CropLife INTERNATIONAL

Representing the Plant Science Industry

Biodiversity and the Plant Science Industry

Managing natural resources sustainably in agriculture

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Content

Foreword

The international community has identified the need to address biodiversity loss and increasingly seeks to rally all concerned to help meet the 2010 biodiversity target: to achieve a significant reduction in the current rate of biodiversity loss.

The plant science industry is committed to playing its part in the conservation and enhancement of biodiversity resources. It contributes specialist knowledge and experience to these efforts, recognising the essential links between biodiversity objectives and the goals of sustainable food and non-food crop production.

The Convention on Biological Diversity (CBD) re-invigorated at the 2002 World Summit on Sustainable Development, is the key instrument for the conservation and sustainable use of biological diversity. It also seeks to assure the fair and equitable sharing of benefits arising from the use of genetic resources.

Crop protection products are also used to control invasive species which, according to the CBD, are "one of the main causes of biodiversity loss". Enhanced seeds and herbicides facilitate the use of no-tillage farming systems, which help improve soil biodiversity and fertility as well as a better water retention system. Finally, the core focus of the plant science industry is on increasing productivity per hectare. This in itself reduces the pressure to bring more land into cultivation, by increasing the quantity and quality of crops produced from land already under cultivation.

The approaches and case studies contained in this publication illustrate the variety of ways in which the plant science industry contributes to biodiversity conservation. They show how product stewardship is implemented through a life-cycle approach to protect biodiversity both on and off the farm; how efforts to retain biodiversity on the farm contribute to more economic and efficient pest control; and how plant science companies are taking direct action to protect and enhance biodiversity on corporate land and in communities, for instance through tree growing activities.

The achievement by 2010 of a significant reduction in the current rate of loss of biological diversity requires actions at all levels.

Through this publication we hope to inspire and energise further action. The biodiversity goals for 2010 will however only be achieved if all sectors work together in partnerships that take advantage of their respective skills and strengths. The plant science industry looks forward to future opportunities for collaboration with all interested stakeholders.

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I. The plant science industry's contribtution to biodiversity

Biological diversity, in short biodiversity, is the variety of all living organisms within ecosystems. Biodiversity comprises all animals, plants and micro-organisms, and is the life support system for our planet. It contributes to oxygen production, carbon recycling, water purification, soil fertilisation and food supply. The essential purpose of biodiversity conservation is to maintain the evolutionary potential and health of ecosystem services to support life on Earth.

The plant science industry supports the global aims of sustainable agriculture – to produce sufficient, affordable food and non-food crops, economically and in an environmentally and socially sensitive manner, and to maintain the natural resource base for future generations. In this context we are committed to contributing to biodiversity conservation and enhancement.

There are many ways in which the plant science industry, represented by CropLife International, contributes to biodiversity conservation and enhancement, ecosystems management and environmental sustainability:

- **Improving agricultural productivity** reduces the need to convert natural habitats to farming.
- **Promoting a life-cycle approach to responsible product stewardship:** from research and development, through sustainable use on the farm, to disposal of waste.
- **Integrating biodiversity conservation objectives within agricultural technology research and development (R&D).**
- **Promoting Integrated Crop Management (ICM) practices** includes the safeguarding of a farm's natural assets, for example by encouraging the conservation or establishment of natural habitats within and around the farm, as one element to enhance biodiversity within agricultural landscapes.
- **Supporting the Convention on Biological Diversity (CBD)**[1] to encourage innovation, development and capacity-building for agricultural technologies, and supporting international **seed bank collections** for the conservation, exchange and sustainable use of the world's valuable plant genetic resources.
- **Preventing damage to ecosystems from invasive species** through the use of crop protection products.
- **Managing corporate land** and tree planting activities to benefit communities.

Aspects of all the above areas of the plant science industry's contributions to biodiversity conservation and enhancement are illustrated through the approaches and case studies highlighted in this publication.

[1] Convention on Biological Diversity (CBD) 5 June 1992.
http://www.biodiv.org/doc/legal/cbd-en.pdf
The three main objectives of the CBD are to halt the loss of biodiversity, to secure its beneficial uses, and to ensure the fair and equitable sharing of these resources.

II. Context: biodiversity & agriculture

Biodiversity sustains vital ecosystems functions that make farming possible, such as soil, water and air quality. It also provides the genetic resources necessary to breed new, locally adapted crop varieties, helping make agriculture more productive and efficient. The protection of biodiversity is a key component of integrated crop management strategies, promoted by industry along with its integral product stewardship approach.

Challenges and opportunities

Producing food and non-food crops for a growing world population, while protecting and enhancing precious biodiversity resources is an important global challenge[2]: All agricultural activities are a human invention to provide for people's need[3]. Conversion of land for agriculture therefore needs careful considerations to conserve biodiversity and to optimise agricultural production. In this context, it is necessary to consider the wider environmental landscape as a whole, and not just the "farm" or the "protected area" as separate entities.

In certain regions of the world, agricultural production faces major constraints in terms of land availability, as well as climatic, technical and practical factors. In many instances, great potential remains to increase efficiency in agricultural production on existing, cultivated land through more appropriate crop management approaches and the use of improved technologies. Many countries already address the inter-relationships between biodiversity and agricultural production by firmly embedding conservation objectives in land-use practices[4].

"Wild" and "agricultural" biodiversity

Although "wild"[5] and "agricultural"[6] biodiversity intermingle in practice, it is helpful to clarify what is understood by these terms. Agricultural biodiversity can be defined as the variety and variability of domesticated plant and animal species associated with crop cultivation and animal rearing and the ecosystems of which these species are part of. Wild biodiversity, is the variety and variability of animals, plants and micro-organisms necessary to sustain key functions of ecosystems, including the agro-ecosystem, its structure and processes associated with agricultural production. This publication focuses primarily on wild biodiversity, but some agricultural diversity aspects are also addressed.

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[2] Körner, H., 2002. Einflüsse auf die Artenvielfalt der Ackerfauna, Forum 7; Published by: Industrieverband Agrar e.V. Karlstraße 21, 60329 Frankfurt, Germany.

[3] McNeely, J.A and Scherr, S.J. 2003. Ecoagriculture: strategies to feed the world and save wild biodiversity. Island Press, ISBN 1-55963-645-9.

[4] Current, D. E., Lutz, E. and Scherr, S. J., (eds.) 1995. Costs, Benefits and Farmer Adoption of Agroforestry: Project Experience in Central America and the Caribbean. World Bank Environment Paper Number 14. The World Bank, Washington D.C.

[5] McNeely, J.A and Scherr, S.J. 2003. Ecoagriculture: strategies to feed the world and save wild biodiversity. Island Press, ISBN 1-55963-645-9.

[6] FAO (Food and Agricultural Organization of the United Nations), 1999. Multifunctional Character of Agriculture and Land: Conference Background Paper No. 1, Maastricht Sept 1999.

Mutual benefits for biodiversity and agriculture

Wild biodiversity plays an essential role for agriculture, not only by providing the "raw materials" for plant breeding (for instance, a wide range of agricultural wheat varieties have been derived from just a handful of wild species), but also in terms of providing beneficial species that deliver a range of services to agro-ecosystems, such as pollination, or contributions to integrated pest management. Wild biodiversity habitats at the farm level also help maintain a healthy ecosystem's base (for example water flows) upon which agricultural production depends.

Sustainable agriculture that benefits biodiversity is also essential to meeting the Millennium Development Goals (MDG)[7], which aim to halve poverty and hunger by the year 2015, while ensuring environmental sustainability. This requires not only sustained increases in food production, but also reversing current trends in natural resource degradation, especially biodiversity loss.

Agricultural lands can accommodate corridors of biodiversity habitats to enhance their viability in the wider landscape. By firmly embedding conservation objectives into agricultural practices, productivity and profitability can be enhanced in an environmentally sustainable way. This way food security, income generation and biodiversity conservation goals can be accomplished jointly, and contribute to achieving the objectives of the CBD.

[7] UN (United Nations) General Assembly, 2000. United Nations Millennium Declaration, New York. http://www.un.org/millenniumgoals/

III. Increasing productivity on land already cultivated

Making farming more efficient and productive on a limited land area helps prevent new land from being transformed for agricultural purposes, and so avoids additional habitat loss.

Human activities are increasing pressure on ecosystems. Now more than ever, improved productivity per unit area of land is required to meet the food and non-food needs of the world's growing population in a sustainable way.

Currently more than 40% of the world's surface is used for agricultural purposes (cultivation and grazing/range lands). Technologies such as crop protection and nutrition products, enhanced crop varieties, irrigation systems and agricultural machinery have helped farmers over the past 50 years to achieve a dramatic rise in agricultural productivity. They have also helped prevent new land from being transformed for agricultural purposes, avoiding additional habitat loss.

1. Crop Production and Pest Management

Agriculture is one of the key motors of the global economy, and a way of life for millions. In emerging economies, the contribution agriculture makes to GDP is 11.5% on average, compared to 2.1% in developed countries. Reducing losses to crop production from pests (insects, weeds and diseases) is, and will remain, a crucial element in safeguarding the crop and so contributing to an efficient productivity increase. Globally, an average of 30-40% of crop yields is lost to pre-harvest pests and 10-20% to post-harvest pests[8]. These astounding global figures also mask some important differences. Crop losses in emerging economies in **Africa, Asia, and Latin America** – precisely those areas where agriculture is the most crucial economic activity - are considerably higher than in the developed world. Continual improvements in pest management adapted to local conditions is essential for meeting the world's food and non-food crops needs, while maintaining environmental sustainability and diversity.

2. Improved seed varieties contribute to yield increases

New crop varieties' breeding goals mostly include improving plant vigour, which is the key to ensuring a plant's full yield potential. The increase in yields through incremental seed improvement - and of course technological improvement overall - can be best demonstrated by the pure bred rice and wheat varieties which formed the basis of the green revolution. These varieties have increased yields, on average, by 20 - 30% since the 1970s. In a fitting tribute to the 2004 International Year of Rice, two breeders Yuan Longping of China and Monty Jones of Sierra Leone received the World Food Prize for their success in breeding new rice varieties which today are used in many countries contributing to a yield increase of about 20% over conventional varieties. Studies by the Washington-based National Centre for Food and Agricultural Policy (NCFAP), in the US concluded in 2002 that the widespread adoption of six biotechnology-enhanced crops increased farmers' income, boosted yields, spurred greater use of non-tillage agriculture, and an environmentally-friendly and also biodiversity-enhancing arable land management system[9]. The six crops are canola, corn, cotton, papaya, soybean and squash. The breeders working for the plant science industry have contributed to breeding new varieties both through traditional means and through plant biotechnology.

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[8] Oerke, E.-C. (1994):Estimated crop losses due to pathogens, animal pests and weeds. In: Oerke, E.-C., Dehne, H.-W., Schönbeck, F. and Weber, A. (ed.): Crop production and crop protection - Estimated losses in major food and cash crops, Elsevier Service B. V., 72-741.

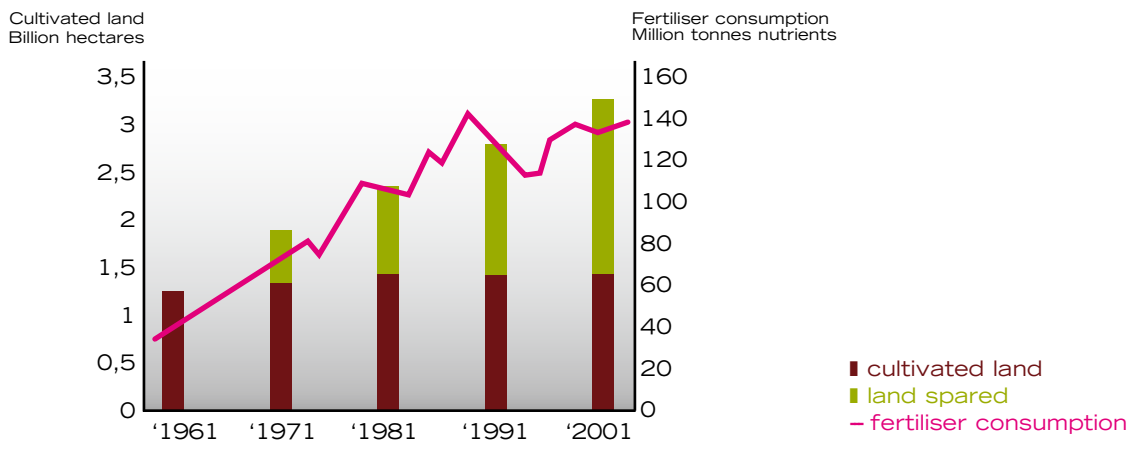
[9] National Centre for Food and Agricultural Policy, 2002. Plant Biotechnology: Current and Potential Impact For Improving Pest Management In U.S. Agriculture: An Analysis of 40 Case Studies by Leonard P. Gianessi, Cressida S. Silvers, Sujatha Sankula and Janet E. Carpenter.

3. Plant nutrition contributes to productivity increase

The judicious application of fertilisers increases yields from cultivated land, avoiding the need to cultivate new areas of wild land, as illustrated in graph 1. Integrated plant nutrition, that uses both organic and mineral sources of crop nutrients, uses precision application methods and adapts methods to crop, soil and climate needs. This helps improve nutrient use efficiency in crops and reduces nutrient losses to the environment. For example, in the United States, maize production increased by 58% in 2003 compared to 1980, yet farmers used 2% less nitrogen fertiliser.

Fertiliser use efficiency is good for farmers' incomes and for biodiversity, as it reduces draining into watersheds. The fertiliser industry and its partners continue to develop site-specific best agricultural practices. The International Fertilizer Industry Association (IFA -- www.fertilizer.org) is also engaged with scientists and policy makers in the International Nitrogen Initiative (INI -- www.initrogen.org), which is dedicated to optimising the use of nitrogen in food production, in relation to productivity, health and the environment.

Graph 1: Evolution of cultivated land and fertiliser consumption



4. "More Beans": supporting local communities to achieve increased productivity

The plant science industry's involvement in the countries where they operate, goes beyond sales of technologies to include on-the-ground support, which helps farmers find solutions to increase productivity through improved practices which also protect the environment. An example is the Syngenta "More Beans" project in **Brazil**. This project aims to improve yields of beans for small farms by providing growers with training, technologies (crop protection products and seeds) and contacts with large supermarket chains, in order to achieve high quality produce and yield improvements in a sustainable way. The project has been so successful that a major supermarket chain has adopted "More Beans" as a brand. The whole service package has helped the farmers to improve productivity on land already used, which in turn ensures a better livelihood and reduces the pressure to convert more land for cropping.

5. Increasing Productivity with Smart Alternatives (IPSA)

In many countries, agricultural land use occurs in wild biodiversity-rich areas and land conversion is at the expense of important forest habitat and species. It is therefore crucial that biodiversity conservation goals are pursued alongside those of agricultural productivity. **Malaysia** is one of the most biodiversity-rich countries. Improving agricultural productivity on cultivated land is crucial to reduce further conversion of land to production. Initiated in 2003, a programme called "Increasing Productivity with Smart Alternatives" (IPSA) was developed through a public-private partnership between Bayer CropScience and various Malaysian national institutes and organisations. This nation wide campaign is focusing initially on the oil palm plantation sector before it expands to other crops. IPSA specifically aims to increase productivity through improved good agricultural practices within the overall concept of Integrated Crop Management, to ensure environmental sustainability and economic viability.

6. Productivity increase through pest resistant crops

In Makhathini Flats, South Africa, cotton can again be grown productively following the introduction of Monsanto's Bt cotton. Bt crops have built-in protection against certain devastating insect pests. This protection is achieved by the introduction of a special gene, which produces proteins that stop destruction of the crop from pest feeding. In previous years, growing cotton in this region was not possible because of the high density of insect pests. The benefits of Bt cotton reported by farmers include significantly increased yields, decreased production costs and better insect control. Similar results have been reported in other countries. In a typical season, on an average holding of 1.7 hectares in the Makhathini Flats, a woman farmer is relieved of 12 days of arduous spraying, saves over 1,000 litres of water, walks 100 kilometres less and increases her income significantly through using Bt protected cotton. Case studies by ISAAA published in 2002 and 2003[10] from eight countries demonstrate clear benefits to farms of all sizes.

[10] James, C., 2002. ISAAA Briefs No. 26. ISAAA. Ithaca, NY. www.isaaa.org.
James, C., 2003. ISAAA Briefs No. 30. ISAAA. Ithaca, NY. www.isaaa.org.

IV. Responsible product management

A life-cycle approach to the management or 'stewardship' of the plant science industry's technologies maximises benefits to the farmer as well as protecting biodiversity.

Agricultural technologies increase productivity from cultivated land and thus keep new land from being farmed. However to ensure their environmental sustainability, they need to be used responsibly to maximise benefits for farmers. The effective and responsible provision of the industry's products and technologies requires systematic product stewardship that extends throughout a product's lifespan – from research and development, to sustainable use on the farm, through to disposal of waste.

Responsible technology management (also called stewardship) is an important priority for CropLife International's member companies. The lifecycle approach to stewardship begins during the research and development phase, includes use on the farm, and extends through to responsible disposal of any potential unused products. Technology packages and services are increasingly sought to address farmers' needs and are supplied along with proper support adapted to local conditions.

7. Responsible use of crop protection products

Some of industry's most visible stewardship activities are the 'Safe Use' programmes taking place around the world. The training covers all aspects of the handling and use of crop protection products, including how to minimise environmental impact and hence protect biodiversity, and targets a range of people including farmers and pesticide applicators, farm families, trainers, pesticide dealers, school children in rural areas, teachers, medical personnel and the general public. In most cases, training has been carried out in partnership with other stakeholders (governments, intergovernmental organisations and NGOs). Since 1991 more than 3 million people have been trained through CropLife supported programmes. Significantly, around 10% of those are "multipliers" who will train or advise other individuals, to increase outreach. Training by individual companies adds to the activities of the industry association and reaches an additional hundreds of thousands of people each year.

8. Seed treatment: protecting ecosystems through targeted control of pests

Young plants are often threatened by diseases and pests. Seed treatment technologies target pests or diseases that harm a crop, while other organisms creatures living on the plants remain largely untouched. These technologies deliver clear economic benefits to the farmers, while ensuring that farm biodiversity is protected. Such technologies protect plants while significantly reducing the overall amount of crop protection product needed, as well as the area exposed to the treatment. In seed or furrow treatments, only about 60 m^2 or 500 m^2, respectively, are treated per hectare instead of a whole area treatment of 10,000 m^2 (one hectare). This means that less than one percent of the soil comes into contact with a product. Headlands and adjacent water bodies and their biodiversity are hence also protected. These technologies deliver clear economic benefits to the farmers, while significantly reducing the environmental footprint.

9. Targeted application technologies – optimal product use

Responsible use of pesticides is fostered through precise and targeted crop protection product application technologies, which make a considerable contribution to optimising product use, for both user safety and environmental protection.
These technologies include ready-to-use and closed-system technologies (i.e. systems where products are delivered directly from the product package to the crops (through precision application) or plant (through paint-on-tree stem formulations), and range from hand-held sprayer systems to state-of-the-art GPS tools for precision farming. The hand-held sprayer system, for instance, involves single pack doses dropped straight into a back pack sprayer. Other systems, such as comprehensive seed-treatment services for major field crops seeds, enable cost-effective highly accurate product application. Diagnostic tools monitoring pest levels enable targeted application on a limited area of crops and contribute to more economical, efficient and environmentally responsible pest management approaches.

10. Product Resistance – avoided by applying management guidelines

Product resistance occurs when target species adapt to a product, resulting in the product being ineffective as a control measure. The resistance build-up arises from repeated use of products from the same chemical class. Since various companies market similar products, Product Resistance Management makes most sense through inter-company collaboration. CropLife International coordinates four Resistance Action Committees (RACs), for Insecticides (IRAC); Fungicides (FRAC); Herbicides (HRAC); and Rodenticide (RRAC). Management guidelines have been developed and implemented to help minimise resistance occurrence. A key resistance avoidance measure is product rotation with active ingredients belonging to different chemical classes that have different modes of action. The guidelines recommend avoiding product overuse (i.e. through increased frequency of applications and/or exceeding the recommended dose rates). Better understanding of resistance has resulted in resistance-prone products no longer being developed and marketed. All these management approaches support the responsible and environmental sustainability of products, which makes economic sense for both the farmers and the companies.

11. Biotech stewardship lifecycle

CropLife International promotes a lifecycle, or stewardship, approach to the management of plant biotechnology products. It starts with gene discovery, includes plant development, seed production, seed marketing and distribution, crop production and crop use, through to product phase-out. The overall aim of Croplife International's stewardship initiatives substantiates industry's commitment to maximise the benefits, and minimise any risk, from using plant biotechnology products. CropLife International's initiatives seek to complement and build on regional stewardship programmes and materials. The «Protocol for Compliance Management of Confined Field Trials of GM Plants» builds upon similar initiatives by CropLife Canada and BIO in the United States. It aims to strengthen the management of plant biotechnology field trials by educating trial managers, informing the development of quality assurance programmes, and helping to ensure the protection of biodiversity. The global relevance and applicability of CropLife International's Protocol demonstrates industry's commitment to ensuring that trials are conducted under appropriately controlled conditions, especially in emerging economies. First steps have been taken in Africa and Latin America with plans underway in Asia.

V. Research and development (R&D) for crop protection products and links to biodiversity

R&D-driven companies represented by CropLife International are continuously working to improve their technologies. Approaches include work to develop more efficient and environmentally sound crop protection products to enable farmers increasingly to make use of environmentally sound farming practices. New crop protection products require up to ten years of R&D before they gain regulatory approval and reach the market. Measures to ensure environmental sustainability of crop protection products begin very early on. They relate to intrinsic product characteristics, including tracking of product decomposition-pathways and testing of impacts on non-target species, in ecosystems and at a landscape level.

The plant science companies do not conduct their R&D activities in isolation. They collaborate with universities, public and private research institutes, and invest in start-up companies, venture capital funds and joint ventures. All of these links provide sources of new knowledge and technology, and enhance industry's ability to develop and constantly improve innovative new products, applications and services.

12. Non-target species – impacts avoided through laboratory testing

Environmental R&D parameters of crop protection products include testing on non-target species, ecosystems trials and landscape level evaluations to ensure the environmentally responsible use of new products.

Environmental parameters include the testing of a crop protection product's impacts on non-target species within water, soil and air. In order to evaluate the safety profile as thoroughly as possible, the test organisms are specially selected indicator species, which may be affected by a product's use. These chosen indicator species have been agreed upon by countries and international authorities as standards in order to harmonise tests[11]. They aim to represent common species worldwide and include water organisms (such as algae and macrophytes - the larger water plants); cold-water and warm-water fish; aquatic invertebrates (such as water fleas); terrestrial plants; soil micro- and macro-organisms (such as earthworms); terrestrial arthropods (such as mites, parasitic wasps and bees); ducks and other birds; and certain mammals, including mice[12].

13. Ecosystem trials – ensuring full product safety

The sensitivity of individual non-target organisms to a product under laboratory conditions does not demonstrate the scale of possible effects under field conditions, as these effects also depend upon exposure rates. Exposure rate studies are integrated into the full product safety evaluation and are known as "ecosystem trials". By way of example, non-target insects living in the soil are less exposed to spray applications than those living above ground level or on the crops themselves. These differences can be reflected in tests undertaken in the field. The tests evaluate the influence of crop protection products on the complex interactions between species in the ecosystem (aquatic and terrestrial). For example, to investigate the safety to aquatic environments, small standing water bodies (i.e. pond ecosystems), are exposed to products at various doses and the dynamics of the aquatic community are studied over several months to ensure environmental sustainability.

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[11] Pesticide registration is highly regulated under many different national frameworks including:
EU (European Union), 1991. EU Council Directive 91/414/EEC (Plant Protection Products); United States Environmental Protection Agency, 1996. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 7 U.S.C. s/s 136 et seq.;
MAFF (Ministry of Agriculture, Forestry and Fisheries), Japan, 2004. The Agricultural Chemicals Regulation Law, as revised 26 May, 2004. Bunsatsu Roppo Zensyo.

[12] Bayer Crop Protection, 1996. Safeguarding our Flora and Fauna. Safety research for plants and animals in the environment, Agrochem Courier 1/1996, 5 – 8.

14. Landscape approach – safety assured on a larger scale

The landscape approach scales up field trials to provide an indication of effects over a broad geographical scale. Over time, through increasing knowledge and improved technologies, data processing and satellite data availability, product development has incorporated complex environmental testing and evaluation procedures. This includes identifying the location of, and special measures to protect, endangered species. For example, in the US, the Endangered Species Act requires special measures to protect listed species. If endangered species are likely to be present where the product may be used, and if the combined crop and product use-pattern suggests they could be affected, then label instructions would include management approaches to reduce risk to a realistic minimum. For instance, if a product used on wheat is considered harmful to an endangered fish, the use restriction specified on the label may entail maintaining a greater safety margin (buffer zone) along any bordering river in districts/counties where this fish occurs.

15. Water and Soil – health of ecosystems maintained

In addition to living species studies, crop protection products also undergo exhaustive tests to ensure they do not unacceptably impact physical aspects of soil, water or air quality. Investigating interactions between crop protection products and soils is important because 30 -100% of a product can end up in the soil.

Micro-organisms, climate conditions and water in the soil are responsible for breaking down, both organic plant material, and inorganic material – such as crop protection products. So called “persistent” materials would be broken down too slowly in the soil, hence they are not acceptable and will not pass the registration requirements. To protect water bodies, answers to three primary questions are sought: does the new compound reach water ecosystems and how; how does it behave in water; and, if it reaches water ecosystems, how does it affect water quality and the health of living aquatic organisms?

VI. Integrated crop management – key to biodiversity enhancement

The plant science industry is committed to Integrated Crop Management. A basic component of this is to encourage the protection of natural wildlife habitats within and around the farm.

The plant science industry has been committed to Integrated Crop Management (ICM), for many years[13]. ICM combines care for the environment with the economic demands placed on agriculture. Strategic approaches to biodiversity conservation within ICM systems include the conservation or establishment of natural habitat areas as well as the good management of hedges or uncut field margins. These provide cover, refuge or food for mammals, birds or other fauna and flora on the farm. Land management approaches such as conservation agriculture, including reduced tillage, also contribute to that goal.

16. ICM – a farm-level and landscape management approach

The development and implementation of locally-adapted ICM strategies can create opportunities to integrate economically-viable, mutually beneficial, biodiversity conservation strategies into farming systems, regardless of geographic location, farm size, socio-economic context, technology options or affordability.

For biodiversity conservation, ICM encourages the establishment of both temporary (i.e. rotating), and permanent areas of natural habitats within the farmed landscape. Temporary conservation areas include conservation headlands, field margins, and set-aside field strips, including "beetle banks" (soil mounds for beetle habitat), which provide refuge areas for beneficial species, such as natural predators of crop pests[14]. By one estimate, the network of such temporary conservation areas (3-8 meters wide) includes some 2 million kilometers in **Germany** alone[15].

Permanent wildlife conservation areas, such as hedgerows and lines of trees (as windbreaks) or other natural habitats, help maintain both agricultural and wild biodiversity. Whilst primarily a farm-level approach, ICM also contributes to landscape management approaches such as eco-agriculture[16], which integrates biodiversity conservation goals into agricultural landscape management. For example, the conservation or creation of natural habitats on farms can contribute to preserving and linking areas protected for wild biodiversity conservation within agricultural landscapes on a wider scale. They also provide the biodiversity services important to agricultural production such as predator or pollinator refuges[17].

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[13] CropLife International, 2003. Integrated Pest Management. The way forward for the plant science industry. ECPA (European Crop Protection Association), 1999. Integrated Crop Management: The Road to Sustainable Agriculture in Europe, ECPA, Belgium. http://www. ecpa.be

[14] Game Conservancy Trust, Fordingbridge, Hampshire, SP6 1EF. Leaflets: The management of field margins and conservation headlands. Beetle Banks – Helping Nature to control pests. Both undated. http://www.gct.org.uk/gallery.asp?PageId=77

[15] Artenvielfalt in der Landwirtschaft, 2003. Arbeitsblatt 4. Published by: Industrieverband Agrar e.V. Karlstraße 21, 60329 Frankfurt, Germany.

[16] McNeely, J.A and Scherr, S.J. 2003. Eco-agriculture: strategies to feed the world and save wild biodiversity. Island Press, ISBN 1-55963-645-9.

[17] Lefroy, E.C., Salerian, J. and Hobbs, R.J., 1992. Integrating economic and ecological considerations: A theoretical framework. In Hobbs, R. J. and Saunders, D. A. (Eds), Reintegrating Fragmented Landscapes: Towards Sustainable Production and Nature Conservation. Sprinter-Verlag, New York.

17. Integrated Pest Management – a knowledge intensive approach

Integrated Pest Management (IPM) systems are of increasing importance in many world regions. Predatory mites and parasitoids are used along with crop protection products within an IPM context to control a range of field and greenhouse pests[18]. To avoid side-effects on beneficial arthropods from crop protection products, and to maintain species diversity in agro-ecosystems, extensive investigations are carried out during the development phase of a crop protection product. The identification of a product that is selective with regard to beneficial arthropods indicates that this product will be more compatible for IPM and therefore its further development is favoured. Information on the sensitivity of beneficial arthropods is also of importance to determine the optimum use pattern of a product. Proven suitability of a crop protection product for IPM allows its use together with (in combination or in succession) commercially available beneficial species, such as ladybirds, parasitic wasps, predatory mites or pollinators such as bumble bees.

18. Conservation agriculture increases resources for wildlife

Reduced or no-tillage as part of integrated crop and weed management are collectively described as "conservation technologies" or "conservation agriculture." This land management system, which involves minimum or no-tillage of the soil, is facilitated by the use of herbicides and where possible, biotech crops that are herbicide-tolerant.

Using conservation tillage practices leads to improved food resources for wild animals such as deer and birds, since waste grain is not buried by tillage. The resulting mulch also provides an insect-rich environment, which benefits many bird species. Research has shown that quails can obtain enough food in four hours per day in no-till fields, while it takes up to 22 hours per day in conventionally farmed fields. In addition the crop mulch provides protective cover for wildlife. Earthworm populations have been shown to be higher under some reduced tillage systems. Conservation tillage also reduces soil erosion by up to 90% and increases water retention by about 15%. The demonstrable benefits of conservation tillage have led to its widespread adoption in many countries, including **Australia, Argentina, Brazil, Chile, Paraguay, Canada, the United States, and the Indo-Gangetic plains (Bangladesh, India, Nepal and Pakistan).**

In **Australia**, for example, over 80% of all crops sown in 2002 used conservation agriculture. In **India** and **Pakistan** it is estimated that the area under conservation tillage for the establishment of winter crops (wheat, maize, lentil, chickpea, etc.) has increased to nearly 2 million hectares over the last 5 years[19]. More information can be found in the CropLife International report "Conservation Technologies and the Plant Science Industry - Managing Resources Sustainably"[20].

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[18] Zimmermann, Olaf, 2004 Die Anwendung von Nützlingen im biologischen Pflanzenschutz in Deutschland, Gesunde Pflanzen 56, 151 - 156.

[19] Gupta, RK and AK Seth (2004). "A review of resource conserving technologies for sustainable management of rice-wheat cropping systems of the Indo-Gangetic Plains," Presented at the 4th International Weed Science Congress, 20-24 June 2004, Durban, South Africa).

[20] CropLife International, 2005. Conservation technologies and the plant science industry, managing natural resources sustainably.

19. Integrating biodiversity conservation into agricultural production systems

Within the United Kingdom, Bayer CropScience engaged in an initiative to further understand the interactions between agricultural management practices and biodiversity, and the potential economic benefits derived from on-farm biodiversity conservation. The Boarded Barns Farm study was initiated in 1988. It compared the economic and environmental viability of three agricultural systems: integrated, 'conventional' (defined in the study as 'production focused') and organic farming.

While yields were not consistently enhanced in ICM relative to conventional systems, organic production was consistently lower (about 40% lower than conventional methods in winter wheat production) and also more variable. Under ICM the efficiency and profitability was improved by targeting the application of external inputs on areas in need through GPS technologies, by creating on-farm temporary habitat niches (e.g. field margins) to enhance levels of beneficial insects and by integrating nitrogen-fixing legumes into crop rotation regimes to maximize natural soil nitrogen levels.

The influence of the farming systems on biodiversity over the 10-year farm study period was evaluated through the monitoring of 22 small mammal species and 13 bird species. Overall, none of the three farming systems were demonstrated to be significantly more beneficial to the on-farm species monitored. The impact of the farming systems on population levels depended on the species. For example, trap catch samples were collected to monitor carabid beetle populations in each system. Seven carabid beetle species were trapped more frequently in the organic system than in the conventional system, while eight other carabid species were trapped more often in the conventional than in the organic system. Overall, major influences on biodiversity levels included crop choice and the extent of soil disturbance (tillage), as well as level and types of inputs. With regard to tillage, the potential role of minimum till as a strategy for biodiversity conservation also exemplifies the challenge of balancing trade-offs between agricultural practices used and their affect on biodiversity. While soil biodiversity tends to increase with reduced frequency of mechanical tillage, minimum till is often facilitated through herbicide applications, which cannot be used in organic systems.

In all three farming systems, 70% of the biodiversity measured was found to be located in the field margins. This indicates that, regardless of the farming system and crop choice, it is possible to make responsible management interventions that favor biodiversity. The extent to which such management interventions will be implemented depends on the socio-economic context, the knowledge base (high intensity required) but also on the availability of incentives for farmers to undertake responsible land stewardship. In the European Union various national voluntary schemes, for example the UK Entry Level Stewardship Scheme[21], are offering farmers financial incentives to establish field margins. In Germany a similar voluntary scheme has fostered the establishment of an estimated 2 million kilometers of field margins[22].

To further enhance awareness of the economic benefits derived from on-farm biodiversity conservation, a five-year Biodiversity Project started in 2003. A baseline survey of existing bird and plant wildlife biodiversity was established and additional wildlife habitats created. The additional habitats included: a "beetle bank" (vegetated mounds favoured by beetles), uncut field margins and a permanent conservation area. These measures have demonstrated the valuable role that on-farm biodiversity can play in enhancing efficiency and thus economic viability[23].

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[21] DEFRA (UK Department of Environment, Food and Rural Affairs), 2005. The Entry Level Stewardship Scheme Handbook - Terms and conditions and how to apply, DEFRA, London. http://www.defra.gov.uk/erdp/pdfs/es/els-handbook.pdf

[22] Dollacker, A. and Rhodes, C, 2007. Integrating crop productivity and biodiversity conservation, Pilot Initiatives developed by Bayer CropScience. In Crop Protection 26 (2007) 408-416. Elsevier.

[23] Bugg, R. L., Anderson, J. H., Thomsen C. D. & Chandler, J., 1998. In: Enhancing Biological Control: Habitat Management to Promote Natural Enemies of Agricultural Pests, ed. Bugg, R. L. (Univ. of California Press, Berkeley), pages. 339–374.

20. The Buzz Project: Promoting wildlife diversity

The Buzz Project is a three-year research and knowledge-transfer initiative sponsored by Syngenta that looks at techniques to manage farmland to improve biodiversity while maintaining farm profitability. It is being run on six arable farms in the **United Kingdom**, with six different habitats being compared on each site.

On the sites, farmers have been encouraged to take out the lower yielding parts of their fields to create a network of permanent wildlife margins. After only one year, the project has seen wildlife return in abundance to these newly created field margin habitats. The project sites have seen a 13-fold increase in butterflies, 38 times more birds and over 3,000 bumblebees on habitat plots. The project aims to provide new evidence on the value of creating wildlife habitats on farmland. It will also help farmers to understand the new skills and knowledge required by the challenge of biodiversity. (The Buzz Project web site: http://f-e-c.co.uk/Buzz/)

21. Partnership promotes streamside buffers

The Illinois Buffer Partnership in the **United States** is a collaboration of private and public agricultural and conservation organisations to promote and showcase the voluntary efforts of farmers and landowners in the planting, maintenance and enhancement of streamside buffers. The programme was initiated by the Illinois Council on Best Management Practices and Trees Forever. Its sponsoring partners include Syngenta, Illinois' Department of Agriculture and Environmental Protection Agency and the US Department of Agriculture's Natural Resources Conservation Service. One hundred demonstration sites were planned by 2005, primarily on farms. Farmers and landowners learn how buffer plantings of trees, shrubs, and grasses improve water quality, reduce soil erosion, and increase wildlife habitat.

22. Green biotechnology products and sustainability in agriculture

Biotechnology research may identify potetially sustainable approaches to crop production. These include reducing soil erosion and creating options for more selective use of pesticides. For the plant biotech products introduced to date some research interpretations indicate the impact on biodiversity to be minor compared to existing agricultural management practices.

For instance, a recent study of herbicide-tolerant sugar beet and winter oilseed rape, conducted in the **United Kingdom** by the National Institute for Agricultural Botany, found no evidence of reduction of the weed seeds, which provide food for insects and native birds. Herbicide-tolerant crops in comparison with conventional approaches reduce the need for chemical applications. (See http://www.hgca.com) In this way, the agricultural "footprint" (the change to natural biodiversity resulting from an activity, such as agriculture), may be reduced.

Biotechnology products also increase farmers' options for planting, as new seed varieties are added to the traditional varieties. The practice of incorporating traits from other species to expand the agronomic performance of crops also highlights the importance of taking steps to preserve these existing traits. Genetically enhanced traits do not displace existing traits or species.

VII. Contributing to the convention on biological diversity

The achievement by 2010 of a significant reduction in the current rate of loss of biological diversity requires actions at all levels.

The Convention on Biodiversity (CBD)[24] is the key instrument for the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from use of genetic resources. As highlighted in the Johannesburg Plan of Implementation[25], meeting the CBD objectives is essential to achieving, by 2010, a significant reduction of biodiversity loss.

The plant science industry views halting biodiversity loss and meeting the global demands for high quality food and non-food crops as inter-linked challenges. Its contributions to the CBD include: contributing to the development of ecological networks; strengthening efforts to control invasive species; and, through practical measures to assist access to the results and benefits of agricultural technologies, including enhanced scientific and technical cooperation on biotechnology and biosafety.

Over 180 countries are Parties to the Convention on Biological Diversity (CBD), the aim of which is to encourage and enable all countries to conserve biodiversity, use its components sustainably, and share equitably the benefits arising from its utilisation.

23. Partnership enhances conservation corridors

The task of conserving the Atlantic Rain Forest in **South America** requires fast and innovative action; and cooperation on many levels, from NGOs and private landowners to other interested stakeholders. It was this insight that triggered the creation of the Brazilian NGO Ibio in 2002. DuPont do Brasil is one of the sponsors of this NGO, along with Aracruz, Conservation International do Brasil, Petrobras and Veracel. Through this unique partnership, Ibio enjoys access to Conservation International's know-how in terms of environment conservation, along with the supporting companies' engagement and assets. Within the partnership, the major landowner, Veracel, a forestry company, operates under the "mosaic landscape" philosophy, interspersing its eucalyptus plantations with corridors of native forest. By connecting the natural forests, animals can migrate freely across the landscape, and so, this approach contributes also to one of the objectives of the CBD, to increase ecological networks. The "Conservation Project" is now developing the technologies most suitable to boost Atlantic Forest conservation and large-scale recovery[26].

[24] Convention on Biological Diversity (CBD) 5 June 1992. http://www.biodiv.org/doc/legal/cbd-en.pdf

[25] Johannesburg Plan of Implementation (JPOI 1.), 2002. http://www.johannesburgsummit.org/html/documents/summit_docs/2309_planfinal.htm

[26] WBCSD (World Business Council for Sustainable Development). Sustain, Issue 25, November 2004, Business & Biodiversity When Conservation and Business go hand in hand. www.wbcsd.org

24. Replenish native vegetation to re-establish water flow

Protecting and managing land, water and biodiversity in a sustainable and integrated manner is the focus of a pilot programme, initiated in 2001 by Bayer CropScience in partnership with the Department of Biological Sciences of Sao Paulo University and a **Brazilian** citrus farmer. A "rehabilitation through replantation" strategy is being employed to replenish native vegetation alongside a farmland water source in an attempt to restore the water flow that was slowly drying up. Success from this approach should, in time, demonstrate the important service natural resources contribute to an economically-viable agricultural production base. By 2005 about 8,000 native plant seedlings had been planted. The 63 tree species now also attract diverse wildlife species, including important birds and insects. To raise awareness among other farmers, and to help them improve their knowledge on biodiversity and the adoption of similar approaches, various communication tools have been developed. The initial success of the project has led to more being implemented in other parts of the country. In this way, fragments of habitats are being established, which contribute to forming an overall network of ecological corridors as stipulated by the CBD.

25. Protecting habitats for wildlife

Syngenta along with the Escuela De Agricultura De La Region (EARTH), Dole Food Company and Del Monte examined the impact of different management practices on the sustainability of wildlife populations in banana plantations in **Costa Rica**. The study confirmed that rich and complex populations of invertebrates exist within banana plantations even in conditions of relatively heavy pesticide use. Also, many species of rainforest birds were found to live and breed successfully in the forest margins and rain forest fragments adjacent to banana plantations. The study suggested that bird populations were supported by better planning and management of the agricultural landscape through replanting and connecting forest corridors, trees and shrubs along rivers and drainage canals. Other studies show that the aquatic environment, i.e. in drainage canals on-farm or in major rivers close to the farms, can be effectively protected from overspray or spray drift by planting trees and shrubs alongside the water courses. All of these approaches support one of the basic principles of integrated farming systems: maintain, replace and protect habitat for wildlife on the farm or close by. The surveys took place between 1997 and 2000.

26. Reforestation with local communities plants over 450,000 trees

ECOAGUAS, a Syngenta-led re-forestation and water conservation programme in **Columbia**, seeks to preserve sources of surface water and biodiversity. This extensive programme comprises several projects. The "Project for Integral Management of Hydrographical Basins" is carried out in conjunction with users of irrigation water. The re-forestation part of the project established biodiversity conservation corridors in areas next to agricultural crops with the participation of the sugar cane industry, as well as the state highway re-forestation unit. The projects are active in 49 locations in 14 municipalities of the Cauca Valley, Colombia. Thanks to all the activities developed during the last two years over 3,000 volunteers have participated directly and benefited over 300 families and 15 schools located in neighboring areas. They are responsible for planting over 450,000 trees in the main river basins of the country, improved local understanding of water resource conservation and management, agricultural development and improved quality of life for communities in the Colombian South-West. The projects have protected hundreds of hectares for the conservation of biodiversity in forest areas and water sources, including protecting natural springs.

27. Partnership raises funds to maintain crop diversity collections

Even with advances in genetic engineering of crops, the traditional approaches to plant breeding remain essential for access to the full diversity of genetic material needed to increase the productivity of crops, their reliability and nutritional quality. Retaining viable seeds at "seed banks" requires technical and financial resources and effective global co-ordination. Companies represented by CropLife International are supporting these activities. The Global Crop Diversity (GCD) Trust, a public-private partnership, was launched at the World Summit for Sustainable Development in 2002. It seeks to establish an endowment of US$ 260 million to provide a permanent source of funding for crop diversity collections, and system of crop diversity conservation. There are nearly 1,500 collections of plant genetic resources around the world, holding more than 6 million plant samples. To ensure adequate financial support, the Trust was established following a campaign. It involves a partnership between the UN Food and Agriculture Organization (FAO) and the 15 Future Harvest Centres of the Consultative Group on International Agricultural Research (CGIAR). Syngenta and DuPont each pledged US$1 million for the GCD Trust in 2004 - an element of the funding strategy of the International Treaty on Plant Genetic Resources for Food and Agriculture[27].

28. Crop genetic diversity is enhancing

Through the work of plant breeders, the diversity of agricultural crops is being enhanced[28]. Every year, 6,000 to 7,000 new distinct varieties are protected in the UPOV (International Union for the Protection of New Varieties of Plants) member states. Some 40-50% of these are field crops. The 2000 OECD list of cultivars traded internationally, mainly in field crops, comprises 24,274 cultivars. Nevertheless, there is a common misconception that the fruits, vegetables and crops we use today come from only a few varieties. This perception is based on the fact that only a few varieties are grown very extensively, however, the range of genetic material in crops overall has been shown to be greater than ever before. A range of studies, have underlined this fact. For example, in the 1930's, several European countries established variety catalogues[29]. This cataloguing led to the identification of varieties, which were identical but were listed under different names. So, although fewer varieties were listed, this did not reflect a loss of diversity. Parent varieties in the market today are much more diverse than in the past. In France for instance, parents derived from exotic germplasm represented less than one third used in breeding programmes in the 1960's but by 1980, they represented over 50%[30]. A more recent study with UK crops using molecular markers showed no statistically significant narrowing of genetic diversity over the past 60 to 70 years. Also, in the Indian Punjab, between 1968 and 1986, the genetic diversity of the top 5 wheat cultivars in most common use, showed an increase in diversity of parents of these cultivars[31].

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[27] The Global Crop Diversity (GCD)Trust. website: http://www.startwithaseed.org/items/homepage.php

[28] Simon M., in "Seeds for Mankind", May 2002.

[29] Law J., et al, 1998: European Commission report: The assessment and interpretation of diversity at the molecular and phenotypic levels in past and present varieties of wheat, barley and oilseed rape.

[30] Simon M., 1999 Les variétés de blé tendre cultivées en France en cours du XXème siècle et leurs origines génétiques, C.R. Acad. Agric. Fr., 1999, 85, No 8 pp.5-26.

[31] Smale M., 1995: Ongoing Research at CMMYT: Understanding Wheat Genetic Diversity and International Flows if Genetic Resources, Part I of CIMMYT World Wheat Facts and Trends, Supplement, 1995. Mexico, D. F.: CIMMYT 40pp

29. Plant breeders contribute substantially to the global effort on plant genetic resources

Plant breeders were, from the early stages, concerned about the necessity to maintain plant genetic resources for agricultural use. They created the first gene banks during the 1930s. A survey of plant breeders in 2001[32] showed that on average their members spent over 5% of their research budget on maintaining internal gene banks. A further 5.8% was spent on characterisation and evaluation of the plant genetic resources held in those gene banks. In financial terms, this amounts to a budget of around US$ 170 million a year spent on conservation, characterisation and evaluation of germplasm. The survey also showed that more than 80% of those surveyed maintain old varieties; about two-thirds conserve landraces and, more than half maintain wild relatives in their genebanks. Collaborative international programmes and technology transfer activities are also significant components of their work, which help the global effort for biodiversity conservation. Over 40% of the plant breeders surveyed grant licences free of charge to developing countries.

[32] Simon M., in "Seeds for Mankind", May 2002.

VIII. Managing invasive species

"Strengthening efforts to control invasive species which are one of the main sources of biodiversity loss". Johannesburg plan of implementation, WSSD 2002.

The management of invasive plant species is key to the health of many ecosystems, and the use of crop protection products can be an important tool, in this context. Significant economic implications occur when species are introduced outside their natural habitats to places where they have few natural enemies or competitors. They out-compete native species and threaten the conservation and sustainable use of global, regional and local biodiversity. The international community made a decision at the World Summit on Sustainable Development in 2002, to include in their plan of action[33], the need to tackle many thousands of cases of alien invasive species occurring throughout the world.

30. Management of alien rodents on islands

Rodents such as rats have been accidentally introduced to many islands when ships have docked. They have had a devastating effect on local fauna. In particular, on nesting birds, but also other mammals, molluscs, insects, spiders, amphibians and reptiles. Foraging rodents, including rats, are also very good at finding plant seeds and seedlings for food and, frequently, the normal cycle of vegetative decay and regeneration is interrupted and this has profound effects on entire island ecosystems[34]. One example is **Lord Howe Island** in the south-west **Pacific Ocean**, where 40% of the islands native land birds were driven to extinction within just a few years[35]. Syngenta and Bayer CropScience have been working on products and techniques to manage such invasive rodents in ways which avoid impacts on non-target species and, which are in line with the IUCN's Global Invasive Species Programme's management guidelines[36]. The technology of conservation rodent control will continue to be developed so that more and larger islands are capable of being cleared of their alien invaders. These approaches will be used increasingly to redress some of the damage done when humans, albeit unwittingly, allowed rodents to accompany them on their voyages of exploration.

31. Removing alien plants saves water and protects ecosystem health

One widely known example of an invasive plant is the water hyacinth. It was introduced from South America in the 1950s into many countries as an ornamental plant, that also provides livestock food and can control pollution by absorbing heavy metals. The species reproduced rapidly and spread over many countries, out-competing other plants for space and water. Due to its great thirst for water, arid countries in Africa have spent an estimated US$60 million annually to control water hyacinth and other alien weeds. In South Africa, a multi-stakeholder programme under the Department of Water Affairs and Forestry (Working for Water, WfW) was set up in 1995 to tackle the matter of invading alien plants. Over 150 invasive plants exist in South Africa, taking up some 10% of the scarce annual rainfall. The WfW programme has approximately 300 projects throughout South Africa and clears alien plants from 200,000 hectares per annum. Some biological control programmes are in place, but they are insufficient to deal with the problem exhaustively. The programme is now using herbicides, from companies represented by CropLife International, which have proved to be very useful in dealing with invasive species.

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[33] Johannesburg Plan of Implementation (JPOI), 2002. http://www.johannesburgsummit.org/html/documents/summit_docs/2309_planfinal.htm

[34] Buckle, Alan. 2004. Outlooks on Pest Management, June 2004.

[35] Atkinson, I.A.E. 1985. The spread of commensal species of Rattus to oceanic islands and their effects on island avifloras. In: Moores P.J., editor. Conservation of Island Birds ICBP Technical Publication No 3. International Council for Bird Preservation. Cambridge, England. Pp. 35-81

[36] Wittemberg, R., and Cock, M. J. W. 2001. Invasive Alien Species: A Toolkit of Best Prevention and Management Practices. CAB International, Wallingford, Oxon.U.K.

32. The mighty thirst of the invading Salt Cedar Tree

In the United States the Salt Cedar tree, which was originally introduced from Eurasia to prevent soil erosion near rivers and lakes, now threatens native plant species through its ability to absorb great quantities of water. A mature Salt Cedar tree may absorb up to 200 gallons (over 1000 liters) of water each day. Where these have spread, rivers and lakes have shrunk. The problem is exacerbated because the plant's leaf glands excrete a saline solution that increases soil and water salinity. US Government agencies started a three-year experimental project along the Pecos River, which runs south through New Mexico and Texas. A BASF herbicide together with a state-of-the-art application technology has cleared some 2,566 hectares and over 200 kilometers of Salt Cedar trees, resulting in an estimated increase of over 60 billion liters of water flow in the river during the 2002-2003 season. The improvement in water quantity and quality has also protected the Pecos River pupfish from becoming endangered. The cleared areas have seen a marked increase in wildlife biodiversity.

33. Stopping tropical Soda Apple in Florida

Tropical soda apple (*Solanum viarum*) is an invasive weed that has spread through more than 500,000 hectares of pasture in the state of **Florida** alone, crowding-out desirable native forage species. The wide spreading of this weed is a result of both natural pollen movement and dissemination by animals including cattle, which eat its sweet smelling golf-ball-sized, yellow fruit. Although the plant has thorns and a prickly skin, cattle are undeterred and reach into the plant with their long tongue and remove the mature fruit from the plant. As cattle are moved to other states for winter feeding or slaughter, they transport ingested seeds with them, resulting in the seeds being spread via composted manure, grass seed, turf or, hay. Dow AgroSciences is developing a new herbicide to address this and other noxious weeds adversely affecting the biodiversity of range and pastures. This herbicide will effectively provide long lasting residual control of tropical soda apple, spotted knapweed, yellow star thistle and many other invasive species.

34 Controlling Acacia in Southern Africa

Invasion of exotic trees and shrubs in rangeland areas of South Africa, such as the Fynbos Biome, pose a severe threat to plant and animal diversity, with negative environmental consequences including alteration of soil nutrient cycling, reduction of runoff, increased river bank erosion, and reduced light reaching the ground flora. One of these exotic trees is the acacia (*Acacia spp.*), which has dominated areas to the extent that natural vegetation has been almost lost, thus reducing the diversity and cover of indigenous plant species. The acacia is a tree with very deep roots allowing the tree to reach and use much of the available water and reproduce to the extent that it is difficult for animals to graze and roam the land. In South Africa and Namibia, herbicides developed by Dow AgroSciences have been used with success to control acacia such that previously unusable land has been returned to its original use.

35. Slowing Invasive Snails' Destructive Path

Rapid population growth and the need for adequate, healthy protein sources led to the importation of the Golden Apple Snail from South America to South East Asia in 1980. This snail was subsequently released into the environment, with serious consequences for an important food staple in the region: rice. The Golden Apple Snail has adapted to feeding on rice seedlings as a major source of its nutrients and has spread widely into the South East Asian rice belt. These snails do not have natural predators in the region and have caused considerable damage in paddy fields. For example, a study published in Ambio[37] estimated that the cumulative cost to Philippine rice farmers between 1980 and 1990 was between US$425 million and US$1200 million. As a result, farmers, governmental organisations and Bayer CropScience are searching for solutions. Integrated Pest Management Systems, including the development of management approaches tailored to the requirements of farming paddy fields, are being investigated. Control of these snails is essential, with implications for environmental protection and economic and social development of rice farmers in many South East Asian countries.

[37] Naylor, R. 1996. Invasions in agriculture: assessing the cost of the golden apple snail in Asia. Ambio 25: 443-448.

IX. Biodiversity Conservation on corporate land and tree-planting activities

These projects make a significant contribution to local biodiversity conservation

Many companies represented by CropLife International have land holdings associated with their offices, laboratories and experimental areas which hold actual or potential wildlife value. Within these areas projects have, and are, being initiated to manage, or develop, their biodiversity conservation potential. Such projects are corporate-driven cooperative efforts between management, employees, community members, local conservation groups and local, state and federal agencies. Some of these projects make a significant contribution to biodiversity conservation in the region. All are key to developing company and community experience and understanding of the needs for biodiversity conservation.

36. Wise Council - protecting and enhancing wildlife habitat

The Wildlife Habitat Council (WHC) is a group of corporations, conservation organisations and individuals dedicated to protecting and enhancing wildlife habitat. Created in 1988 in North America, WHC helps large landowners, particularly corporations, manage their unused lands for the benefit of wildlife. Corporations often own large tracts of valuable land that can be managed for habitat without affecting their operations. Through WHC-assisted projects, over 800,000 hectares in 48 states of the United States, Puerto Rico and fifteen other countries are managed for wildlife. Over 120 companies are WHC members, including BASF, Bayer, Dow, DuPont, Monsanto and Syngenta. Projects on these lands are also corporate-driven cooperative efforts between management, employees, community members, local conservation groups and local, state and federal agencies. For more information on the case studies below and additional Wildlife Habitat Council certified sites which CropLife International's leading companies have developed, visit http://www.wildlifehc.org/registry_certifiedsites/index.cfm

37. Habitats improved by increasing vegetation and organic material

BASF employees and volunteers working to improve habitat on **Fighting Island in Canada** have made a conscious effort to maintain and improve the quality of the natural resources on and around the site while providing quality services to its customers. Re-vegetation and reforestation have been the primary goals since the middle, north and south lime tailings beds were shut down in 1954, 1978 and 1982 respectively. Habitat recreation projects on the 500 hectares island have included planting over 140,000 trees and seedlings, primarily poplar and Norwegian pine. In 1982, 30% of the beds were covered with vegetation; today approximately 80% of the island is covered with vegetation. Site employees placed thousands of bales of straw, hay and alfalfa and scattered seven years of leaves from the nearby town of LaSalle to increase the amount of organic material incorporated in the soil. They also introduced 300 wild turkey and 5,000 ring neck pheasants to the island habitat. Recently developed projects include the conversion of existing runoff canals into marshlands, control of invasive weed species on existing man-made marshes, habitat management for migratory bird species, and the addition of habitat components for cavity-nesting species.

38. Partnership recognised for commitment to watershed restoration

The Three Rivers Habitat Partnership has promoted wildlife management on over 1,000 hectares on 20 corporate sites in southwest Pennsylvania, **United States** by encouraging corporate environmental stewardship and providing the knowledge and resources for individual landowners to do the same. Bayer Corporation's involvement in this Partnership has included hosting the Three Rivers Habitat Partnership office, placing and monitoring over 50 bluebird boxes (which have given rise to over 70 bluebirds hatched annually), eliminating mowing on over 8 hectares of its corporate land, expanding a bluebird trail, creating a Wellness Trail, promoting outdoor enjoyment as a healthy pursuit, with interpretive signs, and planting three native wildflower gardens. In 2002, this partnership was awarded a prestigious Governor's Award for Watershed Stewardship, in which it was one of only 24 organisations from across Pennsylvania to be recognised for its commitment to watershed restoration and environmental protection.

39. Tidal wetland management enhances habitat for local wildlife populations

The Dow Chemical Company's property in Pittsburg, California, **United States** encompasses approximately 190 hectares, 100 of which are actively managed for wildlife conservation. Of these 100 hectares, 70 hectares consist of a tidal wetland named the Dow Wetlands Preserve. Habitat enhancement activities on the reserve are discussed, designed and implemented by the 30-person Wetland Environmental Team and typically include planting native trees, shrubs and wildflowers throughout the property, improving the availability of nesting sites for native and migratory birds and regular wildlife monitoring. Team members also created a bird forage field to attract additional birds to the reserve. Other projects include building a wildlife-viewing platform, placing additional birdboxs, road improvements, clean-up programs and enhancing educational and recreational opportunities on-site. This project was awarded WHC's "Corporate Habitat of the Year" Award in 2000.

40. Wetland refuge for over 1,000 water birds restored

DuPont Company's 350 hectares Asturias Site is located along the banks of the Alvarez River on the Atlantic Coast of northern **Spain** and consists of wetlands, old fields and woodlots. The site was previously used for agriculture, dairy production and as a eucalyptus plantation. The DuPont wildlife team, with the assistance of local organisations, implemented several wildlife enhancement programs aimed at improving existing habitats, reintroducing extinct ones and, in general, increasing biodiversity. The pinnacle of the habitat enhancement projects is the restoration of the "La Furta" wetland. These 6 hectares of lake and marsh provide refuge to over 1,000 water birds, including a variety of species that is considered to be extremely rare. The DuPont Asturias Site received a special award from the American Birding Association in recognition of the site's exceptional accommodation of birdwatchers who regularly visit the area.

41. Native flora and fauna at company headquarters increased

Monsanto's World Headquarters site is located near St. Louis, Missouri, **United States** on approximately 115 hectares. The open space consists of woodlands (approximately 40 hectares), grasslands (12 hectares) and lawns (40 hectares). The mixture of wooded areas and open meadows results in a diversity of habitat that is reflected in the species found on-site, including coyote, wild turkey and white-tailed deer. The four primary goals of Monsanto's habitat enhancement program are to increase and enhance the quality and diversity of native flora, to increase the diversity of native fauna, to protect and enhance the existing hydrological systems and to raise employee awareness about habitat enhancement activities and environmental issues in general. Specific activities include conducting controlled burns to enhance previously established wildflower meadows, planting several hectares of native prairie, developing a peregrine falcon release programme in partnership with the World Bird Sanctuary, and erecting and monitoring nest boxes for eastern bluebirds. The wildlife team also devised a Wildlife ID card, which enables employees to report wildlife and habitat observations. Completed cards are submitted to the site inventory database via internal company mail.

42. Wildlife habitat and environmental education opportunities enhanced

Syngenta's 500 hectares St. Gabriel Facility in Louisiana, **United States** has 240 hectares available for both wildlife habitat enhancement and environmental education opportunities. An Employee Environmental Committee focuses on enhancing and maintaining an on-site nature trail, continuing and expanding on nest monitoring efforts, monitoring reforestation projects and adding additional plantings to augment natural succession of the forest and open lands on the property. The 1.5 kilometer nature trail provides educational opportunities for the community and local school groups. The team added educational signs to the trail, such as species identification plaques to identify the native trees located along the trail. Team members purchased and planted "Millennium Trees" from a local arboretum to celebrate the year 2000. Also, an educational brochure was produced about the nature trail and was made available to site employees at the entrance of the trail during Employee Environmental Committee sponsored Nature Walks.

43. Re-forestation - sponsoring one of the largest tree-planting event in history

In early 2006 Bayer CropScience and The Arbor Day Foundation, a nonprofit educational organisation with several million members in the United States, organised the largest tree planting event in U.S. history. The first Arbor Day on April 10 1872 was invented by J.Sterling Morton, editor of Nebraska´s first newspaper. The goal is to recruit individuals and groups to plant millions of trees throughout the U.S. In 2005 tens of millions of trees were destroyed in the country as a result of insects, diseases, hurricanes, and wildfires. Bayer CropScience was the corporate sponsor of the 2006 event and in addition donated one tree for every bottle of an insect control product purchased, to restore the national forests. In addition, all employees of Bayer CropScience in the U.S. were invited to participate in the Arbor Day to encourage tree caring and more tree planting activities. In 2007 Bayer CropScience joined the United Nations Environment Programme (UNEP) «Billion Tree Campaign» and pledged to plant 300,000 trees.

44. Anniversary celebration: Planting trees

To celebrate its fifth anniversary, Syngenta decided to plant a tree for every employee. It made these 20,000 new contributions to sustainable agriculture in Africa, where trees are needed most. The company partnered here with the World Agroforestry Centre. This organisation is ensuring initial care of the trees. Syngenta also encouraged its subsidiaries worldwide to plant a further tree per employee nationally, in cooperation with local communities. Planting of more trees continues in 2006.

Glossary

Integrated Crop Management (ICM) is a farming system that meets the requirements of long-term sustainability. It is a whole-farm approach that involves managing crops profitably, in ways that suit local soil, climactic and economic conditions and respect the environment. Making sensible use of the latest research, technology, advice and experience, ICM safeguards a farm's natural assets, for example by encouraging the conservation or establishment of natural habitats within and around the farm, as one element to enhance biodiversity within agricultural landscapes.

Integrated Pest Management (IPM) means 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 minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

Product Stewardship means the responsible and ethical management of a pesticide product from its discovery through to its ultimate use and beyond.

CropLlife International is the global federation representing the plant science industry. It represents a network of regional and national associations in 91 countries. It is led by companies such as BASF, Bayer CropScience, Dow AgrowSciences, DuPont, FMC, Monsanto, Sumitomo and Syngenta.
The plant science industry develops crop protection products as well as plant biotechnology products that help make crop production sustainable. Through collaboration with a range of stakeholders, CropLife International initiates stewardship programmes that work hand in hand to foster a start to finish approach to the sustainable use of agriculture products that are environmentally sound, economically viable and socially acceptable.

This publication and further information on some of the case studies can be found on CropLife International website: www.croplife.org

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Case study contributions from CropLife member associations and companies,
with additional ones from the International Fertilizer Industry Association.