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BIODIVERSITY VIS A VIS AGRICULTURE

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INTRODUCTION

Biodiversity can be described as the richness and diversity of all life on earth. Biodiversity is not just about the individual species, but also about the diversity of ecosystems, species and genes, and the relationship between them [1]. Biodiversity is not only relevant in/for (semi-)natural areas, but also for agricultural areas, which often have specific biodiversity which contributes to ecosystem services.

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Agriculture in turn can contribute to the increase and conservation of biodiversity, for example by smarter management of marginal land, but also by the management of fertile areas. Agricultural biodiversity includes those components of biological diversity relevant to food and agriculture as well as the components of biological diversity that constitute the agro-ecosystem. It exists at several levels, from the different ecosystems in which people raise crops and livestock, through the different varieties and breeds of the species, to the genetic variability within each variety or breed. Countless other species contribute to the essential ecological functions upon which agriculture depends, including soil services and water cycling.

However, the Earth's biodiversity is being lost at an alarming rate, putting in jeopardy the sustainability of ecosystem services and agriculture, and their ability to adapt to changing conditions. The conservation and sustainable use of biodiversity is essential for the future of agriculture and humanity. At the same time, since agricultural lands extend across such a considerable proportion of the Earth's surface and harbor significant biodiversity, the conservation of biodiversity within agricultural landscapes must play an important part in global conservation strategies. The Convention on Biological Diversity, with near universal membership of countries around the world, provides a comprehensive framework for collective action among the countries and citizens of the world to halt the destruction of biodiversity and decline in ecosystem functions that are of such basic need to human survival.

Positive and negative effect of Agriculture on Biodiversity:

1. Agriculture can promote Biodiversity:

a. Delivery of ecosystem services:

Managed sustainably as ecosystems, agricultural systems contribute to wider ecosystem functions such as maintenance of water quality, waste removal, reducing runoff, and promoting water infiltration, soil moisture retention, erosion control, carbon sequestration, and pollination.

b. Incentives:

Species needed by agriculture such as pollinators need habitat diversity to survive. Agriculture therefore provides incentives to preserve areas such as hedgerows and field borders. Farming of aquatic species often occurs in natural water bodies, providing incentives to protect the aquatic environment from adverse impacts, for example from pollution and water diversion. The need for adaptation and potential for improvement in productivity provides an incentive for the conservation of a diverse range of genetic resources.

c. Ecological knowledge:

Much of our knowledge of ecology and biodiversity, its importance, and functions have been gained and will continue to be gained through agricultural practice.

2. Agriculture can reduce biodiversity

a. Higher Crop production:

Many modern practices and approaches to intensification aimed at achieving high yields have led to a simplification of the components of agricultural systems and biodiversity and to ecologically unstable production systems. These include use of monocultures with reduction in cropping diversity and elimination of crop succession or rotation; use of high-yielding varieties and hybrids with the loss of traditional varieties and diversity together with a need for high inputs of inorganic fertilizer; control of weeds, pests and diseases based on chemical (herbicides, insecticides, and fungicides) treatments rather than mechanical or biological methods.

Land and habitat conversion to large-scale agricultural production, including drainage of land and conversion of wetlands has also caused significant loss of biodiversity. The homogenization of farming landscape with elimination of natural areas, including hedgerows, woodlots and wetlands, to achieve larger scale production units for large-scale mechanized production has also led to decline in biodiversity and ecological services.

b. Higher Livestock production:

Intensive or so-called landless, large-scale production systems are on the rise leading to an increase in both demands for animal feeds and of site-concentrated livestock wastes. The increased demands for feed puts increased pressures on cultivated systems, with consequently an increased demand for water and nitrogen, other fertilizers and other chemical inputs. Emphasis in modern systems on quantity of yield, has led to selection and breeding for high production and the loss of traditional breeds that held other traits, qualities and adaptations, now lost.

Challenges Ahead: Reasons of Biodiversity loss

1. Loss of biodiversity and ecosystem services

Despite the fundamental importance of biodiversity and ecosystem services to the Earth's functioning and to human society, human activities are driving the loss of biodiversity at an unprecedented rate, up to 1000 times the natural rate of species loss. And despite the specific importance of crop and livestock diversity, and of associated agricultural biodiversity, advances in

agricultural production over recent decades have been achieved largely without major regard to the erosion of biodiversity.
The biggest driver of terrestrial biodiversity loss in the past 50 years has been habitat conversion, in large part due to conversion of natural and semi-natural landscapes to agriculture. Nutrient loading, particularly of nitrogen and phosphorus, much of which derived from fertilizers and farm effluent, is one of the biggest drivers of ecosystem change in terrestrial, freshwater and coastal ecosystems. Climate change is projected to become a major driver of biodiversity loss as well as a serious challenge to agriculture, whose response, to adapt, will draw upon the genetic diversity of crops and livestock and the services provided by other components of agricultural biodiversity. Against the backdrop of a declining natural resource base and environmental change, food production in the coming decades will need to increase considerably to feed a growing population and rising expectations.

2. Population and economic growth

Global demand for food is increasing considerably, driven by growth in world population, by dietary change arising from urbanization and increasing real incomes of households worldwide, and by the need and international commitment to lift people from poverty and malnutrition. The global population has doubled over the past 50 years and is expected to reach 9 billion by 2050.

Demand for food and feed crops will nearly double in the coming 50 years. The increase in population is above the rate of increase in the yields of the three major cereals (wheat, maize and rice) that supply most nutritional needs. To date, the response to the increase in demand has been a combination of land conversion and the intensification of agricultural systems.

The significant increase needed in global agricultural production will require major contribution from large-scale intensive farming. Learning from experience —both positive and negative—associated with the advances in production over recent decades, to ensure sustainability the value of the environment will need to be included in the cost of production; improvements in efficiency sought; and post-harvest losses reduced. Biodiversity will provide an essential resource to meet the challenge—through genetic diversity within crop and livestock species that will enable breeding and adaptation to changing conditions and enable production in diverse conditions; and through the maintenance of healthy service-providing ecosystems.

3. Climate change, agriculture and biodiversity

Climate is the most important environmental factor affecting agricultural production and is also now significantly influenced by agriculture. About 24% of the Earth's land surface is covered by cultivated systems (defined by the MA to be areas in which at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture in any particular year) and the cumulative impact of worldwide agricultural practices on the global climate is significant. Global agriculture is estimated to account for about 20% of the total anthropogenic emissions of greenhouse gases (GHG) (UNEP 2001).

The most important categories of agricultural emissions are:

- Increasing land under cultivation by decreasing carbon sinks, including deforestation and the conversion of wetlands, especially peatlands
- Carbon dioxide (CO2) emissions from burning forests, crop residues and land
- Methane (CH4) emissions from rice cultivation
- Methane emissions from ruminant livestock such as cattle
- Use of nitrogen fertilizers that release nitrous oxide (N_2O)
- CO2 emissions from farm machinery, facilities, processing and transport.

Climate change poses a serious challenge to agriculture and is expected to affect agricultural activities through a number of factors, including:

- Changes in water availability;
- Increases in exposure to heat stress;
- Changes in distribution of agricultural pests and diseases;
- Greater leaching of nutrients from the soil during intense rains;
- Greater soil erosion due to stronger wind and rainfall; and
- More frequent wildfires in drier regions and increased flooding in others.

Measures to stabilize Biodiversity in Agriculture:

1. Delivery of sustainably agricultural systems

Sustainable agriculture seeks to make use of nature's goods and services while producing good yields in an economically, environmentally, and socially rewarding way, preserving resources for future years and future generations. Sustainable agricultural management aims to:

- Use water, land, nutrients, and other natural resources efficiently or at the rate they are replenished so that resources are conserved. For example, using water efficiently means taking into consideration other ecosystem services that water provides (flood mitigation, nutrient cycling, drinking water supply, and sanitation)
- Manage biodiversity in such a manner that biological resources are sustained
- Minimize the impact of agriculture on the wider environment in order to sustain the other ecosystem services, such as, minimizing chemical inputs, especially non-renewable sources, so there is minimal damage to the surrounding environment.

2. Water management

In order to increase agricultural production in a sustainable manner, improvements in agricultural water management will be required. Inappropriate and excessive use of water often decreases water quality and increases land salinization. When agricultural activities change the quality, quantity, and timing of water flows, this can change the ecosystem services provided by the connected system, including supporting services, jeopardizing the sustainability of agriculture. In rain-fed cropping systems, various soil management practices, inter-cropping, cover cropping and mulching can increase infiltration and moisture retention in the soil. In irrigated systems, greater precision over the timing and frequency of applications, the delivery and distribution of water, and total volume used can significantly help to improve efficiency of water use—and help to minimize both economic and ecological costs.

3. Energy resource

As part of concerted action to combat climate change, efficiencies can also be gained in the consumption of energy in farm operations and the processing and delivery of food. Important in this will be working within environmental constraints, rather than in spite of them by creating artificial environments —for example the production of summer horticultural crops, in winter, under glass. Where feasible and appropriate, the use of renewable forms of energy, including solar, wind and geothermal, and energy derived from farm wastes will also be important in these and other farming systems.

CONCLUSION

From the earliest examples of the domestication of plants and animals, human civilizations have used a rich diversity of wild species and modified landscapes and environments to facilitate agriculture. Diversity at ecosystem, species and genetic levels, brings many direct benefits for specific aspects of agricultural production. However, our knowledge of the nature and extent of these benefits remains imperfect and further studies are needed to explore not only the intrinsic benefits but also effects manifested at different scales. The challenge has always been to manage agricultural systems and their associated landscapes in a sustainable manner ensuring that future generations have access to these resources.

In the face of new direct and indirect drivers of change, policymakers and consumers must do their part to ensure that farmers and agricultural producers have the right incentives to adopt sustainable agricultural practices. Individually, education about the consequences of food choices will be an important step in the right direction.

If humanity can create sustainable agricultural systems, preserving biodiversity and ecosystem services globally, we can feed the world and ensure resources for future generations. If we fail in this collective challenge, environmental security and human wellbeing will be in peril.

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