Biodiversity and agriculture
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Dear Readers,

Farming invariably interferes with the habitats of plants and animals. However, this does not necessarily mean that agriculture and biodiversity are incompatible. In fact, quite the opposite is true. The sustainable cultivation of plants for food and feed actually enables us to preserve biodiversity.

This brochure takes a close look at the relationship between farming and biodiversity.

By 2050, global demand for food will have risen by 70 percent. But the expansion of land available for cultivation has its limits. This is one of the greatest challenges facing agriculture today: how do we balance the increased demand for food with the need to maintain biological diversity, now and in the future?

The efficient use of land will be key to preserving natural animal and plant habitats. Achieving this efficiency will depend to a considerable extent on the use of modern agricultural methods. If these methods are successfully applied, we believe that agriculture and biodiversity can coexist in harmony.

Best wishes,

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Global Product Safety & Registration Crop Protection

Dr. Andreas Ufer
Global Ecotoxicology Crop Protection
Agriculture and biodiversity go hand in hand
Agriculture and biodiversity go hand in hand

Over thousands of years, man has left his mark on a landscape that, in Europe, was once dominated by thick forest. While it is true that the clearing of trees has encroached on the natural habitat of forest-dwelling animals, it has also created the open spaces that have attracted animals and plants from other regions, such as the steppes of Asia. Today we are keen to preserve species not originally native to Europe like the hamster, gray partridge, cornflower and corn cockle, which number among the 215,000 animal and plant species now living in this region.

Farming in Europe has created a landscape of arable land dotted with flowery meadows and pastures, heathland, woodland borders, hedges, shrubs and trees. With these habitats farming contributes to biological diversity.

The preservation of biological diversity is also linked with basic human interests. This is evident when we consider the services rendered by the so-called functional biodiversity – for example, the contribution of soil organisms, insects, bacteria, plants and fungi to agriculture. Together they provide, for instance, soil fertility and the breakdown of organic waste. Strong vegetation is a defence against erosion, predatory insects help to control pest insects like aphids, and bees pollinate crops. According to France’s National Institute for Agricultural Research (INRA) and National Center for Scientific Research (CNRS), the “pollination service” provided worldwide by bees is worth 153 billion euros each year. These example show how closely farming and biodiversity are linked.
In part, biodiversity has even been created by humans. Mankind has introduced countless new varieties and breeds of indigenous plants and animals – the so-called “agrobiodiversity”. Over 10,000 years, we have bred numerous plant species and regional varieties for human use. For example, the Andean highlands between Peru and Bolivia – the home of the potato – have produced 5,000 potato varieties in all sorts of shapes, sizes and colors, all of which have a distinctive flavor. This genetic diversity is invaluable. It allows us to select plants and animals that are less vulnerable to stress and diseases, or that flourish in the special conditions found in a particular region.

What is biodiversity?

Biological diversity is described as “the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.” Biological diversity therefore refers to all aspects of the living world – genes, species and ecosystems. There are three levels of biological diversity that are generally recognized:

- Genetic diversity – the different genetic makeup found in members of the same species
- Species diversity – the variety of plants, animals and microorganisms at a given location
- Habitat diversity – the variety of ecosystems in which organisms live

Agriculture and biodiversity are closely interrelated in three areas: agrobiodiversity, functional biodiversity and nature conservation issues.  

Sustainable land use enables high yields and biodiversity
Declining species are dependent on the preservation of natural areas. In Europe, this may be meadows and moors, in other parts of the world, the rain forests and steppes. At the same time, human world population growth leads to increased demand for agricultural products while the amount of arable land available is limited.

By 2007, there were more than twice as many people living on the planet as there were in 1961. Over the same period, the total amount of available arable land grew by just 10 percent. In comparison with population growth, the expansion of arable land was small. And there are limits to further expansion. A large proportion of the Earth’s surface – like deserts – is not suitable for cultivation, and other areas are utilized by humans for roads and buildings. Some land that is rich in biodiversity needs to be preserved and thus should not be converted into arable land. The tropical rain forests, for example, have the highest species density in the world, and changing this land for crop cultivation would be detrimental to these species’ habitats and, indeed, existence.

This shortage of land suitable for expansion makes it all the more important to secure and increase the productivity of the existing farmland by using advanced technology. Modern machinery, high-yield plant species, mineral fertilizer and pesticides have almost doubled crop volume since the early 1960s. Without their contribution, the world would have far fewer wildlife habitats than it has today.

Enhanced efficiency has also directly affected the diversity of the farmland. Modern cereal crops, for instance, grow so close together that they leave virtually no space
for corn poppies and cornflowers to grow. Both mechanical and chemical farming methods have led to a reduction of weeds in our fields. For some wild plants and animals, cultivated farmland is no longer a welcoming habitat. This is sometimes intentional and practical. Wild flowers growing on farmland might look pretty, but could cause problems at harvest time with the flowers contaminating the crop. Weeds increase the moisture content and the risk of decay during storage. Many weed species are also inedible or even poisonous. All these factors can render the crop unsuitable for sale.

For farmers, increasing the yield and quality of crops is essential. Thanks to technological advances, farming is now much more efficient than it used to be, allowing farmers to increase yields and profits without having to convert natural reserves and sanctuaries into farmland. As the American scientist Dr. Indur M. Goklany said: “If technology had been ‘frozen’ in 1961, then merely to feed the world’s 1993 population at the inadequate levels of 1961, it would have been necessary to increase agricultural lands by at least 80 percent.”

### Development of global cropland in relation to human population

<table>
<thead>
<tr>
<th>YEAR</th>
<th>HUMAN POPULATION (BILLION)</th>
<th>GLOBAL CROPLAND (MHA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>3.1</td>
<td>1,280</td>
</tr>
<tr>
<td>2000</td>
<td>6.1</td>
<td>1,400</td>
</tr>
<tr>
<td>2007</td>
<td>6.7</td>
<td>1,411</td>
</tr>
<tr>
<td>Increase</td>
<td>111%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: Food and Agriculture Organization of the United Nations

In future, agriculture will have to meet two requirements. Firstly, securing and increasing yields from existing arable land while maintaining the ecological functions of biodiversity, which are essential for production. And secondly, managing land, which also includes land for nonagrarian uses like natural habitats, in the best way.

New farming methods can make a significant contribution, for example by using soil-friendly techniques and applying pesticides in a way that further minimizes the risks to plants and animals. However, measures that promote biodiversity are not just confined to arable land. They may also include uncropped field margins. These encourage the growth of wild herbs and flowers, which attract a variety of insects, thus providing food for birds and mammals. Biotope management can likewise make use of fallow land near roadsides, railways or woodland.

How diverse is cultivated land?

That is a subject even experts find difficult to tackle, given the complexity of the interactions in ecosystems. By monitoring the populations of specific bird species as an indicator for biodiversity, biologists have managed to identify quite robust criteria to provide an answer to this question. Their results are no surprise: biodiversity in Europe is deeply influenced by changes of agricultural practices. Modern farming methods have enabled a positive population development of some species, such as the white stork, while other populations, like the red-backed shrike, have remained relatively stable over the long term. Still others, like the gray partridge, have become rarer. Farmers can help protect these declining species by participating in various programs and initiatives such as > agri-environmental measures and > nature conservation contracts.
Comparative development of the white stork, red-backed shrike and gray partridge populations in Europe

Population index (percent)

Source: European Bird Census Council (EBCC)
Crop protection and biodiversity are compatible
In modern farming, pesticides help to promote the efficient cultivation of land while complying with biological diversity requirements. Before pesticides are approved, they are subject to comprehensive studies to ensure they are not harmful to the environment or humans. For companies engaged in research and development, such as BASF, responsibility does not stop at the lab door. The company supports the sustainable use of pesticides and advocates additional steps to protect biodiversity.

The purpose of crop protection products is evident. They are designed to control pests, diseases and weeds that threaten crop quality and yields. Pesticides are only legal for sale if they do not harm water and soil quality and the populations of wild birds, mammals and beneficial insects like bees, when used according to label instructions. This is why in-depth risk studies and precise use instructions are the basis for safety in crop protection.

Innovation also has a crucial role to play. For example, BASF and other manufacturers are developing pesticides in granular form as well as the more traditional powders and liquids. Farmers can plough these products directly into the soil. This helps to reduce contact with the pesticides by surface-dwelling organisms. Innovations like these mean that pesticides are applied in ways that are increasingly more considerate to the environment. New products are also more efficient and targeted, resulting in reduced dosage levels per hectare. Also, farmers can more and more combine chemical crop protection with other pest management methods like biological or mechanical measures (> integrated pest management).
Progress has also been made in the type of nozzles used for spraying crops. In the past, manufacturers focused their efforts on developing the finest possible spray so that droplets would cover the crop as evenly as possible. However, finer droplets have a significant disadvantage: the wind can blow them beyond the target field so that they land on hedges or in water. For this reason, manufacturers have come up with an optimal compromise. The current nozzles produce larger droplets that drift less but still provide sufficient protection against pests, weeds and diseases. Intensive farmer training (> product stewardship) also contributes to ensuring correct dosages and application within the intended fields’ boundaries.

The correlation between agriculture and biodiversity is complex and in a permanent state of flux. To gain a better understanding of this relationship, BASF has been working with a commercial farm based in Rawcliffe Bridge, England, since 2002. The farm belongs to the Hinchliffe family, who have agreed to implement and monitor new biodiversity methods suggested, for example, by the Farming and Wildlife Advisory Group (FWAG) and the Royal Society for the Protection of Birds (RSPB). The goal is to combine high economic yield on the farm with the greatest possible biological diversity. This well-documented project has proven that biodiversity management is indeed compatible with modern farming methods. In one experiment, the farmers planted trees on a strip of unproductive, sandy soil. They set up nest boxes on the trees and planted wild bird food crops to provide season-long food supplies for the birds.
The results are impressive. Since 2003, BASF Rawcliffe Bridge has provided a habitat for some 100 bird species. More than 25 percent of these species are considered endangered, including gray partridges and Eurasian tree sparrows. Scientists have recorded approximately 150 plant species growing in the field margins – a third more than average. Dragonflies buzz around the network of drainage ditches of the farm and sticklebacks build their nests along the banks of the streams.

BASF’s biodiversity programs are not limited to farmland. The company supports the “Symbiose” biodiversity program, which covers an area of 400 square kilometers in the Champagne-Ardenne region of France. Over the next three years, this initiative aims to encourage plants, insects and endangered bird species to colonize field peripheries and roadside verges.

BASF also supports the Brazilian “Mata Viva” initiative, an environmental education and reforestation program. The goal is to restore and conserve biodiversity by creating areas in which native vegetation and wildlife are preserved. Employees of BASF Brazil have joined forces with a broad range of partners from both the business and scientific communities, including cooperatives and growers, to plant more than half a million native Brazilian trees in degraded land. Experts use the term “degradation” to describe a process by which leaching renders soil virtually unsuitable for flora and fauna. The planted trees have helped growers to protect their farmland and have also allowed e.g. the area around Guaratinguetá, where BASF has its biggest chemical complex in South America, to regain its lost biodiversity.
As a partner of farmers, and also as part of the society, the agroindustry takes biodiversity very seriously. Together, farmers and the industry can strike an important balance – both preserving biodiversity and producing sufficient quantities of healthy, diverse and affordable food.

**Approval and use of pesticides: measuring the effects on biodiversity and minimizing risks**

- **Industry**
  - Provides database

- **Authorities**
  - Evaluations of studies and risk assessment
  - Approval of pesticides and definition of use instructions

- **Farmer**
  - Use in line with regulations
  - Possible additional measures to promote biodiversity

To protect:
- Habitats such as water and soils
- Groups such as birds, mammals, insects, plants and water/soil organisms
Agri-environmental measures. Voluntary measures implemented to protect the environment, particular species or a regionally specific landscape. The measures are designed at a national, regional or local level to ensure maximum compatibility with local conditions. For example, farmers in the EU are compensated for costs and potential loss of revenue if they make a commitment to use special farming methods that surpass the legal requirements.

Integrated pest management (IPM). An approach that involves “the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.” In combination with other agronomic methods, IPM can be regarded as an integral part of crop protection that is location-specific and based on farmers’ responsibility. It takes the economics of pest management into account and attempts to reduce pesticide use to the lowest level necessary.

Nature conservation contracts. A strategy whereby a nature protection agency enters into an agreement with a property owner – most commonly a farmer – that obliges the latter to perform certain tasks on his or her property. For example, the contract may require a farmer to mow his meadows on specific dates to give ground-nesting birds time to raise their brood. The contracts governing the preservation of endangered native plants and animal species and their habitats are voluntary and provide compensation for the landowner’s expenses.

**Product stewardship.** The responsible and ethical management of crop protection products throughout the entire product life cycle – from development and use to disposal in line with regulations. BASF works closely with clients, suppliers and users and supports, for example, training courses in numerous countries where farmers are taught the responsible use of pesticides.
Your contacts

✍️ The content of this brochure has been compiled by a large number of different experts, including agronomists, chemists, ecotoxicologists and environmental scientists.

We hope the information provided here is helpful and stimulates further discussion.

We are keen to hear your viewpoints and answer your queries. We very much welcome your feedback and look forward to hearing from you.

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Other brochures from this series:
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