH) co-developed the sustainability criteria of the HORTICERT standard.

Making Sustainable Choices: Moving Away from Peat-Intensive Plant Cultures

A vital part of the peat reduction strategy is to make more sustainable choices in ornamental horticulture by **reducing the focus on highly peat-intensive plants**, particularly acid-loving plants such as rhododendrons, azaleas, camellias, hydrangeas, ericas, and heather plants. These species are highly popular with consumers due to their aesthetic appeal and versatility in landscaping, but their cultivation is rather reliant on peat, posing significant environmental challenges. To address this issue, the horticulture industry must explore sustainable alternatives that maintain the quality and appeal of these plants while reducing peat dependency. At the same time, it is essential to shift consumer interest toward **less peat-intensive species** by showcasing their unique qualities and environmental advantages.

12 Pollution: Pesticides

12.1 Relevance for Biodiversity

Pesticides have a major impact on biodiversity. Their application eliminates both target organisms and non-target organisms.[57] Each application influences biodiversity through direct and indirect effects[58] on the agro-ecosystem and its surroundings. Pesticides can accumulate in the soil, in water bodies as well as in living organisms and can have acute and/or chronic negative effects on human health and entire biotic communities.[59] They do not only affect the biodiversity on the area where it is applied to, but also have harmful effects on other, nearby habitats. Those off-site effects result from evaporation, run-off or leaching processes and drifts occurring in open as well as closed production systems.[60] They cause considerable environmental and economic damage, for example through yield losses caused by pollinator decline.[61]

According to a recent, global assessment of the state of pollinators, pesticides are amongst the most important factors that drive their decline globally.[62] The availability of pesticides has led to homogenous landscapes, large scale, vulnerable monocultures, and cultivation of susceptible varieties; altogether driving biodiversity and habitat loss. The economic success of such simplified cropping systems is increasingly dependent on the continuous use of pesticides; also described as a 'self-reinforced dependency'.[63]

The flower and ornamental plant industry is highly dependent on the use of pesticides, even more than other industries. This has many reasons, but is mainly due to:

1. High visual and quality requirements from the market and consumers and the fragility of flowers as a product
2. The necessity to minimize risks of imported pests and diseases from outside the EU (EU legislation on plant health), leading to a substantial use of pesticides.

As a result, high volumes of a wide range of pesticides are applied despite legal requirements to implement the integrated pest management principles (IPM) in the European Union and thus to reduce pesticide use as much as possible. As cut flowers and ornamentals are not meant for consumption, optimizing production methods and pesticide use are not in the

[57] Dicks, L.V., Breeze, T.D., Ngo, H.T. et al. A global-scale expert assessment of drivers and risks associated with pollinator decline. Nat Ecol Evol 5, 1453–1461 (2021). https://doi.org/10.1038/s41559-021-01534-9

[58] Solé, M., Brendel, S., Aldrich, A. et al. (2024): Assessing in-field pesticide effects under European regulation and its implications for biodiversity: a workshop report. Environ Sci Eur **36**, 153 (2024). https://doi.org/10.1186/s12302-024-00977-8

[59] Global 2000, BUND, Giftfalle Bienenfreundliche Pflanzen 2022: Pestizide auf Zierpflanzen (2022)

[60] Neumeister, L. Locked-in pesticides: The European Union's dependency on harmful pesticides and how to overcome it. (2022)

[61] Chwoyka, C., Linhard, D., Durstberger, T. et al. Ornamental plants as vectors of pesticide exposure and potential threat to biodiversity and human health. Environ Sci Pollut Res **31**, 49079–49099 (2024). https://doi.org/10.1007/s11356-024-34363-x

[62] Dicks et al (2022)

[63] Neumeister (2022)

focus of producers and retailers. This is reinforced, as IPM plans, and their implementation depend on individual interpretation and implementation. Further, the share of organically produced ornamentals and cut flowers is still low, however growing.

There is little to no transparency regarding which pesticides are used where and when, particularly in production countries outside the EU. In addition, as the approval of pesticides is regulated at national level, there is a high probability that pesticides not allowed to be applied in EU countries are used in non-EU countries.[64]

Lacking Maximum Residue Levels (MRLs) for pesticides on ornamentals and cut flowers hinder efforts to reduce negative effects on biodiversity and human health (see figure 1). A recent EU study found that plants that are declared as "bee-friendly", such as lavender or hyacinths, show high levels of pesticide residues in more than 90% of cases examined at the point of retail.[65] More than 20% of those pesticides were banned in the EU. Another study found similar results: On 39% of plants labeled “bee-friendly”, pesticide active ingredients (AIs), that were assessed as toxic to bees, were detected at the point of purchase.[66] Adding to this complexity, these pesticides are often produced in the EU and then exported to the Global South, where they are applied and then re-imported into the EU as residues, potentially harming people[67] and the environment. The lack of European legislation for pesticide residues on ornamentals and cut flowers endangers the health of people working in the industry and jeopardizes efforts to reduce the negative impacts of pesticides on biodiversity in both countries of production and retail.[68]

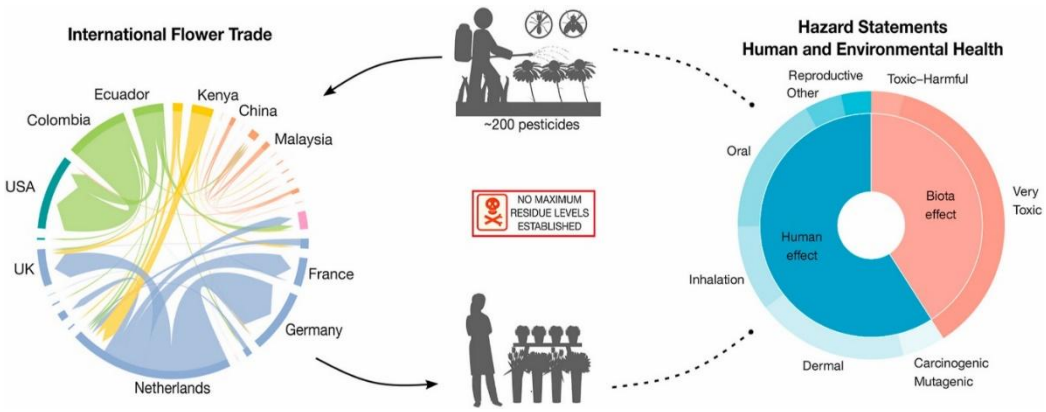


Figure 4 Lacking MRLs for pesticides in the flower industry reinforce harmful effects of pesticides on human health and ecosystems in production countries and countries of retail[69]

In Germany, the Netherlands and Belgium for example, individual retailers have set limits for pesticide residues on flowers. However, no unified limits exist in the retail sector.[70]

[64] The Danish Environmental Protection Agency, Survey of pesticides in flowers from countries outside the EU (2022)
[65] Global 2000, BUND (2022)
[66] Chwoyka, C., Linhard, D., Durstberger, T. et al. (2024)
[67] Toumi, K., Joly, L., Vleminckx, C., Schiffers, B. (2017). Risk Assessment of Florists Exposed to Pesticide Residues through Handling of Flowers and Preparing Bouquets. Int J Environ Res Public Health. 14(5):526. doi:10.3390/ijerph14050526. PMID: 28505067; PMCID: PMC5451977.
[68] Chwoyka, C., Linhard, D., Durstberger, T. et al. (2024)
[69] Pereira, P., Parente, C. Carvalho, G. et. al. (2021). A review on pesticides in flower production: A push to reduce human exposure and environmental contamination, Environmental Pollution Vol. 289, https://doi.org/10.1016/j.envpol.2021.117817.
[70] The Danish Environmental Protection Agency (2022)

Leaking pesticides from closed systems are another issue in the floriculture industry**.** The flower and ornamental plant industry either operates in open fields – meaning the production under the open sky – or closed systems, addressing production in greenhouses. Following a recent report published by the Pesticide Action Network (PAN), harmful pesticides – which are partially banned in open systems – are released from the supposedly closed system into the environment, often in high concentrations, leading to severe ecosystem contamination and destruction in nearby areas. [71]

Enforcing this, Suárez-López et al. (2020) measured reduced acetylcholinesterase (AChE) activity in children living near floriculture greenhouses in Ecuador indicating exposure from pesticide drift of several hundreds of meters.[72]

Pesticides escape mostly due to inadequate control and prevention mechanisms for drained and condensed water as well as through ventilation. Pesticides are subsequently found in surface and rainwater. The fact that pesticides escape from greenhouses is not new and hardly avoidable, even in modern and well managed greenhouses. This is mainly due to particular spraying methods, the low vapor pressure of pesticides and a lack of adequate techniques to remove pesticides from water and air.

Despite the fact that reducing pesticide use is a challenge for the ornamental plant and cut flower industry, it is clear that reduction of use is key to minimize the multiple negative effects on biodiversity and human health. The industry has acknowledged this, but despite efforts from standards and companies to properly manage and reduce the use of pesticides in open as well as closed systems through several approaches[73], pesticide use and its impact on biodiversity and human health remains substantial.

There are announcements to reduce the use of pesticides in the European Union. The Farm to Fork Strategy and the Biodiversity Strategy 2030, two strategies resulting from the EU Green Deal, for example entail the goal “to reduce by 50% the use and thus the risks of chemical pesticides by 2030 and to reduce by 50% the use of more hazardous pesticides by 2030”.[1] There is however no indication that any of these announcements will lead to a substantial reduction of pesticide use in floriculture, emphasizing the responsibility and potential of standards and companies to set a positive example to reduce pesticides in open and closed production systems.

In order to advance those efforts and mitigate the impacts of pesticides on biodiversity, the following recommendations for standards and companies were developed.

12.2 Recommendations

The following recommendations aim to support standard organizations and companies in minimizing pesticide pollution, with specific roles clarified where applicable. The

[71] PAN, It rains pesticides from greenhouses: The end of a myth, greenhouses are releasing pesticides into the environment. (2022)
[72] Suárez-López, J.R., Nazeeh, N., Kayser, G., Suarez-Torres, J., Checkoway, H., López-Paredes, D., Jacobs, D.R., Cruz, F. de la (2020). Residential proximity to greenhouse crops and pesticide exposure (via acetylcholinesterase activity) assessed from childhood through adolescence. Environ. Res. 2020 109728. https://doi.org/10.1016/j.envres.2020.109728.
[73] such as IPM plans, trainings on IPM, negative lists, documentation of used ppm, attributes of ppm storage facilities

recommendations regarding plant protection are based on the following principles, accounting for both open and closed systems:

The general principle and long-term objective are to combine agro-ecological pest and disease management with the cultivation of plants that are adapted to the respective location.
For those purposes, the standard organization/ company

- declares agro-ecological, preventative pest and disease management as a general principle, where chemical control is the last resort,
- promotes that the cultivation is adapted to the local conditions to avoid the use of pesticides.

In line with CBD Target 7, the basis that every standard organization/ company should build its efforts on is the consequent implementation of all principles of integrated pest management (see following recommendation).[74]

The target is to reduce the negative impacts of pesticides on biodiversity and human health as much as possible, at least by half until 2030, following CBD Target 7. Even though the CBD is not bounding, national legislation is supposed to follow.

The strategy is the continuous improvement in terms of pesticide use, meaning the continuous reduction in the frequency of use and toxicity. The application of pesticides that are particularly harmful to biodiversity such as non-selective insecticides/ acaricides (e.g. pyrethroids, organophosphates), systemic[75] insecticides/ acaricides (e.g., fipronil, neonicotinoids and new neonics such as Sulfoxaflor and Cyantraniliprole[76]), all nematicides and all pre-emergent and non-selective herbicides must be excluded or strictly prohibited.

Decision makers responsible for plant protection need to be regularly trained and motivated to understand and achieve the reduction target, supported by the standard organization/ company.

For those purposes, the standard organization/ company:

- Prepares an annually updated IPM guide available to farm operators based on the most common pests and diseases and how to prevent and control them biologically.
- Provides a list of suitable beneficial organisms incl. their banker plants.
- sets annual targets for a reduction in pesticide uses measured by the Treatment Frequency Index (TFI)[77].

[74] Convention on Biological Diversity, The Biodiversity Plan for Life on Earth, Target 7, https://www.cbd.int/gbf/targets/7
[75] These types of pesticides can be applied directly to the soil (as a "drench") around a plant's roots, or as a coating on a plant seed. The plants take them up with the water over the root system, and the chemical is distributed in the entire plant incl. pollen and nectar (when relevant).
[76] Azpiazu, C., Bosch, J., Martins, C., Sgolastra, F. (2022). Effects of chronic exposure to the new insecticide sulfoxaflor in combination with a SDHI fungicide in a solitary bee. Science of The Total Environment Vol. 850, https://doi.org/10.1016/j.scitotenv.2022.157822.
[77] See Annex 1 for more information on the Treatment Frequency Index (TFI)

- Commits to produce and disseminate information material (e.g. from FAO[78] on safe use and storage) and implement regular information workshops on pesticide reduction.
- Requests an annual map from each operation showing the cultivated area, habitats, non-spray areas and other ecological infrastructure.
- Demands the implementations of at least five measures enhancing functional biodiversity in- and around the cultivated area.
- Provides cultivar and application specific rules for pesticide use adjacent to water bodies and gives precise information about the minimum distance (minimum 10 meters) and quality of riparian buffer zones (height, width, vegetation density). The height must be defined depending on the height of the cultivated crop and the application method.

Recommendations for Open and Closed Production Systems

General Recommendations for Practices Promoting Biodiversity on Farms:

- The use of **pre-emergence herbicides** is prohibited and should be substituted with techniques like mechanical weeding during early growth stages.
- The application of pesticides in **riparian buffer** zones and non-cultivated farm areas (e.g., natural and semi-natural habitats, paths, fences, parking areas, edges etc.) is generally prohibited.
- The use of tank mixes combining different pesticide types (e.g. fungicides with insecticides) is prohibited to prevent non-targeted control and resistance development.
- A maximum of 80% of large cultivation areas (to be defined by the standard organization/company) may be treated with pesticides annually. The remaining 20% of the area is free of pesticide application and can be managed with alternative techniques (mechanical and/or biological pest control). This 20% surface ratio can rotate annually.

General Recommendations for Reducing Pesticides Across the Supply Chain

The standard organization/ company:

- Promotes organic farming practices that contribute to a reduction in the use of pesticides.
- Encourages techniques that lower pesticide use in the post-farm-gate conservation of products.
- Establishes **standard criteria** to monitor the reduction in the use of pesticides.
- Supports **research initiatives** to measure the impacts of pesticides on biodiversity and health.

[78] FAO, International Code of Conduct on Pesticide Management (2014), http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/

- Develops criteria that **exceed legal requirements**, particularly in relation to limit values, while identifying mandatory legal requirements as such.
- Supports **learning groups** of producers with similar crops to collect best practices and share learnings among producers.

Moving Away from Pesticide-Intensive Cut Flowers/ Potted Plants

The cut flower and ornamental plant industry relies heavily on pesticides due to, among others, a high susceptibility of many plants to pests, consumer demand for flawless appearances, intensive cultivation methods, the complexity of pest management, and the pressures of global supply chains. Among the most pesticide-intensive crops are **roses, lilies, chrysanthemums, and gerberas**. Cut flowers use as much as double the amount of pesticides compared to potted plants (see below, 1. for further information). To mitigate the environmental and health impacts of pesticide use, the industry could:

- Shift focus toward cultivating more pest-resistant plant varieties, adapted to local growing conditions.
- Emphasize the cultivation of native and speciality ornamental plants as sustainable alternatives to pesticide intensive plants.
- Focus on cultivating potted plants instead of cut flowers.

These strategies could help reduce dependencies on pesticide intensive plants and promote more sustainable practices. However, those suggestions can only work **if market expectations around – among others – visual perfection are reshaped**. This requires collective efforts from all involved stakeholders.

Further information:

1. Ornamental plants as vectors of pesticide exposure and potential threat to biodiversity and human health | Environmental Science and Pollution Research
2. Pesticide Residues on Three Cut Flower Species and Potential Exposure of Florists in Belgium - PMC

1. Consequent Implementation of the Integrated Pest Management Principles (IPM), Paired with Controls

The standard organization/ company provides detailed information on crop-based preventive measures, biological control, as well as **damage thresholds and monitoring methods per pest** in accordance with the basic measures of Integrated Pest Management (IPM):

- Inter- and mixed cropping

- Crop rotation incl. intercropping and/ or cover crops for field sanitation and maintenance of soil organic matter. The standard organization/ company lists effective methods in the IPM guide.
- Use of adequate cultivation techniques, e.g. non-chemical seedbed sanitation, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing where appropriate.
- Adjustments of the irrigation system to avoid foliar pathogens (e.g., avoid overhead irrigation in fungi susceptible crops).
- Proper cross ventilation in greenhouses to avoid foliar fungi infection.
- Use of pest resistant/ tolerant cultivars and standard/ certified seed and certified disease-free planting material[79].
- Balanced soil fertility and water management, making optimum use of organic matter.
- Minimum use of mineral N-fertilizer to reduce susceptibility to pathogens (e.g. mildew) and arthropod pest (e.g. aphids and white flies). See chapter on fertilizer for further recommendations regarding fertilization.
- Prevent the spreading of harmful organisms by field sanitation, insect nets[80] (if applicable) and hygiene measures (e.g., by removal of affected plants or plant parts, regular cleansing of machinery and equipment).
- Monitoring plans for arthropods: pest and beneficial organism populations must be monitored weekly during their peak season. The producers must be trained to identify both pests and positive effects of beneficial organisms as well as be able to calculate the related damage thresholds per pest. The producers must use the appropriate forecasting and diagnostic methods for pathogens (fungal, bacterial, viral).
- Release (if allowed by authorities), protect, and enhance important beneficial organisms, e.g. by establishing/maintaining ecological infrastructures inside (e.g. banker plants[81]) and outside the production sites incl. greenhouses.[82] The standard organization/ company trains producers and farm operators on the potential and appropriate use of beneficial organisms and physical traps as well as risks associated with their release. The farm operator ensures that the risk of escaping invasive organisms from closed systems is minimized as well as invasive beneficial organisms are not released in open production systems.

The standard organization/ company must make information on IPM easily accessible. A clear definition of expectations, external support and advice should be available, and it must be ensured, that information reaches the entire supply chain. A company with an interest in selling pesticides should not employ the external expert hired as external support. The

[79] Certification delivered via the EU passport for quarantine pests: Trade in plants & plant products from non-EU countries - European Commission

[80] Tokumaru, S., Tokushima, Y., Ito, S. *et al.* (2024). Advanced methods for insect nets: red-coloured nets contribute to sustainable agriculture. *Sci Rep* **14**, 2255. https://doi.org/10.1038/s41598-024-52108-1

[81] https://www.biobestgroup.com/news/biobest-is-banking-on-banker-plants

[82] Li, S., Jaworski, C.C., Hatt, S. *et al.* (2021). Flower strips adjacent to greenhouses help reduce pest populations and insecticide applications inside organic commercial greenhouses. *J Pest Sci* **94**, 679–689. https://doi.org/10.1007/s10340-020-01285-9

standard organization/ company should monitor the proper implementation of IPM practices.
The application of pesticides is only permitted if all preventative measures have been implemented and where defined thresholds per pest are exceeded:

- The application of preventative and alternative measures must be documented.
- Prevention of pests and disease and biological pest management must be prioritized over chemical control.
- The promotion[83] of beneficial organisms is a key measure advised by the standard organization/ company and a focal point of the farm operator's preventative pest controls.
- The preventative use of chemical pesticides is generally excluded by the standard organization/ company and is only permitted if no other alternatives are possible.
- The use of seeds treated with chemical pesticides is a preventive measure that is not in line with damage thresholds. The standard organization/ company does not allow the use of seeds treated with chemical pesticides.
- Only spot-on spraying devices for localized treatments are used in open and closed systems, and spraying equipment is calibrated every year.
- The burning of vegetation as a plant protection measure is only allowed if no other alternative measures exist. This must be proven by the documentation of all possible preventive and alternative measures. Farm operators in or close to protected areas can only burn vegetation if this is in accordance and with technical assistance by responsible nature conservation authorities.

[83] Promotion here is also meant as the provision of ecological infrastructure, i.e., banker plants.

Best Practices of Pesticide Avoidance Techniques

According to the Integrated Pest Management (IPM) principles, pesticides should be used only as a last resort. Additionally, they can contaminate soil and water, causing long-term environmental damage. A change of perspective is needed for the sector: What can be done to strengthen plants and make them less susceptible to diseases and pests? There are several strategies within the sustainable horticulture and floriculture industry to avoid the use of pesticides as far as possible:

- **Prevention**, with measures such as selecting pest-resistant plant varieties and choosing the right planting conditions.
- **Plant-strengthening techniques**, such as using organic compost or herbal extracts, to enhance plant health and resistance to pests.
- **Reducing sterility of production** and strengthening diversity of microorganisms
- Use of **red-coloured nets** to reduce plants' exposure to pests.
- **Habitat manipulation** to support beneficial insects by creating environments that encourage their presence, such as planting flower-rich grass margins or establishing habitat blocks or banker plants for natural pest control.

Further information:

1. Advanced methods for insect nets: red-coloured nets contribute to sustainable agriculture | Scientific Reports and Global 2000 (https://www.global2000.at/alternativen-zu-pestiziden)
2. Li, S., Jaworski, C.C., Hatt, S. et al. (2021). Flower strips adjacent to greenhouses help reduce pest populations and insecticide applications inside organic commercial greenhouses. J Pest Sci 94, 679–689. https://doi.org/10.1007/s10340-

2. Appropriate Use and Storage of Pesticides and Corresponding Controls

- Only authorized and regularly trained staff can access and use the machinery and apply the pesticides.
- The standard organization/ company must require and randomly check the proper use of chemical-synthetic pesticides: storage, application technology (e.g. maintenance and proper equipment settings), cleaning of equipment and disposal of residual materials/ packaging.
- Relating to permanent crops, the standard organization/ company provides specific recommendations for the calculation of an application rate, which is adjusted to the respective location (plant density and crown density).
- Pesticides are not applied at (or below) air temperature above 25°C, in the mornings if necessary. This reduces the chance of drift due to temperature inversions or evaporation.

- Pesticides are not applied at wind speed higher than 5m/s. This reduces the chance of drift due to temperature inversions or evaporation.
- Storage facilities for pesticides are to be separated from other storage facilities. They must be locked and properly ventilated to avoid toxic pesticide accumulations in the air.

3. Revision and Unification of a Negative List for Open and Closed Systems

The standard organization/ company:

- Defines a negative list consisting of all pesticides that are NOT allowed in open and closed systems, having damaging effects on bees, pollinating insects, beneficial organisms, amphibians or fish as well as being harmful to humans. The objective is to exclude high risk pesticides step by step. The PAN list[84] for highly hazardous pesticides is used to identify such pesticides.
- Defines a strategy with clear time-bound targets aimed at the continuous reduction of substances part of that list considered harmful to humans and the environment.
- ensures that certified farms and farm operators only use substances not included in the current negative list.
- Has defined clear sanctions in case of violations by certified farms and farm operators.
- Agrees with other standard organizations /companies on a unified negative list as well as any addition to it to avoid that farms with diverse certifications are faced with different negative lists.

4. Ban on Non-Selective Herbicides

Herbicides are generally not very “selective”: they commonly kill either all broad-leaved plants (dicotyledon plant) or all grasses (monocotyledon plants) – some herbicides kill both groups. The use of very harmful substances such as

- Glyphosat
- Diquat
- Paraquat
- Glufosinate ammonium
- Indaziflam and the salt equivalent versions

is not allowed. If these substances are still used, the standard organization / company clearly defines where and when application is permitted (e.g. not in flowering crops, not for siccation).

In line with IPM guidelines, the application of herbicides is only permitted as a last resort. Following the principle of continuous improvement, herbicide applications must be avoided and reduced as much as possible. The implementation of cover crops, mechanical measures such as mulching, mechanical removal or foil wrapping help to reduce the necessity to apply herbicides. Guidelines on those measures must be provided by the standard organisation/ company and reduction targets need to be developed.

[84] PAN, International List of Highly Hazardous Pesticides (2024)

5. Implementation of Maximum Residue Limits (MRLs)

Introducing MRLs into the flower industry are an effective way to incentivize the reduction of pesticide application at production level, as they will limit the concentration of individual pesticides on plants.

Thus, the standard organization/ company:

- Introduces maximum residue limits (MRLs) for the total contamination of ornamental plants and cut flowers from pesticides. Those can be based upon the EU MRLs for strawberries, including young plants for further reproduction/distribution[85]. EU Food MRLs have already been used internally by flower growers as a proxy for MRLs. Alternatively, Lavender MRLs (256990) or Rosemary MRLs (0256060) can be used.
- Limits the number of to be detected pesticides in the final product to five[86].
- Agrees with other standard organizations/ companies on MRLs for the total contamination of plants from pesticides.
- Ensures that MRLs are frequently controlled.
- Has defined clear sanctions in case of violations by certified farms and farm operators.

[85] https://eur-lex.europa.eu/eli/reg/2005/396/oj

[86] A limitation of detected pesticides to five is another incentive to reduce pesticide use. It does not imply a maximum application of five, as the last applications before harvest leave residues, not every early application.

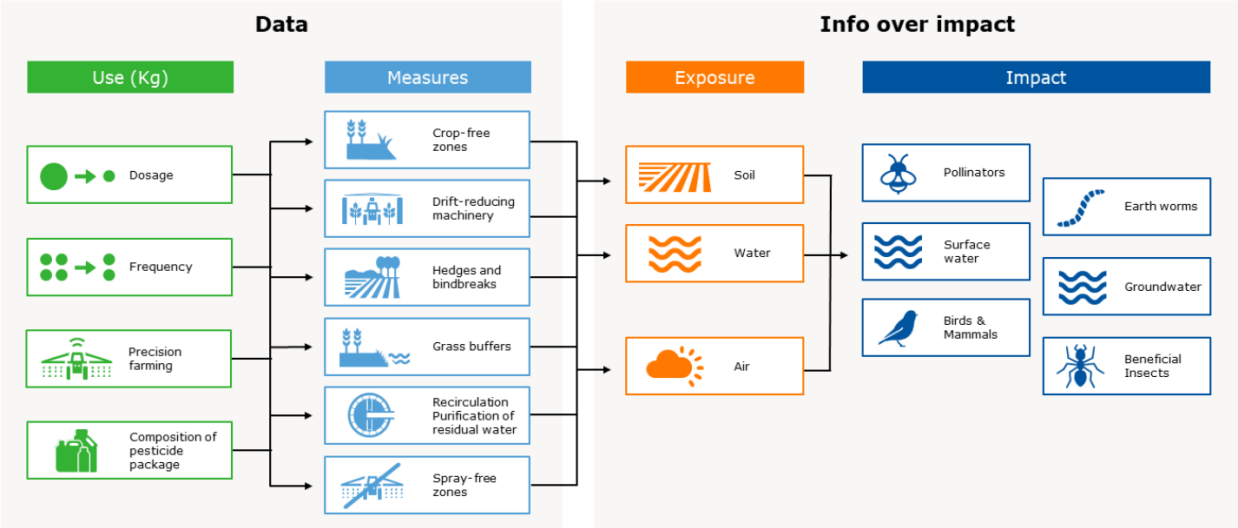
The Environmental Indicator Crop Protection (EICP)

The Environmental Indicator Crop Protection (EICP) is an indicator that calculates the impact of plant protection products (PPP) applied by producers and growers on the environment and biodiversity. It aims to harmonize efforts to reduce the environmental impact of PPPs. The EICP aims at balancing the needs of different sectors, markets, and society.

Producers can use the EICP to make informed choices about plant protection products and optimize farm management, while buyers can integrate it into sustainable purchasing policies. The overarching goal is to minimize environmental impact and promote transparency across the agricultural supply chain.

It is important to note that the EICP focuses solely on environmental and biodiversity impacts; human health considerations are not included. Additionally, the indicator provides a "reasonable representation of reality," without incorporating worst- or best-case scenarios.

The conceptual approach of the EICP



Further information: Focks, A., Lageschaar, L., Leendertse, P., Helmes, R., & Bremmer, J. (2023). Environmental Indicator Crop Protection (EICP): documentation of calculation rules. (Report / Wageningen Economic Research; No. 2023-015). Wageningen Economic Research. https://doi.org/10.18174/586066

6. **Continuous Improvement and Documentation of Pesticide Use (Treatment-Index, Toxicity-Index)**:

The standard organization:

- Uses the "Treatment Frequency Index (TFI)" in combination with toxicity indices[87] for several organism groups as a measure to describe the intensity of chemical pest management.
- Implements a maximum value for Treatment Frequency Index and Toxicity Index
- Uses these indices in general and on a regional level to reduce the pest management intensity, communicate successful reduction strategies, and foster the exchange and comparison between farm operators. It is advisable that the Treatment Frequency Index and the Toxicity Index are calculated annually in order to contribute to a continuous improvement (mid-term trend, e.g. 3 years).

The farm operator:

- Must continuously document the pesticide applications and other operations carried out to manage weeds, pests and diseases, and demonstrates a continuous improvement in the application of pesticides (see treatment frequency index and toxicity index).
- Proves continuous improvement in the use and appropriate handling of pesticides.
- Must receive consultation on the topic of pesticides. Issues to be covered include biodiversity impacts and reduction strategies. The consultation must be independent from the pesticide industry (no consultation by the pesticide industry, sub-contractors or consultants to the industry).

7. An Accident Procedure is Available Near the Plant Protection Product (PPP) and Chemical Storage Facilities

The standard organization/ company must ensure that risks for accidents during mixing, loading and transport and use of chemicals are minimized. Accident procedures and measures (e.g. absorption materials) to ensure that accidently spilled chemicals are contained are available. See chapter on water for further information on contaminated water treatment.

8. Ban of Chemical Soil Sterilization/Fumigation

The use of pesticides like chloropicrin, dazomet, 1-3-dichloropropene, formaldehyde, methyl bromide and metam-sodium/potassium for soil treatment is not allowed. These treatments eliminate all soil life and thus all soil biodiversity for several months.

Additional Risk Mitigation Measures for Closed Production Systems/Greenhouses

The standard organization/ company:

- Offers information material and trainings on ways to minimize pesticide leakage from greenhouses through i.e. ventilation and/ or runoff water.
- Develops and provides an adequate pesticide risk assessment on all types of greenhouses to assess their emissions into the environment (PAN).

[87] Toxicity indicies can be derived from the existing endpoints in the PPDB and Ecotoxicity Categories for Terrestrial and Aquatic Organisms: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-0.

- Adds otherwise banned pesticides in greenhouses to the negative list, permanent or not (PAN).
- Offers information material and trainings on ways to control ventilation directly after the application of pesticides to avoid their escape from greenhouses.
- Demands that ventilation after a pesticide treatment is avoided until the foliage and other surfaces have dried up.

13 Pollution: Fertilizers

13.1 Relevance for Biodiversity

Pollution of the environment has many sources. However, pollution from nutrients, such as nitrogen and phosphorus, is one of the main drivers of biodiversity loss. Nitrate is an important nutrient for plants, but too high concentrations in the environment can have negative effects on water, soil, and human health. Thus, the Convention on Biological Diversity, CBD, set itself the target to reduce excess nutrients lost to the environment by half (Convention on Biological Diversity (CBD), Target 7)

In the environment, nitrogen causes damage to waterbodies, soil, and air. Excessive nitrate concentrations in waterbodies can lead to eutrophication – where nitrate accelerates plant growth, which in turn extracts oxygen from the water and causes death of fish and other aquatic organisms. Nitrate leached from the soil can further enter the groundwater and pollute it. In drinking water, it may cause cyanosis in infants and increase the risk of cancer in adults. Airborne, the conversion of nitrate to nitrous oxide in the environment produces a powerful greenhouse gas.

In the ornamental flower and cut flower industry, the application of fertilizer is high due to the high quality and visual standards (see chapter on pesticides for further information) and the high competition that exists in this sector. This drives producers to use fertilizers to ensure their products meet market expectations and stand out among competitors. Fertilizers help speed up the growth cycle of plants, allowing for more frequent harvests and increased profitability. Adequate nutrition from fertilizers can improve the plants' resistance to pests and diseases, reducing losses and ensuring a healthy crop.

13.2 Recommendations

The following recommendations aim to support standard organizations and companies in minimizing fertilizer pollution, with specific roles clarified where applicable:

Recommendations for Open Production Systems

Each standard organization requires:

- Detailed documentation of fertilizer application, providing information on time of application, amount of applied fertilizer, nutrient content and plant availability of fertilizer, the correct name of the fertilizer and equipment and method of fertilizer application.
- A ’farm-gate’ nutrient balance, provided by the producer.

- Soil testing for nutrient contents at least every three years and carried out using a reliable method. Results are carefully documented and used to determine the exact nutrient needs of plants, preventing overuse of fertilizers.
- Prior to the application of essential amounts of nutrients (N=50kg/ha, P=30kg/ha), the exact nutrient requirement of a crop must be assessed by a nutrient demand determination.
- A continuous improvement in the use of fertilizers, leading to a reduction of fertilizer amounts to a minimum, necessary level.
- Requires regular training of staff on at least the following topics regarding fertilization:
  - Types of fertilizers and their risks
  - Secure storage and handling
  - Content and how to use the labels and MSDSs
  - Correct use of personal protective equipment
  - Prevention and emergency attention (accidents and spills).
- The application of the concepts and procedures taught in the training must be demonstrated and checked.
- The adoption of organic fertilizer should be preferred to mineral fertilizers, as it potentially improves soil health and decreases the dependency on synthetic fertilizers.
- No fertilization in times prone to leaching. Fertilization is not allowed on frozen or snow-covered soils nor on water-saturated soils or in times of heavy rainfall.
- Immediate incorporation of organic fertilizer into the soil, after application.
- defines crop specific nutrient limits adjusted in accordance with the plant's requirement and – where necessary and applicable - site-related and with tolerance thresholds. Any threshold must be based on scientific work and must be appropriate for the respective region.
- defines requirements for buffer zones along waterways, in which no fertilization is allowed, in order to reduce leaching. The width of the buffer zones lies above national legislation.
- offers advice and information on how to apply slow-release fertilizers. Those can significantly reduce the risk of leaching and runoff by gradually releasing nutrients, ensuring that plants receive them over an extended period.
- Promotes fertigation, allowing for precise nutrient delivery directly to plant roots via irrigation systems.
- Ensures that efficient irrigation systems are in place to reduce nutrient runoff and ensure that fertilizers are used more effectively.
- Introduces beneficial microorganisms and fungi to enhance nutrient uptake and improve soil health.
- Rotates different plant species and incorporation of a variety of plants to improve soil structure and fertility, reducing the need for additional fertilizers.
- Fosters the appropriate use and storage of fertilizers and corresponding controls.
- Only authorized and regularly trained staff can access and use the machinery and apply fertilizers.

- The standard organization /company must require and randomly check the proper use of fertilizers: storage, application technology (e.g. maintenance and proper equipment settings), cleaning of equipment and disposal of residual materials / packaging.
- Storage facilities for fertilizers are to be separated and need to be built in a way that does not allow any kind of leaching in the soil or the surroundings. Storage facilities for fertilizers must be locked and properly ventilated.
- Soil disinfection is prohibited where possible and reduced to an absolute minimum in all regards. If soil is disinfected, alternatives for chemical disinfectants are used.

Recommendations for Closed Production Systems

Soilless Production

- Detailed documentation of fertilizer application, providing information on time of application, amount of applied fertilizer, nutrient content and plant availability of fertilizer and the correct name of the fertilizer.
- Test the incoming water on quality.
- Implement fertigation.
- Reuse the water used in production.
- When water is discharged, do not discharge in the open environment and install a purification system for nutrient and ppp residues.
- Appropriate use and storage of fertilizers and corresponding controls.
- Only authorized and regularly trained staff can access and use the machinery and apply fertilizers.

Cultivation in Soil

- Detailed documentation of fertilizer application, providing information on time of application, amount of applied fertilizer, nutrient content and plant availability of fertilizer and the correct name of the fertilizer.
- Offers advice and information on how to apply slow-release fertilizers. Those can significantly reduce the risk of leaching and runoff by gradually releasing nutrients, ensuring that plants receive them over an extended period.
- Ensuring that efficient irrigation systems are in place to reduce nutrient runoff and ensure that fertilizers are used more effectively.
- Introduction of beneficial microorganisms and fungi to enhance nutrient uptake and improve soil health.
- Appropriate use and storage of fertilizers and corresponding controls.
- Only authorized and regularly trained staff can access and use the machinery and apply fertilizers.

14 Pollution: Waste Management

14.1 Relevance for Biodiversity: Plant Waste and Other Waste Materials

Plant Waste

In the ornamental plant production sector, **20-40% of plants** are estimated to be discarded or wasted. This waste occurs due to overproduction, failure to meet quality standards, unsold inventory, and logistical challenges during distribution. The percentages can vary depending on production systems and regions, with factors like demand forecasting inaccuracies playing a significant role.[88]

Measures to avoid plant waste should be developed by certifiers and producers, as none seem to exist currently.

Other Waste Materials

Effective waste management and recycling are essential for preserving biodiversity, as they reduce negative impacts and can contribute to a reduced virgin raw materials footprint.

It needs to be acknowledged that waste management possibilities and regulations **differ extremely from country to country**. Also, the use of e.g. plastic for tunnels is depending on the climate of the region. Even if in Germany or the EU recycling might be an established possibility at least for certain kinds of waste, this might not at all be the case in other countries / regions where e.g. young plants or cut flowers are produced.

Besides chemical waste, according to a report by Deutsche Umwelthilfe, the German plant trade alone generates 150 million items of single-use transport packaging (21,000 tons of plastic) per year.[89] The situation is similarly problematic with plastic plant pots. Another problem is the amount of waste produced in greenhouses. Per hectare and year, this amounts to 1.1 tons of greenhouse film, 500 kg of plastic from irrigation systems, containers and the like, and 50 kg for insect traps alone.[90] Growing crops in greenhouses and covered tunnels using plastic films is common in most producing countries. These films need to be replaced every 2-3 years and, at the moment, are oftentimes not recycled, which generates tons of plastic film waste annually that is illegally incinerated, disposed of in nature, or sometimes diverted to proper landfilling. A recently published report claims that agricultural plastics are one of the major contributors to soil pollution, contributing to large quantities of microplastics.[91]

[88] Darras AI. Implementation of Sustainable Practices to Ornamental Plant Cultivation Worldwide: A Critical Review. *Agronomy*. 2020; 10(10):1570. https://doi.org/10.3390/agronomy10101570

[89] Pflanzenhandel – Deutsche Umwelthilfe e.V.

[90] Salama K, Geyer M. Plastic Mulch Films in Agriculture: Their Use, Environmental Problems, Recycling and Alternatives. *Environments* (2023): 10(10):179. https://doi.org/10.3390/environments10100179

[91] https://switchmed.eu/wp-content/uploads/2024/01/Israel_Business-case_Circular-business-model-for-greenhouse-agricultural-plastic-waste_EN.pdf

Waste, especially chemicals and plastic, significantly threatens biodiversity. Plastic waste alone constituted 12% of all municipal solid waste in 2020.[92] The hazardous chemicals in plastics and debris disrupt habitats and natural processes, affecting numerous species, including 800 marine species as noted in a CBD report.[9394] Recycling plays a crucial role in mitigating these threats by converting waste into reusable materials, thereby reducing the need for raw resource extraction, and protecting natural habitats.

(Some) floriculture standards differentiate between:

- organic waste,
- paper,
- plastic/plastics,
- chemical waste,
- glass.

Contamination is acknowledged in soil, water, and air. However, contamination can also change the functioning of species and species composition, which is so far not reflected.

14.2 Recommendations: Other Waste Materials

The following recommendations aim to support standard organizations and companies in improving the management of other waste materials, with specific roles clarified where applicable. The focus lay on plastic waste, however, which is addressed in the following sub-chapter.

Recommendations for Standards (and Companies)

Waste management systems are elaborated in most of the revised standards and follow in parts the waste mitigation hierarchy. Standards should integrate the concept of the waste hierarchy more thoroughly, comprising criteria for each step or the concept as such:

[92] Md Atik Fayshal (2024): Current practices of plastic waste management, environmental impacts, and potential alternatives for reducing pollution and improving management, Heliyon, Volume 10, Issue 23, https://www.sciencedirect.com/science/article/pii/S2405844024168697

[93] Secretariat of the Convention on Biological Diversity, Montreal (2016): Marine Debris: Understanding, Preventing and Mitigating the Significant Adverse Impacts on Marine and Coastal Biodiversity. Technical Series No.83. cbd-ts-83-en.pdf

[94] United Nations Environment Programme and Secretariat of the Basel, Rotterdam and Stockholm Conventions (2023): Chemicals in plastics: a technical report. Genev. Chemicals in Plastics - A Technical Report | UNEP - UN Environment Programme

EU Waste Hierachy / © Circulate8

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14.3 Plastic Waste and Relevance for Biodiversity

The German NGO NABU in collaboration with the scientific Fraunhofer Institute have conducted studies on agriculture, including floriculture, and (micro)plastics in 2021[96], with learnings that also apply to other geographical regions: Every year, approximately 13,000 tons of plastics are released in Germany alone through fertilization with sewage sludge and compost, the use of agricultural films and other agricultural activities. The use of plastic and non-agricultural inputs has a direct toxic effect on soils and organisms, which in turn has a significant impact on biodiversity. Several studies have analyzed soil samples for plastics, with results indicating concentrations of up to 50,000 plastic particles per kilogram of soil and levels of up to ten milligrams per kilogram of soil. This high content poses a risk to earthworms and other insects and can affect plant growth as it can be absorbed by the plants via roots.
In general, microplastics cannot be retrieved from the soil and hardly degrade. This is similar to the behavior of biodegradable polymers such as PLA, which also do not degrade in the soil. This highlights the importance of reducing plastic consumption wherever possible.

Overall, four impact areas have been identified:

Sewage Sludge, Coated Fertilizers, and Compost

- **Sewage sludge:** The largest source is sewage sludge, through which 8,385 tons of plastic end up on agricultural land every year (in Germany). Bringing out sewage sludge is forbidden by the standards we revised.

[95] https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en
[96] Bertling, Jürgen; Zimmermann, Till; Rödig, Lisa (2021): Kunststoffe in der Umwelt: Emissionen in landwirtschaftlich genutzte Böden, Oberhausen, Fraunhofer UMSICHT. https://www.umsicht.fraunhofer.de/content/dam/umsicht/de/dokumente/publikationen/2021/umsicht-studie-plastikemissionen-landwirtschaft.pdf

- **Coated fertilizers** are responsible for 2,520 tons of plastic inputs. The polymer coating of these fertilizers enables controlled nutrient release. This can have ecological benefits for the soil, as fertilizers can be applied less frequently and more precisely. Research is still being carried out into biodegradable coatings for the controlled release of fertilizers and pesticides.[97]
- **Compost and fermentation residues** are an important source of humus and nutrients for agriculture, but an estimated 1,234 tons of plastic end up on the fields.[98]

Foils, Nets & Silo Coatings

- **Plastic films or foils** serve various purposes in plant cultivation: thermal, perforated, and black films reduce heat radiation and increase the soil temperature, they also help to reduce pesticides in the soil. Plastic emissions arise for various reasons: Films are stressed by wind and weather as well as use. Pieces of plastic can be released when some films are punched and perforated, as well as when the bales are opened, or the films are retrieved. As the plastics are constantly exposed to UV radiation, they can fragment over time, especially if they are used for too long. Damage caused by vandalism and animals also contributes to emissions, as does the improper disposal of film waste. The thinner the film, the greater the risk that pieces of film will remain on the field and accumulate in the soil or blow away into the surrounding countryside. The coatings of the mobile silos are worn and abraded over the years.

Especially in ornamental horticulture, plastic consumption is a significant issue also in terms of the numerous products and mechanical applications involved:

- **Plant containers** are used for a variety of purposes, including growing, packaging, and transporting plants, as well as for keeping them permanently. Additionally, growing trays and multi-plates are employed for growing young plants, which are often filled with fleece or press pots or swellable plugs (soil press pots).
- In addition to plant containers, various **planting aids** are also made from plastic. These include planting sticks, stakes, wires, cable ties, cords, and ribbons for securing plants, as well as nets, covers and pillars for protection against browsing, mowing and herbicides.
- In addition to the plastic products that are immediately apparent, the **wider plastic consumption in the production** of ornamental plants also encompasses a number of ancillary items. These include hoses, greenhouses, paints, varnishes, buckets, sacks and baskets, fences, and labels. The materials used include glass fiber reinforced polyamide, PVC, polypropylene and polyethylene.

As NABU puts it, **"Every ton that is reduced counts."**

[97] In the EU, microplastics in fertilizers is regulated since 2023: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4581

[98] Compost is an important peat alternative. However, consumers need to be sensitized for correct waste disposal so that plastics no longer end up in organic waste

14.4 Plastic Waste and Recommendations

The following recommendations aim to support standard organizations and companies in reducing plastic waste and improving its management, with specific roles clarified where applicable:[99]

The standard:

- closes the eventual gaps that the “EU Regulation (EU) 2023/2055 - Restriction of microplastics intentionally added to products” does not yet address. Also, the content of the regulation is applied internationally through the standards.
- develops an overall strategy for avoiding plastic in the production.
- Standards promote trainings for employees in purchasing of production materials.

The standard promotes the improvement of organic waste collection:

- Controls within the company
- Educating employees through mandatory training programs

The standard develops and audits a suitable and standardized measurement technique for plastic content in soils.

- Take soil samples: This leads to the analysis of the plastic yield in the soil, which is important for the knowledge of one's own business and expands the state of research on analyzing the plastic content in the soil.

The standard requests the sustainable use of alternative packaging material for flowers and transport or omit it completely.

Standards define requirements for the proper use of films.

Companies develop take-back systems for irrigation systems and durable films.

[99] The German NGO NABU and the scientific Fraunhofer Institute have put forth a series of recommendations for action on how plastic can be reduced in horticulture and agriculture, which can also be applied to ornamental plant production.[99] The recommendations refer to classic agriculture, but also floriculture, and can be applied to other geographical contexts. We have expanded on these and added further standards. Bio-based materials were largely excluded as alternative from these recommendations, as their impacts on biodiversity are not yet sufficiently clear.

Initiative ERDE - Nationwide recycling of agricultural films

Über die Initiative ERDE werden heute große Mengen an Agrarfolien einem Recycling zugeführt.
Bild: RIGK

One important approach in Germany is the Initiative Erntekunststoffe Recycling Deutschland - ERDE for short. It supports producers in returning used films and other plastics such as yarns, nets and nonwovens to the recycling loop. The voluntary initiative was initiated and implemented by the Industrievereinigung Kunststoffverpackungen e. V. in cooperation with RIGK GmbH. The project is financed by the manufacturers and primary distributors of the plastics.
ERDE began with the collection and recycling of stretch and silage films from animal feed production. And with great success: as early as 2020, more than half of the silage and stretch films sold in Germany were collected and recycled via ERDE.

https://www.praxis-agrar.de/pflanze/gartenbau/kunststofffolien-im-gartenbau/ruecknahme-und-recycling-von-agrarfolien

15 Pollution: Light Emission

15.1 Relevance for Biodiversity

Light pollution, or the loss of night darkness, is one of the most common forms of environmental pollution and possibly the fastest growing. Globally, it increases by about 6% annually and is considered one of the main threats to biodiversity. Light and darkness are important resources, just like clean water or air.[100] In addition to insects, bats, and birds, other vertebrates are also affected by nocturnal light emissions.[101][102]

Key Impacts of Light Pollution from the Floriculture Industry

1. **Disruption of Natural Light Cycles**: Greenhouse lighting, especially when used extensively at night, can disrupt the natural light-dark cycles. This disruption can affect the behavior and biological processes of nearby wildlife, such as migration patterns, breeding cycles, and feeding behaviors.
2. **Altered Plant-Pollinator Relationships**: Artificial lighting emissions (greenhouse or general) can attract or repel pollinators, leading to changes in plant-pollinator interactions. This could have downstream effects on plant reproduction and biodiversity.
3. **Disorientation of Nocturnal Species**: Many nocturnal animals rely on darkness for navigation and survival. Artificial light can disorientate them, leading to increased predation risks and reduced population sizes.
4. **Changes in Predator-Prey Dynamics**: Artificial lighting can affect predator-prey relationships. For example, illuminated areas might deter prey or attract predators, altering the balance in local ecosystems.
5. **Habitat Fragmentation**: The use of greenhouse lighting can create a physical barrier or perceived barriers for some species, leading to habitat fragmentation and decreased genetic diversity among isolated populations.

Global Relevance of Greenhouse Lighting

While greenhouse lighting has historically been associated with the Global North, its use is expanding in the Global South. This trend is driven by:

- Increasing demand for food.
- The need to extend growing seasons.
- Adaptation to changing climate conditions.

[100] Schweizer Bundesamt für Umwelt (BAFA), 2021: Empfehlungen zur Vermeidung von Lichtemissionen, https://www.bafu.admin.ch/dam/bafu/de/dokumente/elektrosmog/uv-umwelt-vollzug/empfehlungen-zur-vermeidung-von-lichtemissionen.pdf.download.pdf/UV-2117-D_Lichtemissionen.pdf

[101] Bundesinformationszentrum Landwirtschaft: https://www.praxis-agrar.de/pflanze/gartenbau/lichtimmission-verringern-led-technik-kann-einen-beitrag-leisten

[102] Linares Arroyo, H., Abascal, A., Degen, T. *et al.* Monitoring, trends and impacts of light pollution. *Nat Rev Earth Environ* **5**, 417–430 (2024). https://doi.org/10.1038/s43017-024-00555-9

The rising prevalence of greenhouses highlights the urgent need to address the biodiversity impacts of light pollution in diverse geographical contexts.

15.2 Recommendations

The following recommendations aim to support standard organizations and companies in minimizing light pollution, with specific roles clarified where applicable:

Swiss BAFA has developed a 7 points plan (2021, in German) that we recommend as a guideline for standards to apply to their producers. Additionally, a manual focused on reducing the environmental impact of lighting and avoiding disturbances to nature would be beneficial for producers.

Efficient and reduced lighting not only minimizes ecological impacts but also lowers operational costs.

Principles for Limiting Light Emissions (7-Point Plan)

1. **Necessity**
   Does the lighting need to be used? Only light what needs to be lit.
   - Avoid lighting in natural areas whenever possible.
   - If lighting is unavoidable, identify and address conflicts of interest early, involving specialist nature and landscape agencies.
   - Conflicts may arise regarding the protection of landscapes, sensitive species, and habitats.
   - Minimize the impact of light emissions, especially when endangered species are present. In such cases, prohibit lighting.
   - Define **buffer zones** around protected areas and sensitive habitats (e.g., water bodies) in land-use planning. Projects within these zones should consult with nature conservation agencies during the approval process.
   - For facilities or outdoor workstations that must comply with national lighting standards (e.g., work safety), their necessity is not questioned. However, require a **lighting concept and documentation** that minimizes biodiversity impacts.

2. **Intensity/Brightness**
   How bright does the lighting need to be? Use only as much brightness as necessary.

   - **Adapt to ambient brightness**: In darker environments, lower light intensities are sufficient to fulfill lighting purposes. Lighting should also be adjusted to the specific needs of the plant species being cultivated.

- **Protect light-sensitive species**: Current scientific knowledge does not allow for exact quantitative limits on artificial light intensities (e.g., illuminance in dark environments). However, it is evident that the visual systems of nocturnal animals, which are highly sensitive to low light levels, can be disrupted even by minimal artificial lighting.
- **Reduce or avoid lighting**: To mitigate these effects, the intensity of artificial light should be minimized wherever possible, or lighting should be avoided altogether.

Note: Plants have different requirements when it comes to lighting: As plants grow and increase the number of leaves, the need for light increases, for example. Here, an exact adaptation of lighting to plant species is necessary.[103]

3. **Light Spectrum/Light Colour**
   Is the light spectrum properly selected? Match the light spectrum to the purpose of the lighting and its surroundings.

- **Tailored Selection**: Carefully choose the light spectrum to align with the lighting purpose, location, and environmental context.
- **Impact on Animals**: Animals perceive light and colours differently than humans. Nocturnal animals, especially insects, are highly attracted to short wavelengths such as UV and blue light. To minimize this attraction:
  - Avoid or reduce UV and blue components.
  - Use warm white LEDs with a colour temperature below **2700 K** whenever possible.
- **Use of Filters**: In specific cases, luminaires can be equipped with filters to limit undesirable spectral components, such as UV filters.
- **Plant Needs**: Most light absorbed by plants lies within the visible spectrum. Red and blue light are particularly critical for photosynthesis, making them the primary wavelengths used for plant growth. [104]

4. **Selection and Placement of Fixtures**
   Are the fixtures properly chosen and suitably placed? Lighting should be as precise as possible without unnecessary spillover into the environment.

- **Preserve Dark Corridors**: Plan lighting to maintain dark corridors and areas around illuminated infrastructure (e.g., green belts) to keep habitats of nocturnal animals connected and intact.
- **Buffer Zones for Sensitive Habitats**:
  - Establish buffer zones between lighting installations and protected natural areas (e.g., national and regional biotopes, wildlife passages, fish ladders).
  - Impose stricter requirements for lighting in these zones to minimize emissions into protected areas.
- **Sealed Luminaires**: Ensure luminaires are sealed to prevent small creatures, such as insects or spiders, from entering.
- **Optimized Light Fixture Placement**:

[103] https://cropking.com/blog/light-greenhouse-how-much-enough
[104] https://cropking.com/blog/light-greenhouse-how-much-enough

- Use more poles with **lower light fixture heights** to provide uniform lighting and reduce light emissions into the surrounding environment. Lower fixtures reduce long-range effects and allow for more precise light direction compared to taller poles.
- Opt for fixtures with **asymmetrical light distribution** to better confine lighting to the intended area, rather than using fixtures with symmetrical light distribution.

5. Orientation

Are the fixtures optimally oriented? Lighting should generally be directed from top to bottom. Align fixtures precisely during installation to minimize unnecessary light emissions.

- **Top-to-Bottom Illumination**: Orient lighting downward to avoid light spill into the night sky.
- **Horizontal Alignment**: Ensure the fixture's glass cover is as horizontal as possible. Tilting the fixture excessively can lead to:
  - Increased glare for nearby residents.
  - Attraction of more insects due to increased visibility from a distance.

Considerations for Wildlife and Habitats

- **Bats**:
  - Avoid illuminating exit holes of bats' daytime roosts, as this can delay or prevent their emergence for hunting and may cause them to abandon their roosts.
  - Maintain dark corridors between bat roosts and hunting habitats.
- **Birds and Other Animals**:
  - Do not directly or permanently illuminate nesting and breeding sites on historic buildings, such as city gates, walls, or churches.
- **Bodies of Water**:
  - Avoid illuminating near-natural water bodies and their banks. These habitats support diverse organisms, including:
    - Fish, crustaceans, and amphibians.
    - Aquatic insects such as caddisflies and mayflies.
    - Zooplankton, water fleas, and whirlpool worms.

6. Time Management/Control

When is lighting needed, and when can it be turned off or reduced? Lighting should be controlled as needed, minimizing use and turning it off or dimming it whenever possible.

Key Considerations for Time Management

- **Time of Day or Night**: Adjust lighting based on the specific time and duration it is required.
- **Seasonal Adjustments**: Modify lighting based on the season to account for varying natural light conditions and wildlife activity.
- **On-Demand Control**: Use intelligent lighting systems that allow for real-time adjustments to reduce unnecessary emissions.

Strategies to Reduce Lighting in Natural Areas

1. **Limit Lighting Schedules**:
    - Avoid lighting every evening. Determine specific days or periods during the week when lighting is truly necessary.
2. **Adapt to Weather Conditions**:
    - Refrain from lighting during fog, low-hanging clouds, or rain, which amplify light scattering and its impact on wildlife.
3. **Consider Natural Ambient Brightness**:
    - Operate lighting only on light nights (e.g., during a full moon) and avoid it on dark nights (e.g., new moon). (see Appendix A5.3.6).

Seasonal Considerations for Wildlife Protection

- **Migratory Birds**:
    - Birds are particularly vulnerable during migration in spring (March–May) and fall (August–November), especially under foggy or overcast skies. During these periods, implement lighting restrictions, such as:
        - Automatic blinds or shading systems on tall buildings to prevent disorientation.
- **Bats**:
    - Avoid lighting near exit holes of bat roosts from spring to fall, as artificial illumination disrupts their hunting patterns. During winter hibernation (typically in caves), bats are generally unaffected by lighting, but new installations in hibernation caves should be avoided.

7. Shielding

Is shielding required? → Add additional shielding in specific cases to reduce light emissions effectively.

Key Considerations for Shielding

- **Available Methods**:
    - What shielding methods are available for the greenhouse?
    - Which options are cost-effective and feasible for the specific greenhouse setup?
    - How many layers of shielding are necessary?
    - What additional control systems (e.g., automation) are important for efficient light management?

Reducing Light Emissions

Light emissions from indoor lighting during early morning or late evening can be minimized using shielding systems such as shutters, blinds, or opaque curtains.

Recommended Shielding Systems Include:

1. **Horizontal Retractable Blackout Screens**:
    - Installed at gutter height or above the light fixtures.

2. **Vertical Light-Restricting Screens**:
    - Installed along the greenhouse sidewalls to block light from all directions.

Benefits of Screens:

- The upper side of horizontal screens reflects sunlight, reducing heat buildup when used during daylight hours.
- The lower side of the screen is white, reflecting light from lamps back toward the crops, which:
    - Increases light intensity within the greenhouse.
    - Provides energy savings by retaining heat within the greenhouse.

Customization and Safety

Greenhouses often require customized shielding equipment to maximize effectiveness and minimize costs. Consider the following:

- **Humidity Transport Properties**: Ensure screens allow adequate humidity control.
- **Fire Safety**: Install screens far enough from the lights to avoid fire hazards.

Advanced Shielding Systems

- **Climate Screens**:
    - Specifically designed for light-abatement purposes.
    - Installed as an additional layer to existing shade or energy-saving curtains, using a separate wire system and motorized controls.
- **Double-Layer Blackout Screens**:
    - Intended for photoperiod control.
    - Can also be closed after dark to prevent light emissions.

Proactive Design: Whenever possible, incorporate additional screens into the initial greenhouse design to avoid costly retrofitting later.

General Benefits of Shading Instruments

Equipping greenhouses with shading instruments involves upfront costs but offers multiple benefits:

- **Summer Regulation**: Helps control high temperatures in summer.
- **Winter Insulation**: Prevents heat loss during colder months, maintaining greenhouse efficiency.

16 Invasive Species

16.1 Relevance for Biodiversity

According to IUCN, invasive alien species are animals, plants or other organisms that are introduced by humans, either intentionally or accidentally, into places outside of their natural range, negatively impacting native biodiversity, ecosystem services or human economy and well-being.[105] Experts estimate that only a small fraction – around 0.1% – of newly introduced species become invasive. However, the consequences for ecosystems can be extensive and especially in the case of invasive animals, which can usually spread faster than plants, even spectacular: Since *bombus terrestris was,* the buff-tailed bumblebee or large earth bumblebee, introduced as a commercial pollinator to Chile in 1998, the species is spreading at around 275 km per year, replacing the endemic *Bombus dahlbomii*.[106] The mechanisms for harmful impact include: interspecies competition, predation and herbivory, hybridization, disease and organism transmission and negative ecosystems impact (e.g. through changed nutrients dynamics). Invasive alien species belong to the top five threats for biodiversity globally.
The production and trade of ornamental species and horticulture in general are among the most common pathways for the introduction of invasive alien plants and especially invasive fungi.

- In Germany, around 60% of plant species considered invasive have been introduced intentionally as “garden plants”.
- Fungi are often spread unintentionally by infected plant material: e.g., *Hymenoscyphus fraxineus* (ash dieback) is suspected to have been spread by infected saplings from Asia.
- The application of beneficial organisms for pollination or pest control can be problematic, as the aforementioned example of the large earth bumblebee demonstrates. Other examples include the spread of certain varieties of *Coccinellidae* (mainly *harmonia axyridis*), introduced to control aphids.

Potentially invasive species can also be spread unintentionally through the products used in plant production (e.g., substrates). Many countries have introduced legal frameworks to restrict and manage the spread of invasive species.

Measures and strategies to manage potentially invasive species include:

- Trade and import restrictions for specific species (“blacklists”)
- Warning lists evaluating (potentially) invasive species

[105] https://www.iucn.org/our-work/topic/invasive-alien-species

[106] Schmid-Hempel, Regula, Michael Eckhardt, David Goulson, Daniel Heinzmann, Carlos Lange, Santiago Plischuk, Luisa R. Escudero, u. a. 2014. „The Invasion of Southern S Outh A Merica by Imported Bumblebees and Associated Parasites“ hrsg. Mike Boots. *Journal of Animal Ecology* 83(4): 823–37. doi:10.1111/1365-2656.12185.

- Frameworks to evaluate main vectors and trends regarding the introduction and spread of potentially invasive species.

Due to climate change, plants that could only survive in urban areas in the past (heat isle effect) and were thus not considered invasive, will have to be reevaluated regarding their invasiveness. Additionally, plants can take considerable time to turn out as invasive. This means, that the legal framework is usually behind the curve. Thus, the application of the precautionary principle (i.e., limiting the further spread of species found on warning-lists) would be desirable.
Evaluating the produced plants in terms of their risk to become invasive (comparing the list of produced plants with warning list), can also be a sound business decision, since there is a high likelihood, that trade restrictions will be imposed in the future on species presently listed as “potentially invasive”. This would force producers and retailers to de-list these species.

Invasive Species in Garden Assortments
DIY and garden markets should check their assortments against at least the following lists:

- **EU Union List (2022)**: Legally prohibited: Union List. This list contains species whose import, sale, and possession are prohibited within the EU.
  - Immediate removal is legally required if affected species are found.
  - Check assortment.
- **List of Early Detection Species of the Union List in Germany (applies to DE as well as EU)**: Early Detection List.
  - Immediate removal is legally required.
  - Check assortment.
  - Inform authorities if such species enter the trade.
- **BfN Warning and Action List (2013)**: Recommendations from experts, not legally binding, but an important guideline: BfN Warning List.
  - Recommendation: Check and apply assortment.
- **Swiss List (2024)**: Does not apply to Germany and the EU but goes significantly beyond German requirements. It is expected that the EU will follow some of these requirements, the list is hence recommended as orientation.

Additionally, EU rules on the import of soils in the plant sector and invasive species introduced through them also apply. More information on "Legal provisions on soil import" can be found on the EU Commission's website.

16.2 Recommendations

The following recommendations aim to support standard organizations and companies in preventing the spread of invasive species, with specific roles clarified where applicable:

Recommendations for Standards and Producers

Evaluation of Potential Contribution to the Spread of Invasive Species

Producers of ornamental plants and flowers should evaluate the risk to contribute to the spread of invasive species tied to

- their products,
- beneficial organisms used for pollination, pest-control, soil health etc.,
- involuntary spread of invasive species during transport.

Producers of plants and flowers should refer to the list of (potentially) invasive species of the countries where their plants are produced, sold to, and used – if possible. As a minimum (and basis to ensure legal compliance), "blacklists" containing species for which trade or other restrictions are already in force, should be considered. To allow for the consideration of the precautionary principle, "grey lists" or "warning lists" of the target-markets should also be taken into consideration. Additionally, blacklists and watch lists are available for many countries. They usually contain a limited number of species and are updated every few years.

Inform Customers, Reduce Risks from Beneficial Organisms and Unintentional Spread (e.g., through transport)

Producers should provide information about potentially invasive species to their customers based on the aforementioned evaluation (e.g., a list of countries / regions where a given plant is considered potentially invasive or the sale restricted).
If beneficial organisms applied on a producer's site are potentially invasive, alternative beneficial organisms should be considered. If no alternatives are available, measures to limit the risk of these organisms spreading into the open landscape should be implemented.
Measures to hinder the spread of (potentially) invasive species during transport should be developed and implemented.

Recommendations for Retailers

Ensuring Legal Compliance and Reconsidering Assortment
Retailers selling plants to end consumers (or landscape gardeners using plants) should ensure that their overview of relevant regulations is up to date (e.g., the list of invasive alien species of Union concern for the EU[107]) and their assortment adheres to the regulations.
At least in some countries (e.g., Germany), a list of *potentially* invasive species (grey list, warning list) is available. Retailers should consider phasing out plants in their assortments that are listed there. This can also as an early warning system, since these species are candidates for which trade might be restricted in the future due to legislation.

Informing customers
Retailers should provide information on invasive plants at the POS and explain to customers what invasive species are, and which plants are considered potentially invasive.

Recommendations for Standards

[107] See: https://op.europa.eu/en/publication-detail/-/publication/047cee1a-077b-11eb-a511-01aa75ed71a1

Awareness Raising and Education
Awareness for invasive species and their impact is very low. Standards should support companies with information and training regarding invasive species (impact of invasive species on biodiversity, legal risks, best-practice-examples…).

Documentation of risk-evaluation and measures to reduce risks
Standards should as a minimum require companies to conduct the aforementioned evaluation of risks to contribute to the spread of invasive species.

17 Glossary

Alien Invasive Species	An alien species is a species, subspecies or lower taxon, introduced outside its natural past or present distribution (Source: CBD). An alien invasive species is an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity, food security, human health, trade, transport and or economic development Source: IUCN – ISSG & 2010 Biodiversity Partnership
Baseline Assessment / Baseline Data	A baseline assessment is an assessment that is usually undertaken before an operation is initiated to provide data on the local environmental and social context prior to the initiation of the project. This data on the baseline context would then be compared with the results of future monitoring and/or targets to assess the impacts of the operation and inform ongoing management of impacts
Beneficial insects	Insects are crucial for almost all ecological processes in terrestrial ecosystems: 1) plant reproduction (e.g. pollinators), 2) biodegradation of waste (decomposers) and 3) natural resistance of agro-ecosystems/natural control of harmful species (natural enemies, predators, parasites). With “beneficial insects” this role is focused on benefits for humans, in addition to the mentioned above, edible insect species in nutrition, with valuable insect products (e.g. silk or honey) and in biochemistry, among others Source: FAO, 2013
Biodiversity	The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems. Sources: CBD
Biodiversity Action Plan (BAP)	A plan to conserve and promote biodiversity, including a baseline, concrete and significant measures and a progress monitoring. Source: Global Nature Fund & Lake Constance Foundation, 2020
Biological pest control	A method of controlling pests, diseases and weeds in agriculture based on natural predation, parasitism or other natural mechanisms that limit the infection with pathogenic organisms Source: FAO (2019)
Biotope corridors /habitat corridors	Ecological structures that connect natural habitats separated by human infrastructure, arable land and human activities (such as roads, buildings or logs, farm production areas, etc.). Habitat corridors allow exchange of individuals between populations, and mitigate negative effects (e.g. on reproduction and breeding) and the loss genetic diversity in isolated populations. Source: http://www.environment.nsw.gov.au/resources/nature/landholderNotes15WildlifeCorridors.pdf.
Buffer Zone	Buffers zones are small areas or strips of land in permanent vegetation, designed to intercept pollutants and manage other environmental concerns. Buffer Zones include the regions near the border of an area which is protected or managed for conservation, transition zones between areas managed for different objectives (including e.g. riparian buffer zones between rivers and production areas), or areas on the edge of protected areas that have land use controls and allow only activities compatible with protection of the core area, such as research, environmental education, recreation, and tourism. Buffers include: riparian buffers, filter strips, grassed waterways, shelterbelts, windbreaks, living snow fences, contour grass strips, cross-wind trap strips, shallow water areas for wildlife, field borders, alley cropping, herbaceous wind barriers, and vegetative barriers. Source: UNEP-WCMC and USDA NRCS

CBD Target 7	CBD is an abbreviation for the Convention on Biological Diversity. Target 7 of this convention deals with the reduction of pollution to levels that are not harmful to biodiversity. Source: https://www.cbd.int/gbf/targets/7
Connectivity (of Habitats)	Landscape connectivity is an ecological description of the degree to which the landscape facilitates or impedes movement between resource patches. Increased connectivity between habitats may be provided by continuous biological corridors, habitat 'stepping stones', or a mosaic of suitable patches.
Continuous improvement	**The principle of continuous improvement** is an objective of all management system standards, e.g. ISO 14001, EMAS and ISO 9000. For some biodiversity related aspects – especially the ones that should be part of a Biodiversity Action Plan such as creation of habitats, connection via biotope corridors or species protection – continuous improvement as a mandatory requirement makes a lot of sense.
Cut-off date	The date after which deforestation or conversion renders a given area or production unit non-compliant with no-deforestation or no-conversion commitments, policies, goals, targets, or other obligations. Source: ADI (2024); https://accountability-framework.org/use-the-accountability-framework/definitions/cutoff-date/
Deforestation	Loss of natural forest as a result of: (i) conversion to agriculture or other non-forest land use; (ii) conversion to a tree plantation; or (iii) severe and sustained degradation. • This definition pertains to no-deforestation supply chains that generally focus on preventing the conversion of natural forests. • Severe and sustained degradation (scenario iii in the definition) constitutes deforestation even if the land is not subsequently used for a non-forest land use. • Loss of natural forest that meets this definition is considered to be deforestation regardless of whether or not it is legal. • The Accountability Framework's definition of deforestation signifies 'gross deforestation' of natural forest where 'gross' is used in the sense of "total; aggregate; without deduction for reforestation or other offset." Source: AFI (2024); https://accountability-framework.org/use-the-accountability-framework/definitions/deforestation/
Degradation	Changes within a natural ecosystem that significantly and negatively affect its species composition, structure, and/or function and reduce the ecosystem's capacity to supply products, support biodiversity, and/or deliver ecosystem services. Source: AFI (2024); https://accountability-framework.org/use-the-accountability-framework/definitions/degradation/
Ecosystem	A dynamic complex of communities of plants, animals, microorganisms, and their inanimate environment, interacting as a functional unit. Source: Convention on Biological Diversity (1992).
Ecosystem services	Benefits mankind obtains from ecosystems. These include services such as food and water; regulating services such as regulation of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits (Millennium Ecosystem Assessment).
Endangered Species	Threatened species in the IUCN Red List i.e. species that face a high (vulnerable species), very high (endangered species), or extremely high (critically endangered species) risk of extinction in the wild.
Global Biodiversity Framework Target 7	Reduce pollution risks and the negative impact of pollution from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including: reducing excess nutrients lost to the environment by at least half including through more efficient nutrient cycling and use; reducing the overall risk from pesticides and highly hazardous chemicals by at least half including through integrated pest management, based on science, taking

	into account food security and livelihoods; and also preventing, reducing, and working towards eliminating plastic pollution.
Genetically Modified Organism (GMO)	Any organism, with the exception of human beings, whose genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination. Source: European Union (2001)
Free, Prior, and Informed Consent (FPIC)	A collective human right of indigenous peoples and local communities to give and withhold their consent prior to the commencement of any activity that may affect their rights, land, resources, territories, livelihoods, and food security. It is a right exercised through representatives of their own choosing and in a manner consistent with their own customs, values, and norms. Source: AFI (2024), https://accountability-framework.org/use-the-accountability-framework/definitions/free-prior-and-informed-consent-fpic/
Floriculture	Floriculture, branch of ornamental horticulture concerned with growing and marketing flowers and ornamental plants as well as with flower arrangement. Because flowers and potted plants are largely produced in plant-growing structures in temperate climates, floriculture is largely thought of as a greenhouse industry, though many flowers are cultivated outdoors in nurseries or crop fields. Both the production of bedding plants and the production of cuttings to be grown in greenhouses or for indoor use as houseplants are usually considered part of floriculture. Source: Britannica (2024)
Habitat	Characteristic living area of a particular animal or plant species or the habitat determined by specific abiotic and biotic factors where the species lives at a stage in its life cycle.
High Conservation Value Areas (HCVA)	According to the High Conservation Values (HCV) Common Guidance Toolkit, HCVs are defined as biological, ecological, social or cultural values which are considered outstandingly significant or critically important, at the national, regional or global level. The six HCVs: **HCV 1** Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels. **HCV 2** Intact forest landscapes and large landscape-level ecosystems and ecosystem mosaics that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance, **HCV 3** Rare, threatened, or endangered ecosystems, habitats or refugia. **HCV 4** Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes. **HCV 5** Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water, etc...). Identified through engagement with these communities or indigenous peoples.

	HCV 6 Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples. Identified through engagement with these local communities or indigenous peoples. Source: HCV Common Guidance Toolkit (2021), https://www.hcvnetwork.org/library/common-guidance-for-the-identification-of-hcv-english-indonesian-french-portuguese
Integrated Biodiversity Assessment Tool (IBAT)	The IBAT-Alliance hosts three key global biodiversity datasets: • IUCN Red List of Threatened Species • World Database on Protected Areas • World Database of Key Biodiversity Areas The Species Threat Abatement and Restoration Metric is derived from the IUCN Red List of Threatened Species and is supposed to allow organizations to quantify the potential contributions that species threat abatement and restoration activities offer towards reducing extinction risk across the world. https://www.ibat-alliance.org
Indicator species	A species whose status provides information on the overall condition and other species in a given ecosystem. They indicate quality and changes of environmental conditions, as well as aspects of species composition. Source: United Nations Environment Programme (1996).
Integrated Biodiversity Assessment Tool (IBAT)	IBAT (www.ibatforbusiness.org) is an online tool maintained by BirdLife International, Conservation International, United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC), and IUCN, designed to facilitate access to accurate and up-to-date biodiversity information. It incorporates data on protected areas and a range of globally important sites for biodiversity. Source: IBAT website.
Integrated Pest Management IPM	The objective of IPM is to combine the various methods of biological and chemical pest management as well as physical and biotechnical measures in the most optimal way. IPM proposes a hierarchy of intervention to prevent plant diseases. This includes the analysis of plant protection methods and the consequent integration of appropriate measures else than pesticides first. The target is to interrupt the dynamic of populations of harmful organisms by natural means and to economically balance the use of plant protection products and other forms of intervention with the loss in yield. IPM reduces and minimizes risks to human health and the environment. Integrated Pest Management fosters the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. Source: EU Directive Plant Protection Framework (2009/128/EC)
Invasive alien species	Invasive alien species are non-native species that damage the environment and potentially cause species extinction, modify ecosystem processes and act as vectors of diseases. Problems caused by invasive alien species have potentially large economic consequences. They are also one of the drivers of biodiversity loss.
Key Biodiversity Areas (KBAs)	Sites contributing significantly to the global persistence of biodiversity. They represent the most important sites for biodiversity conservation worldwide, and are identified nationally using globally standardized criteria and thresholds.

	Source: UNEP-WCMC 2014, Biodiversity A-Z website: www.biodiversitya-z.org
Mitigation hierarchy	The mitigation hierarchy is defined as: Avoid: measures to avoid severe impacts in advance. Spatial or temporal placement of infrastructure elements in order to completely preclude negative impacts on biodiversity. Minimize: measures taken to reduce duration, intensity and extent of impacts (including direct, indirect and cumulative impacts, as appropriate) which cannot be avoided. Restore: measures to restore degraded and destroyed ecosystems after exposure to impacts that cannot be avoided and minimized. Compensate/offset: Measures to counteract residual adverse impacts that cannot be avoided, minimized or rehabilitated. It aims to achieve no net biodiversity loss or gain in a given area trough positive activities such a restoring habitats, halting degradation; or by effectively protecting habitats at risk of a loss of biodiversity. A key principle is that offsets cannot justify projects with unacceptable residual impacts on biodiversity. All options to avoid damages have to be examined in depth. Source: Glossary European Commission and Business and Biodiversity Offsets Programme (BBOP)
Native species	Flora and fauna species that live naturally in a given area or region. Also referred to as indigenous species Source: Convention on Biological Diversity - Glossary
Natural Ecosystems	An ecosystem that substantially resembles — in terms of species composition, structure, and ecological function — one that is or would be found in a given area in the absence of major human impacts. This includes human-managed ecosystems where much of the natural species composition, structure, and ecological function are present. • Natural ecosystems include: 1. Largely 'pristine' natural ecosystems that have not been subject to major human impacts in recent history. 2. Regenerated natural ecosystems that were subject to major impacts in the past (for instance by agriculture, livestock raising, tree plantations, or intensive logging), but where the main causes of impact have ceased or greatly diminished and the ecosystem has attained species composition, structure, and ecological function similar to prior or other contemporary natural ecosystems. 3. Managed natural ecosystems (including many ecosystems that could be referred to as 'semi-natural') where much of the ecosystem's composition, structure, and ecological function are present; this includes managed natural forests as well as native grasslands or rangelands that are, or have historically been, grazed by livestock. 4. Natural ecosystems that have been partially degraded by anthropogenic or natural causes (e.g., harvesting, fire, climate change, invasive species, or others), but where the land has not been converted to another use and where much of the ecosystem's composition, structure, and ecological function remain present or are expected to regenerate naturally or by management for ecological restoration. Source: AFI (2024), https://accountability-framework.org/use-the-accountability-framework/definitions/natural-ecosystem/
Natural Habitats	**Natural habitat** focuses on the place for a specific organism, whereas **natural ecosystem** describes the larger system of interactions within an environment

Living Wage	The remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transportation, clothing, and other essential needs including provision for unexpected events.* Source: Global Living Wage Coalition, https://accountability-framework.org/use-the-accountability-framework/definitions/living-wage/
Producer	The owner or manager of a production unit. This includes smallholders and other individual owners/managers, corporate entities, and communities that own or manage production systems. Source: AFI (2024), https://accountability-framework.org/use-the-accountability-framework/definitions/producer/
Protected areas	Protected areas are a geographically clearly defined, recognized, committed and managed space, through legal or other effective means, for the long-term conservation of nature with associated ecosystem services and cultural values. A protected area can be under either public or private ownership. Source: IUCN (2008)
Protected/endangered species	Species of plants, animals and fungi classified as threatened and endangered by national legislation or classification systems, or indicated as threatened or seriously endangered by the IUCN Red List of Threatened Species ™, and/or listed on Appendix I, II or III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
Risk Assessment / Risk analysis	May refer to assessing impact drivers/pressures on different scenarios. This is used in the context of identifying potential negative and/or positive consequence for the business and/or its stakeholders.
Risk management plan	Scheme within the risk management framework specifying the approach, the management components and resources to be applied to the management of a risk. Source: ISO 31000:2009
Semi-Natural	According to US Federal Geographic Data Committee, "Semi-natural vegetation typically encompasses vegetation types where the species composition and/or vegetation growth forms have been altered through anthropogenic disturbances such that no clear natural analogue is known, but they are a largely spontaneous set of plants shaped by ecological processes" Source: US FGDC.
Semi-natural habitats	An ecosystem with most of its processes and biodiversity intact, though altered by human activity in strength or abundance relative to the natural state (https://ipbes.net/glossary/semi-natural-habitats). E.g. hedges, bushes, rows of trees, single trees, buffer strips, fallow lands, flower strips, slopes, reforested areas, water spaces (creeks, streams, ditches), unmanaged borders or strips, not used for grazing
Soil Biodiversity	Uncountable numbers of microbial and animal species contribute to the soil biodiversity, discompose organic matter and thus produce productive soils: bacteria, fungi, mites, beetles and earthworms, that vary depending on the environment, make up for an immense diversity in soil. This diversity allows for a great variety of ecosystem services that benefit not only these species, but also people who use it.
Substrate(s)	The (natural) environment in which an organism lives, or the surface or medium on which an organism grows or is attached. It is here used equally to the term "growing media" or "growing medium". A growing medium is a material other than soil in the ground in which plants and mushrooms are grown. Growing media provide rooting environment for plants. Source: Growing Media Europe (2024): https://www.growing-media.eu/
Risk Assessment / Risk analysis	May refer to assessing impact drivers/pressures on different scenarios. This is used in the context of identifying potential negative and/or positive consequence for the business and/or its stakeholders.
Toxic Load Indicator	Qualitative indicator for pesticide active ingredients that translates numerical and non-numerical values (toxicological extremes, classifications) into a scoring system

	and applies to pesticide use data to measure and compare them (current use and trend). (Toxic Load Indicator. A new tool for analyzing and evaluating pesticide use).
Treatment Index	A quantitative measure to describe the intensity of chemical crop protection. It represents the number and amounts of pesticide applications in a given area, on a crop or on a farm, taking into account reduced application rates and partial area treatments. In mixed applications, each pesticide is assessed separately. Source: National Plant Protection Plan – Germany
Vegetative Ground Cover	Vegetation, including herbaceous plants and small woody plants, which grow below a canopy or low to the ground.
Waste	Any substance, mixture of substances, material or object which the holder discards or intends or is required to discard (Source: EN 16575:2014 Bio-based products – Vocabulary). Or waste as defined in point (1) of Article 3 of Directive 2008/98/EC, excluding substances that have been intentionally modified or contaminated in order to meet this definition.
Waste Water	Used water, typically discharged into the sewage system. It may contain solid and soluble matter, as well as microorganisms. Source: UN.
Water-Stewardship	Socially equitable, environmentally sustainable and economically beneficial use of water achieved through a process of stakeholder participation involving actions in specific locations and catchment areas.
Wetlands	The Convention on Wetlands defines wetlands as: "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Source: Convention on Wetlands, Ramsar

18 Annex: The Treatment Frequency Index (TFI)

Pesticide use is measured as

A) the Treatment Frequency Index (TFI), where an Index of 1 means one treatment with one product on the entire crop area,

Annual trends are then presented by aggregating the TFI (from A) for the use categories (Herbicides, Insecticides, Fungicides etc.) and the risk indicators below.
The **volume sold** is only used for a trend analysis for pesticides which are not applied to an area (e.g. storage places, burrows, single pots, individual plants [if applicable]).

The trends for these pesticides are represented for the indicators as described under 1-3.

1. Trends for **mammalian risk** are represented on farm level by aggregating annual TFI for active ingredients for the following scale: active ingredients with AOEL (or ADI if AOEL is not available but an ADI is set) value:
    a. below 0,01mg/kg bodyweight
    b. ≤ 0,01 and < 0,1 mg/kg bodyweight
    c. ≤ 0,1 and < 1 mg/kg bodyweight
    d. ≤ 1 and < 10 mg/kg bodyweight
    e. ≤ 10 and "*AOEL/ADI not applicable*"

2. Trends for **risks for aquatic organism** are represented on farm level by aggregating the TFI for active ingredients for the following scale: active ingredients with LC50 (acute in mg/l) for fish and/or aquatic invertebrates (most sensitive species) value:
    a. below 0,1
    b. ≤ 0,1 and < 1 mg/l
    c. ≤ 1 and < 10 mg/l
    d. ≤ 10 and < 100 mg/l
    e. >100 mg/l

3. Trends for **risks for pollinators** (honeybees as representative species) are represented on farm level by aggregating the TFI for the following scale: active ingredients with LD50 (oral or contact acute in µg/bee – more sensitive value) value:
    a. below 2 µg/bee
    b. ≤ 2 and < 11 µg/bee
    c. >11 µg/bee

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