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BIO-DIVERSITY CONSERVATION THROUGH AGRICULTURE

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Abstract: *Agricultural biodiversity will play a central role in achieving these twin objectives. By conserving and harnessing agricultural biodiversity, food and agriculture production can contribute to sustaining healthy bio-diverse ecosystems. By recognizing and value of agricultural biodiversity, agriculture can deliver more benefits to the communities that manage this biodiversity. In addition, as the world copes with the challenge of adapting to climate change, agricultural biodiversity becomes an especially critical resource. The role of biodiversity for food and agriculture in this process is often seen as fundamental: diversity is recognized as the basis for local, possibly forgotten specialties and sustainable food systems that bear a strong connection to cultural diversity. For many rural communities, and particularly indigenous peoples, culture plays a central part in determining the characteristics of their food production systems. Strong local cultures and institutions play a significant role in strengthening both the resilience of local farming systems and their capacity to copy with change in ways that maintain or improve livelihoods.*

Keywords: *Agricultural biodiversity, Food, Production, Farming and Livelihood.*

Introduction: India is an Agrarian country with around 65% of its people directly or indirectly depends upon Agriculture. Current agricultural practices are regarded as one of the most significant drivers of biodiversity loss. At the same time, the goal achieving global food security remains a long way off; indeed, the number of malnourished has recently risen to over 1 billion people. The world desperately needs an agricultural production system that is both sustainable and contributes to achieving food security. Agricultural biodiversity will play a central role in achieving these twin objectives. By conserving and harnessing agricultural biodiversity, food and agriculture production can contribute to sustaining healthy bio-diverse ecosystems. By recognizing and value of agricultural biodiversity, agriculture can deliver more benefits to the communities that manage this biodiversity. In addition, as the world copes with the challenge of adapting to climate change, agricultural biodiversity becomes an especially critical resource. For these reasons UNEP and GEF consider agricultural biodiversity to be a transformative force. The link between agriculture, food security and ecosystems is a vital one. The world is in danger of not achieving the Millennium Development Goals and with less than 5 years to run, evidence shows that agricultural biodiversity can make a critical contribution. By harnessing agricultural biodiversity, we can transform agriculture from a key driver of biodiversity loss, into a motor for securing ecosystem stability, preserving genetic resources in crops and livestock and driving investment towards the sustainable management of natural capital on which the sector depends. In light of the twin crises of increasing food insecurity and worsening environmental degradation, United Nations Environment Programme (UNEP) through the Global Environment Facility (GEF), has partnered with national and international organizations on a set of national and multi-country projects, focusing on different components of agricultural biodiversity over the last decade.

The world population is expected to grow by over a third, or about 2.3 billion people,

between 2010 and 2050. Increases in agricultural productivity will be needed throughout this period, although probably at a declining pace as the rate of population increase slows. Increased demand for meat, dairy, vegetable oils and other products will accompany the need to feed a larger population. Taking all these factors into account, FAO has suggested that global food production will need to increase by about 70% by 2050 relative to production in 2005 [1]. Although globally the agricultural food system has the potential to cope with the expected demand from currently cultivated land, given sustainable management and adequate inputs [2], meeting expected demand in particular countries (those with, for example, high population growth rates) or regions will present significant challenges. While there is the potential to meet expected demand over the next 40 years, there is also a clear recognition that this needs to be done in ways that reduce the dependency of agriculture on external resources. It has been suggested that if current production practices continue, up to 109 hectares of natural ecosystems would have to be converted to agriculture. This would be accompanied by 2.4- to 2.7-fold increases in nitrogen- and phosphorus-driven eutrophication of terrestrial, freshwater, and near-shore marine ecosystems, and comparable increases in pesticide use [3]. Phosphorus will become a severely limiting constraint on production by the end of this century, when readily available stocks are expected to be running out. Demand for water (of which agriculture already accounts for 70% of global use) would increase to unsustainable levels. Unprecedented ecosystem simplification, loss of ecosystem services and species extinction [4] would also occur as a result of the various pressures associated with unsustainable agricultural practices. Specific challenges for agricultural development over the next 20 to 40 years have been described in some detail in a number of recent reports and papers, including the FAO study,

The role of biodiversity for food and agriculture in this process is often seen as fundamental: diversity is recognized as the basis for local, possibly forgotten specialties and sustainable food systems that bear a strong connection to cultural diversity. For many rural communities, and particularly indigenous peoples, culture plays a central part in determining the characteristics of their food production systems. Strong local cultures and institutions play a significant role in strengthening both the resilience of local farming systems and their capacity to copy with change in ways that maintain or improve livelihoods. Local food systems are being promoted, in both developed and developing countries, for their capability to deliver environmental, nutritional and, if appropriately supported, economic benefits to communities. The concept of food sovereignty, defined as the right of each nation to maintain and develop its own capacity to produce the staple foods of its peoples, respecting their productive and cultural diversity [5], often underlies or accompanies the promotion of regional and local food systems.

Biodiversity for Food and Agriculture as a Basis for Food Security: Over the past decades, agriculture has achieved substantial increases in food production but these have been paralleled by serious overuse of non-renewable inputs and natural resources, loss of biodiversity and degradation of ecosystems, particularly with respect to their regulating and supporting services. While high-input industrial agriculture and long-distance transport have increased the availability and affordability of refined carbohydrates and edible oils, this has been accompanied by an overall simplification of diets and reliance on a limited number of energy-rich foods. Diets increasingly low in variation but high in calories contribute to increasing problems of obesity and non-communicable disease [6] which can now be found coexisting with malnutrition or undernourishment in the same family or community. Reliance on a lesser number of crops can also result in erosion of plant genetic resources and increased risk of wide-spread disease when a variety is susceptible to a new plant disease, which results in food insecurity. From an analysis of 104 country reports it appears that genetic erosion may be greatest in cereals, followed by vegetables, fruits and nuts and food legumes.

Agricultural systems that are reliant on biological processes and on the natural properties of agro-ecosystems to provide provisioning, regulating, supporting and cultural services exist around the world. These are the characteristics of most traditional production systems. They are often (simplistically) associated with low levels of productivity, poor farming systems and practices unable to respond to modern demands. However, they are also characteristic of a range of different innovative approaches to agricultural production that seek to combine productivity and

increased farmer incomes with long-term sustainability. Conservation agriculture, integrated pest and disease management and eco-agriculture are all examples of often successful attempts to achieve productivity comparable with that achieved with conventional intensive agriculture through the maximization of efficiency in agro-ecosystems' inherent biological functions rather than through an unconstrained application of external inputs. A growing number of agricultural production models focused on combinations and communities of plants, animals and soil organisms, rather than on one particular species at a time, have emerged over the past decades.

Greater integration in the management of various components of agro-ecosystems involves changes in the management of plants, soil, water and nutrients in ways that take account of interactions between these diverse components, making use, for example, of the abundance and diversity of soil organisms to obtain higher yields and greater production efficiency through synergistic effects among these resources. Where animals are part of the farming system, they are additional resources to be managed in complementary ways. Such ecologically-oriented production models explicitly embrace multiple objectives, rather than directing all efforts toward single goals such as yield or profitability [7].

The wider adoption of ecological approaches will depend on the capacity to develop a sound ecosystem-wide, integrated framework grounded on the maintenance of diversity in production systems, including the human component of diversity Such a framework will emphasize flexible strategies that increase productivity at the total ecosystem level, as opposed to efficiencies within single commodities or isolated production systems. Some of the ways of looking at production that have developed over past decades will need to change. Total productivity of ecosystems and landscapes will become more important than yield per hectare of specific crops. The functioning of the system in terms of regulating and supporting services will need to be considered in addition to the volume of extractable products. Integrated approaches will be required that can take account of the associated production of crop, livestock, fish and agroforestry. New concepts will be needed that, for example, can adequately reflect the way a regional food system is capable of meeting total food and nutritional needs and supporting human health and well-being under increasingly unpredictable environmental conditions.

Past efforts to increase yields and productivity have been undertaken within a framework that has aimed to control conditions and make production environments uniform through more or less unconstrained use of inputs rather than building on, and making use of, the highly diversified, complex and sometimes limiting farming conditions occurring in various regions of the world. This has led to the development and promotion of a narrow set of crops, breeds and management practices suited to high-input farming. It has also led to the neglect of a greater wealth of diversity of genes, organisms and systems that perform better in terms of productivity, economic and environmental sustainability in the majority of farming contexts, especially in the developing world. In contrast, interventions involving or targeting agricultural biodiversity need to encompass a variety of components in an integrated manner: inter- and intraspecific diversity of plants and animals, ecological interactions between wild, cultivated, above-ground, below-ground and aquatic diversity and the resulting ecosystem services should be considered not as self-standing components but as interacting players in processes that ultimately sustain long-term production and food security. Capitalizing on diversity-based dynamics gives agricultural systems the capacity to achieve high levels of productivity and be economically profitable, with a lesser or no need for external, costly and increasingly scarce inputs.

Agricultural systems that use biodiversity and place greater reliance on biological processes to achieve productivity and sustainability objectives need to place increased emphasis on the links and connections that are present within the agro-ecosystem. Since there are different scales at which ecosystems provide services to people, production systems should be managed at scales large enough to encompass cultivated and natural elements, taking into account their interactions and the services they provide to agriculture, even in faraway fields [8].

Need for the Conservation of Biodiversity: The earth's biological resources are vital to humanity's economic and social development. As a result, there is a growing recognition that biological diversity is a global asset of tremendous value to present and future generations. At the same time, the threat to species and ecosystems has never been as great

as it is today. Species extinction cause by human activities continues at an alarming rate, reduction of the earth's biodiversity as a result of human activities is a matter of great concern to prominent scientist. We are in the midst of the sixth era of extinction. This problem can be solved only by proper guidance, awareness, education, transfer of advance technology, research, conservation and sustainable use of biological diversity through the weapon of globalization only.

Sustainable Development: The importance of maintaining the ecological balance and conservation of the resources has been increasingly becoming clear in the last two decades. It has now become necessary for all countries in the world to recognize this fact and plan what is known as 'sustainable development'. The United Nations World Commission of Environment and Development in 1987 has defined sustainable development as "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and the institutional change are in harmony and enhance both current and future generations to meet their needs.

Farmer's contribution in Conservation and Preservation of Bio- diversity: The knowledge of the indigenous people and the traditional farmers has made a significant contribution in the development of new crop types and biodiversity conservation. Agricultural biodiversity is the biodiversity associated with agricultural ecosystems and is known as the multitude of plants, animals and micro-organisms indispensable in sustaining key functions for food production. It is the outcome of the interactions among the environment, genetic resources and the agricultural practices. It yields direct and indirect use values: higher levels of agricultural biodiversity may generate reduced pest incidence, improved soil nutritional levels, crop pollination, and hydrological functions. Agricultural biodiversity also generates significant option values in conserving genetic resources that can be the basis for the development of new crop varieties and animal breeds. This includes biodiversity above and below the ground. Soil management practices as applied under conservation agriculture can significantly enhance soil life and below ground bio-diversity.

Efforts for Conservation: Maintaining biodiversity means undoubtedly habitat conservation and restoration. In a wider this indicates protection against de-fragmentation, pollution, invasive alien species and climate change and it has made a huge impact on bio-diversity. Conservation and sustainable use of biological resources based on local knowledge system and practices are ingrained in Indian ethos and ways of life. Initiation of policies and programs for conservation and sustainable utilization of biological resources dates back to several decades. As a result, India has a strong network of institutions of mapping bio-diversity and undertaking taxonomic studies. The fundamental condition for restoring bio-diversity are obvious, however the realization is more complex for example, as it mentioned above directly or indirectly globalization has an impact on the loss of bio-diversity, but you can neither cancel not stop globalization in general there are lots of efforts on different sector to develop mechanism for conservation. The conservation and sustainable use of agricultural biodiversity on farms, in the wild and in gene banks, is essential to the future of agriculture. Through support to *in situ* and *ex situ* conservation, value addition, benefit sharing and capacity building, governments and international and civil society organizations can help enable farmers and Indigenous Peoples to safeguard agricultural biodiversity. Agricultural biodiversity includes all the components of biological diversity that are relevant to agricultural production, including food production, livelihood sustenance and habitat conservation of the agro-ecosystem. This brief focuses on the diversity of plants and animals that provide our food. Genetic diversity – the diversity within species – is the source of the adaptability that enables agro-ecosystems to respond to stress and environmental risks, including climate change. It also enhances agricultural productivity, by providing farmers and professional plant and livestock breeders with material for selecting more productive varieties or improving the characteristics of crops and livestock to cope with drought, severe storms, pests and diseases.

- Through its biodiversity, agriculture provides a broad range of energy, proteins, fats, minerals, vitamins and other micronutrients that are critical for food security and nutrition.
- Worldwide, an estimated 2 billion people suffer from micronutrient deficiencies, most commonly of vitamin A, iodine, folate, iron and zinc. All of these micronutrients can

easily be assimilated through a diversified and balanced diet.

- Agricultural biodiversity within farming systems and natural habitats is disappearing at unprecedented rates. Over the past 50 years, a small number of agricultural crop varieties have replaced many thousands of local varieties over huge areas of production.
- More than 90 percent of crop varieties have been lost from farmers' fields in the past 100 years, and 690 livestock breeds have become extinct.
- Since agriculture began 12 000 years ago, approximately 7000 plant species and several thousand animal species have been collected, developed, managed and used for food. Today, only 15 crop plants and eight domesticated animals supply 90 percent of the world's food energy requirements.
- Crop and livestock diversity is the result of human selection and domestication; its conservation depends largely on proper management and sustainable use.

Promote *in situ* Conservation: *In situ* conservation is the maintenance and use of valuable and/or threatened biodiversity in habitats where it occurs naturally and has evolved with or without human selection. This strategy is critical for protecting the genetic diversity of livestock and crop wild relatives, including crop ancestors and traditional cultivars or cropland races. These plant genetic resources can be used for crop improvement and can have a very high commercial value. For example, three wild peanuts have provided resistance to the root knot nematode, thereby saving peanut growers US$100million a year worldwide. Crop wild relatives and landraces are important food sources for the poor and essential complements to staple foods in times of famine.

Support on-farm Conservation: As environments evolve and adapt, efforts are required to maintain crop and livestock diversity in dynamic production systems through on-farm conservation and sustainable use. This means managing the entire agro-ecosystem, applying ecological principles and promoting decentralized and community systems in which people maintain, select and exchange varieties and associated knowledge. Community seed banks, informal seed exchange networks, seed and animal fairs that favor the exchange of information and resources, and participatory plant breeding, in which farmers, breeders and other experts collaborate to develop varieties that meet farmers' needs, are all valuable institutional interventions that support on-farm conservation. Policy-makers should also create positive incentives for farmers by improving access to good-quality seeds of neglected or rare varieties, and recognizing the public benefits of growing rare and distinctive crop varieties. Agriculture needs to change. It must become increasingly sustainable at the same time as meeting society's goal of providing sufficient, safe and nutritious food. Production practices based on a continuing and increasing dependence on external inputs such as chemical fertilizers, pesticides, herbicides and water for crop production and artificial feeds, supplements and antibiotics for livestock and aquaculture production need to be altered. They are not sustainable, damage the environment, undermine the nutritional and health value of foods, lead to reduced function of essential ecosystem services and result in the loss of biodiversity. At the same time, food production needs to make its contribution to reducing the number of people who are food insecure and malnourished which remains unacceptably high at nearly 1 billion.

The Challenges: Agricultural production will need to deal with major challenges over the next 40 years. Production will need to increase by about 70% (although at a declining rate over the period as populations begin to plateau) to cope with population increases and changed demands for meat, dairy and other products. There will be increased competition for land and water from growing urban populations and increased reluctance to see natural landscapes converted to agricultural uses. Phosphorus may well begin to run out by the end of the century and current levels of nitrogen pollution will become unacceptable. Climate change is expected to cause substantial reductions in potential crop production in southern Africa (up to 30% by 2030 for maize production) and South Asia (up to 10% for staples such as rice; declines in millet and maize production could exceed 10%). While crops in mid- to high-latitudes may benefit from a small amount of warming (up to +2°C), greater temperature increases will cause declines in production here too. Localized extreme events and sudden pest and disease outbreaks are already resulting in greater unpredictability of production from season to season and year to year and require rapid and adaptable management responses. Most of the food insecure people (70%) live and work in rural

areas and small-scale farmers still constitute 50% of developing country rural populations. Improving food security, reducing poverty and improving sustainability over the next decades will be inextricably linked to the development of strategies that are relevant and appropriate to small-scale farmers. At the same time, production practices will need to reflect a growing awareness by consumers of the importance of producing food in socially, environmentally and ethically acceptable ways.

Modern Approach: There are three reasons for needing to directly address the role of biodiversity for food and agricultural in improving food security and sustainability: first, because of the integrated nature of the contribution; second, because it involves thinking about agriculture in a different way, one that brings together the very positive elements of the various approaches such as sustainable intensification, multi-functionality and the importance of appropriate policy and economic frameworks; and third, because of the need to take account of the realities of small-scale farmers and communities who maintain the agricultural biodiversity that will be used.

Over the next 40 years agricultural practices will need to become increasingly flexible, reflecting the multifunctional nature of agriculture and the need to deal with change and uncertainty. Resilience and adaptability will become more important properties. To achieve this, production systems will need to have greater reliance on ecological processes that produce positive feedbacks on sustainability and production and ensure improved provision of all ecosystem services. These changes will involve the integrated use agricultural biodiversity, bringing together the contributions of crops, livestock, agroforestry species, soil organisms, pollinators and other components. Capitalizing on diversity-based dynamics will give agricultural systems improved capacity to achieve high levels of productivity and to be economically profitable with a reduced need for external inputs.

A number of approaches have already been developed that use biodiversity for food and agriculture to achieve sustainable increases in productivity and provide a sounder ecological basis for agriculture. The use of multi-species and multi-breed herds and flocks is one strategy that many traditional livestock farmers use to maintain high diversity in on-farm niches and to buffer against climatic and economic adversities. Species combinations also enhance productivity and yields in aquatic systems. Crop rotations, intercropping and growing different varieties of a single crop have all been shown to have beneficial effects on crop performance, nutrient availability, and pest and disease control and water management. Multi-cropping, intercropping, alley farming, rotations and cover cropping are all ways of combining crop species that have positive effects on productivity and yield stability.

Below-ground biodiversity is strongly influenced by management practices such as tillage, crop combinations, organic-matter inputs, application of fertilizers and pesticides. All management practices that use complex, ecologically-grounded approaches rather than applying off-farm inputs for achieving short-term outputs dedicate great care to nurturing soil biodiversity. In so doing, they benefit from positive cascading effects on the efficiency and productivity of the entire system, as in the case of conservation agriculture and organic agriculture.

Integrated pest management practices are well-established and have been adopted by millions of farmers throughout the world. Successful programs have shown, for example, that conserving arthropod biodiversity by helping increase local understanding of how agro-ecosystems function is a key ingredient of effective pest management in rice production. These diversity-rich approaches, together with others such as increased use of agro-forestry species, the further development of home gardens, the use of fish–rice systems and the improved maintenance of pollinator diversity, demonstrate the contribution that biodiversity for food and agriculture can make. At the same time a richer diversity of products from diverse production systems can make a significant contribution to improving the nutritional status and health of both the urban and rural poor around the world.

Agricultural Production Practices Need to Change: They need to become increasingly sustainable at the same time as meeting societal goals of access to sufficient, safe and nutritious food [9,10]. The Declaration of the World Food Summit on Food Security [11] stated that not only should there be increased investment in agriculture to meet the challenge of achieving food security but that this investment should be directed more consistently towards sustainability. Production practices based on a continuing and

increasing dependence on external inputs, such as chemical fertilizers, pesticides, herbicides and water for crop production and artificial feeds, supplements and antibiotics for livestock and aquaculture production, need to be altered. They are not sustainable, damage the environment, lead to reduced function of essential ecosystem services, result in the loss of biodiversity and undermine the nutritional and health value of foods. While production and productivity of the major food crops continue to increase, the number of people who are food insecure and malnourished remains unacceptably high at nearly 1 billion and reached a record high in 2009. Over the last ten years there has been increasing evidence that production and productivity are increasingly influenced by the changing frequency and intensity of extreme weather events [12]. It has been argued that unless more sustainable management of food production is adopted prices will rise and become increasingly volatile and the damage to the environment will continue to increase [10].

Conclusions: Agricultural production practices need to change, reducing the negative impact of agriculture on the biodiversity while continuing to increase productivity and improve sustainability. This will be an essential part of improving food security and responding to the challenge. It will require increased emphasis on ecosystem function within agro-ecosystems and the enhanced use of biodiversity for food and agriculture. There is sufficient evidence that agriculture can meet this challenge and that appropriate ways can be found to achieve the sustainable intensification needed. Biodiversity for food and agriculture will play an essential part in this process. Ways in which agricultural biodiversity can contribute to improved pest and disease control, nutrient availability and water use and to increased yields and the production of food with better nutritional content have all been described and are already part of production systems at various scales and in a variety of situations. However, a much more substantial change in approach is needed to ensure that agricultural biodiversity can fulfill its full potential in contributing to food security and adapting to climate change. The shift in thinking and the changes in approach that will be needed encompass policy, social and economic aspects. They will need to involve and engage consumers and all other actors in the agricultural and food industries. The approaches needed will be particularly concerned with supporting small-scale farmers and in ensuring effective ecosystem function and diversity deployment at the landscape level.

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