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Integrating crop productivity and biodiversity conservation pilot initiatives developed by Bayer CropScience☆

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Abstract

Wildlife habitat loss driven by human activities, including conversion of land to agriculture, represents a major threat to biodiversity. Agricultural technologies, for example, irrigation, mechanization, enhanced seeds, crop protection and nutrition products contribute to productivity increases on land already cultivated and, therefore, play a role in preventing further land conversion to agriculture. However, such technologies must be adapted and employed within the context of locally appropriate land management strategies that take an integrated approach to achieving agricultural production, rural livelihoods and biodiversity conservation goals.

This paper was developed for presentation at a workshop on 'Conservation Technologies for Sustainable Agriculture', held during the 4th International Weed Society Congress, [4th International Weed Society Congress, Durban, South Africa, 19–25 June 2004. http://www.olemiss.edu/orgs/iws/4intlweedcong.htm>.], It highlights the potential roles a plant science company can play in addressing the challenge of jointly achieving crop productivity and biodiversity conservation objectives. These relate to activities that integrate biodiversity conservation objectives into technology research and development (R&D) of crop protection products and into land management approaches. Three pilot initiatives developed by Bayer CropScience in Brazil, Guatemala and the UK in collaboration with a variety of local stakeholders illustrate how conservation objectives can be embedded in land management practices that sustainably enhance agricultural productivity and profitability, simultaneously addressing food security and biodiversity conservation challenges.

Bayer CropScience, a subsidiary of Bayer AG, is a market leader in the areas of crop protection, non-agricultural pest control, seeds and plant biotechnology. The company has a global workforce of about 19,000 and is represented in more than 120 countries.

Keywords: Biodiversity; Agricultural technologies; Integrated crop management; Integrated pest management; Pesticides; Conservation tillage; Ecoagriculture

1. The context

The Millennium Development Goals (United Nations 2000) to halve poverty and hunger while ensuring environmental sustainability by the year 2015 presents the international community with a considerable challenge. This will require sustaining current increases in food production per human capita and also reversing current trends in natural resource degradation, particularly biodiversity.

In 2002, the World Summit on Sustainable Development (WSSD) took place in Johannesburg, South Africa. Five key activity areas to achieve sustainable development were highlighted by the UN Secretary General, Kofi Annan.

☆The authors would like to note that while drafting this paper they themselves experienced not insignificant challenges when endeavoring to reconcile their respective perspectives on crop production and biodiversity conservation. Particular aspects included how to appropriately integrate their fields of background knowledge, clarifying understanding of terminologies and addressing preconceptions. The process has been time consuming, but nonetheless the resulting paper demonstrates the potential for collaboration around the mutually supported objectives of conserving biodiversity while sustaining agricultural production.

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They are known as WEHAB: water, energy, health, agriculture and biodiversity (WEHAB Working Group 2002). With regard to agriculture and biodiversity, the Johannesburg Plan of Implementation (JPOI, 2002) states that "sustainable increase in agricultural productivity requires the adoption of integrated technologies and management practices that at the same time conserve land, water and living resources". The international community also agreed at the WSSD to more effectively pursue the objectives of the Convention on Biological Diversity (CBD 1992) and to achieve a significant reduction in the current rate of biodiversity loss by 2010 (JPOI, 2002; CBD, 2002).

The value of biodiversity conservation to issues of economic well-being and social development was further reiterated in 2003 during the decennial Vth IUCN World Parks Congress in Durban (IUCN, 2003a, b), which celebrated the extraordinary achievement of almost 12% of the earth's land surface being covered by protected areas. This exceeds the global target of 10% originally set at the IVth World Parks Congress (IUCN, 1992). Nonetheless, ecosystems continue to be degraded (Millennium Ecosystem Assessment; MEA, 2005) and recent species extinction rates far exceed those typical of the planet's history (IUCN, 2004; Dilys and Hollands, 2004).

2. Sustaining agricultural productivity and conserving biodiversity: challenges and opportunities

Cultivated land, including arable lands and shifting cultivation, covers approximately 24% of the world's land area (MEA, 2005). In turn, protected areas amount to 1.88 billion ha worldwide (Chape et al., 2003), covering approximately 11.7% of the terrestrial surface (MEA, 2005). The overlap between land under cultivation and land designated as protected areas is considerable. Many of these protected areas are explicitly set up to allow sustainable agricultural uses, particularly pastoral co-management in wildlife reserves. Furthermore, protected areas do not exist in isolation and are often situated within a broader matrix of agricultural landscapes (McNeely and Scherr, 2003).

Inevitably, such overlap can result in pressure to deliver two potentially competing objectives: sustaining or enhancing food security and rural incomes versus biodiversity conservation. Drivers to deliver multiple objectives from land use strategies include the growing demand for food crops. From 1958 to 2002, the global human population more than doubled from 2.8 to 6.2 billion while during the same period, total arable land area remained almost stable at about 1.4–1.5 billion ha (FAO, 1959; FAO, 2003). Changing consumption patterns, particularly growing demand for meat, exacerbate demand for cereals as feed as well as for direct human consumption, with global demand for cereal projected to increase by 41% between 1993 and 2020 (Pinstrup-Andersen et al., 1997).

The considerable overlaps between wild biodiversity 'hotspots' (defined as land with especially high levels of biodiversity under threat from natural habitat loss (Myers, 1988)), land already under agricultural use and areas experiencing rapid rates of population growth (Cincotta and Engelman, 2000) highlights the inextricable linkages between food security and biodiversity conservation challenges at a global scale. Strategies to conserve 'wild' biodiversity cannot just be confined to protected areas. Conservation objectives must also be firmly embedded into agricultural practices that sustainably enhance productivity and profitability (Current et al., 1995). While agriculture, by definition, involves the modification of natural ecosystems to provide for people's needs (McNeely and Scherr, 2003), there is growing evidence and awareness that food security, income generation and biodiversity conservation goals can be accomplished jointly. The question is less whether synergies exist, but how best to achieve them (Lee and Barrett, 2000).

2.1. Inter-linkages between biodiversity and agricultural production

Agricultural biodiversity encompasses the variety and variability of animals, plants and micro-organisms necessary to sustain key functions of the agro-ecosystem, its structure and processes associated with food production and food security (FAO, 1999). *Wild biodiversity*, on the other hand, is the variety and variability of non-domesticated plant and animal species (McNeely and Scherr, 2003), and the ecosystems of which these species are a part.

Benefits and services provided by wild biodiversity to agriculture include the pollination activities of insects, birds or bats and their roles as natural enemies to insect pests, key in Integrated Pest Management (IPM) (Daily, 1997). Soil organisms, including earthworms, insects and micro-organisms, are important for maintaining soil structure, quality and for biological nitrogen fixation (Alkorta et al., 2003). In addition biodiversity provides the genetic variability needed for breeding new plant varieties and traits, in terms of crop vigour, yield and quality improvements as well as drought, stress or salt tolerance.

Collectively, at a landscape scale, vital ecosystem functions include water filtration and flow regulation, nutrient cycling, and soil preservation and stabilization. Unfortunately, as highlighted by Kremen et al. (2002), the services and roles of biodiversity are often taken for granted and only fully appreciated once resource over-exploitation has compromised biodiversity, its service provision and thus agricultural production. This paper primarily focuses on strategies aiming to integrate wild biodiversity conservation within cropped land.

3. Addressing the challenge: the role of a plant science company

This paper focuses on three key roles a plant science company can play in improving crop productivity on