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AGRICULTURAL BIOLOGICAL DIVERSITY

Note by the Secretariat

Summary

Decision I/9 of the first meeting of the COP of the Convention on Biological Diversity set out to consider in 1996 the "conservation and sustainable use of agricultural biological diversity within the context of the Convention's three objectives and its provisions." Decision II/1 of the second meeting of the COP took note of the report of the first meeting of the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) in which the SBSTTA, in its recommendation I/2, proposed to provide to the COP "advice on scientific, technical and technological aspects of the conservation of agricultural biological diversity and sustainable use of its components (also taking into account the other provisions in Article 25, paragraph 2)" of the Convention.

In response to the needs of the COP this note outlines the major issues related to the conservation and sustainable use of agricultural biological diversity in the context of the three objectives of the Convention and identifies options for action. For the purposes of the Convention, agricultural biological diversity means the variability among living organisms associated with cultivating crops and rearing animals and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. The unique feature of agricultural biological diversity is the emphasis on its utility to human beings.

This note stresses the importance of making the transition towards sustainable agriculture. The obligations under the Convention are intended to reinforce and guide the work that is already being undertaken by the relevant international, regional and national institutions as well as market-based activities in the field of agricultural biological diversity. Recent international policy efforts to promote the conservation and sustainable use of agricultural biological diversity find their most

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elaborate articulation in Chapter 14 of Agenda 21. Pursuant to that chapter, the international community, operating mainly through the Food and Agriculture Organisation of the United Nations (FAO), has formulated a Global Plan of Action (GPA) on Plant Genetic Resources for Food and Agriculture, which was adopted by the Fourth International Technical Conference on Plant Genetic Resources held in June 1996 in Leipzig, Germany. Other important scientific and technological measures, such as international agricultural research activities under the auspices of the Consultative Group on International Agricultural Research (CGIAR), have contributed to the efforts aimed at the conservation and sustainable use of agricultural biological diversity. Other activities of relevance are carried out by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the United Nations Environment Programme (UNEP), the United Nations Development Programme, and the World Bank, among others. These initiatives and other efforts world-wide form an important basis for the identification of international policy options for integrating biological diversity into agricultural production.

This note is divided into five sections. The first section outlines the biological principles that underlie agroecosystems. The section underscores the importance of taking an ecosystem approach to the conservation and sustainable use of agricultural biological diversity. The second section provides an overview of the impacts of agriculture on biological diversity. The third section presents the rationale for addressing the issue of agricultural biological diversity under the auspices of the Convention on Biological Diversity and stresses the importance of considering the issue in the context of the three objectives of the Convention. The fourth section sets out the scientific, technical and technological issues that should be considered by the SBSTTA, and the last section presents an outline of the kinds of actions that could be considered under the auspices of the Convention.

Summary

I. BIOLOGICAL DIVERSITY AND AGRICULTURE

1.1 An ecosystem approach

1. Agricultural ecosystems, or agroecosystems, are ecosystems in which naturally occurring plants and animals have been replaced by crop plants and livestock animals deliberately selected by human beings. The degree of disruption of the natural system varies widely with different types of agriculture. Low-intensity agricultural practices, such as nomadic pastoralism, traditional home gardens and rotational fallows, retain many of the natural ecosystem processes and composition of flora, fauna and micro-organisms. The most intensive systems, including modern monospecific cropping, plantations and high-density livestock ranches, may change the ecosystem so completely that few of the previous biota or landscape features remain.

2. An ecosystem approach to understanding the impact of agriculture on biological diversity is necessary because the effects of agriculture are felt throughout the agroecosystem, and often far beyond its borders in organisms completely unrelated to agriculture. These impacts vary greatly as one moves along the continuum of intensity indicated above. Thus the impacts on ecosystems have increased over time as agricultural systems have intensified around the world. In addition, domesticated plants, animals and associated micro-organisms have been transported across and between continents, where they often radically change the environment into which they are introduced.

3. Agriculture can affect ecosystem functions and the biota that make up the living part of that ecosystem in a number of ways. At the landscape scale, agriculture results in the conversion of land cover types and the elimination of certain landscape features and habitats. At the farm level, management of the soil and vegetation often results in the reduction of soil cover by plants and the disruption of soil structure. Changes in soil characteristics at the farm level can have a wide impact if soil erosion occurs. The selection and management of domesticated plants and animals directly affect biological diversity by replacing naturally occurring plants and animals. In some cases the number of new varieties may exceed the original ones, but in most cases a narrower species and genetic base is created.

4. The impacts of agriculture on ecosystem functions can be grouped into five distinct areas: soil structure, nutrients and micro-organisms; water cycle; landscape complexity; biotic complexity and linkages; and atmospheric properties. Agriculture affects soil structure and biota primarily though reduction of the organic material incorporated from above-ground and root biomass, through tillage for crops and compacting by livestock. The simplification of agricultural systems by removal of multi-storied vegetation, particularly trees and ground cover, results in the exposure of soil to the erosive forces of sun, rain and wind, and subsequent loss of topsoil. It reduces the incorporation of moisture, air and organic matter into the soil by complex rooting systems, which is essential for micro-organisms and nutrient cycling as well as for maintaining a strong soil structure. Agricultural chemicals further deteriorate soil conditions by reducing the presence of soil invertebrates, micro-organisms and soil insects responsible for decomposition and nutrient cycling. These include nitrogen-fixing bacteria, micorrhizal fungi, earthworms and termites. The deterioration of soil quality results in decreasing agricultural productivity, as well as damage to the local and larger ecosystems' functions.

5. Agricultural activities also affect the movement and quality of the water that is essential for both agricultural productivity and habitat maintenance. Soil compacting, the loss of complex vegetation and the elimination of landscape features such as wetlands and streams, reduce infiltration of water into the ground where it would be available for plant growth. Lack of infiltration also results in flooding and the reduction of groundwater recharge, which can affect water supplies for human use both within the agricultural system and far beyond. Agricultural chemicals and run-off of high-nitrogen manures from livestock operations are a major source of pollution of water resources, both underground and surface waters. This has a far-reaching impact on biological diversity in aquatic systems and those biota that depend on them, such as avian wildlife. In this respect, international efforts to conserve coastal and marine ecosystems and wetlands of international importance need to consider the impacts of agriculture.

6. The third kind of impact that agriculture may have on ecosystem functions is the reduction of biotic and structural complexity at the landscape level. Nearly one third of the world’s land area is used for food production, making agriculture the largest single cause of habitat conversion on a global basis. The trend in agriculture is towards larger, mechanised mono-cultural production units that require a homogeneous topography. Habitats such as woodlands, hedgerows, fallow fields and individual trees are eliminated, and features such as wetlands, streams and ravines are smoothed over. This results in a major loss of habitat for wild flora, fauna and insects, including the valuable wild relatives of domesticated plants and animals. As well as being a direct loss of biological diversity, this simplification of the agricultural landscape increases its susceptibility to pests, disease and weed infestation.

7. The loss of biological complexity at the species and genetic level has an impact similar to that of the landscape homogenisation described above. Intensive agroecosystems that rely on fewer species and varieties have become more susceptible to disease and pests, and to climatic variation. The functions of natural ecosystem resilience and nutrient cycling are increasingly being replaced by external inputs, such as fertiliser and pesticides, which are less able to cope with changing environmental conditions and new pest and disease challenges. Some beneficial wild biota have become linked with agroecosystems, such as certain invertebrates, insects and birds. As agriculture becomes increasingly simplified, for example by eliminating draught animals from cropping systems, the food sources for the beneficial wild biota disappear.

8. Finally, the conversion of land to agriculture, and the increasing intensification of agriculture, can have an impact on atmospheric carbon and nitrogen fixation. The replacement of natural vegetation by a cropping system with lower primary productivity can result in the release of carbon dioxide, methane and nitrogen dioxide. Loss of soil organic matter, draining of wetlands and elimination of trees from agricultural systems all diminish the fixation of carbon. Methane is released from flooded rice cultivation as well as from ruminant production. These impacts link the concerns over biological diversity with those of climate change.

9. In all of the foregoing areas the ecosystem-wide impact of agriculture on biological diversity can be mitigated by changes in agricultural practices and technologies and land use patterns. Clearly a balance must be found between maintaining acceptable levels of agricultural production and biological diversity, but this will not be possible unless the broad systemic impacts of agriculture are recognised.

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1.2 Agricultural evolution and genetic variation

10. For millennia, pastoralists and farmers have developed and maintained a wide diversity of animal breeds and crop varieties through accidental and intentional cross-breeding and selection. As a result, human beings have created a tremendous increase in the intra-specific variation of certain animals and plants. However, the gains for these species have generally been at the expense of other species. In addition, the genetic diversity represented in domesticated animals and plants is numerically insignificant in comparison to the diversity present in the wild. Domesticated species constitute about one in every ten thousand living species. Nevertheless, the future of the world food supply depends on this small subset of organisms.

11. The process of domesticating wild animals began some 12,000 years ago. Today there are over 40 species of domestic animals, which contribute 30-40% of the total value of food and agricultural production. The FAO databank on farm animal genetic resources has information on 28 of these species, totalling 3,882 breeds. As well as providing food, domestic animals have been an integral part of the farming system and economy, providing draught power, transportation, manure for fertiliser and fuel, and other products such as leather, wool and feathers. Customs developed to ensure the survival, exchange and strengthening of valuable stock.

12. Similar success was achieved with plants. In India, for example, the mango, Mangifera indica, has been bred to create 1,000 varieties, and some 100,000 varieties exist of one species of rice, Oryza sativa. In addition, traditional agriculture typically incorporated a wide variety of species into each production system. In Java, small-scale farmers have up to 607 crop species in their gardens, equivalent to the species diversity of a deciduous tropical forest. Farmers developed effective methods for germplasm testing, collection, storage and exchange. These methods were often encoded in customs, such as the passing on of planting material at the time of marriage or migration.

13. At the landscape level, patches of different vegetation types were created by farming methods such as shifting cultivation and the use of fire. This created mosaics of cultivated, grazed, uncultivated, and successional areas, which increased the variety of ecological niches and was thus likely to encourage biological diversity. Evidence from tropical forests as well as desert areas in the Americas shows that certain traditional agricultural activities increased the number of species present rather than decreased them. Some of the areas with the richest species diversity have been managed by humans for centuries, such as the meadows of South Estonia on limestone bedrock, with 63 species per square metre. Not all traditional agriculture enhanced biological diversity. But it is clear that human activity generally resulted in the increased movement, distribution and selection pressures on plants, animals and their habitats, frequently producing increased heterogeneity and pace of change -- as well as utility for humans.

14. Agricultural scientists tend to focus on the intra-specific variation that is the hallmark of agriculture and the most notable achievement of traditional agriculturalists and modern plant and animal breeders. However, it is the interdependence of each variety and breed with its ecological and socio-cultural setting that defines its ability to contribute to the overall goal of sustainable food production. Drought-tolerance, flavour, disease resistance and invasiveness are but four of the hundreds of characteristics that may be important to the long-term productive potential of any particular domesticated organism.

15. Traditional agriculture also ensured the survival of certain non-agricultural species due to the continuity of management techniques. For example, a perennial maize, Zea diploperennis, which grows in abandoned fields, has been maintained by local slash-and-burn techniques. The rangeland

management techniques of pastoralists, such as the use of fire, ensure the continued existence of a number of important species, such as perennial grasses. Many management techniques are perpetuated through custom and belief systems that have become an inseparable part of the agricultural system. The ability of people to inhabit difficult environments, such as arid or arctic areas, has depended on their reliance on certain breeds of livestock and varieties of plants that are well-adapted to these conditions. As these animals and plants are lost, the ability of people to inhabit these areas is also lost. In addition, once the indigenous knowledge and social framework of these production systems have eroded, it becomes far more difficult to revitalise these systems.

16. A rapidly growing global human population and changing consumption patterns have stimulated the evolution of agriculture from traditional to modern, intensive systems. According to the FAO, of the approximately 7,000 species that have been cultivated or collected by humans for food, only 30 crops now account for 95% of the global dietary energy (calories) or protein. Wheat, rice and maize provide more than 50% of the global plant-based energy intake. Nearly 90% of the food energy supplies of the world is provided by only 103 plant species.

17. The 1940s witnessed the emergence of agricultural systems that emphasised maximising crop yields and uniformity and standardisation in farming systems, varieties and technologies. They contributed greatly to increasing agricultural yields and have become the dominant approach to agricultural production world-wide. This approach, which entailed a greater use of energy, agricultural chemicals and mechanisation, was subsequently dubbed the “Green Revolution” because of its radical approach and overall impact in increasing yields. The diffusion of the model was backed by supportive national policy reforms, international agricultural research institutions, donor agencies, private foundations and the private sector.

18. Modern commercial agriculture focused its attention on developing a smaller number of crop varieties, which were then widely disseminated. This approach has been enormously successful. Today, it is estimated that high-yield varieties (HYVs) are now used on 52% of the wheat growing areas, 54% of land planted with rice, and 51% of maize farms. The economic impact of the high-yield varieties was equally dramatic.

19. The diffusion of this new agricultural system has been associated with the growth of the seed and agrochemical industries. Over time, public institutions have gradually reduced their activities in plant breeding and their place has been taken by the private sector. The private sector has been a key agent in promoting the research, development, and distribution of seeds and related agricultural inputs. The seed industry started as networks of small rural enterprises and has, over the last forty years, become one of the largest industrial ventures in the world. The influence of the seed and agrochemical sub-sectors continues to grow, especially as the major firms increase their investment in biotechnology. This growth has also been associated with the concentration of seed and agrochemical activities in the hands of fewer large corporations.

20. Governments around the world have also introduced public policy instruments to promote the adoption of modern commercial agriculture. These measures include general agricultural development policies, pricing policies, subsidies and credit arrangements. Among the most important are incentive systems and programmes such as credit schemes, extension programmes, marketing standards, and subsidies that support the adoption of new agricultural technologies. The diffusion of the new agricultural system has been hailed as a success in raising agricultural productivity, creating new markets, generating income, stimulating employment and contributing to overall economic growth. Debates over the diffusion of modern commercial agriculture have also been extended to the

ownership and control of plant varieties and animal breeds used in agricultural improvement programmes.

21. According to the Global Biodiversity Assessment, "overwhelming evidence leads to the conclusion that modern commercial agriculture has had a direct negative impact on biodiversity at all levels: ecosystem, species and genetic; and on both natural and domestic diversity". On the other hand, modern intensive agriculture has made it possible for the ever-increasing human population to be fed without the extensive destruction of habitats to provide the needed food. While agriculture has both positive and negative impacts, it also depends upon biological diversity for its continued existence. Hence, promoting sustainable agriculture requires the conservation and sustainable use of biological diversity. But this diversity is currently being threatened by the very activities that depend upon it.

II. IMPACTS OF AGRICULTURE ON BIOLOGICAL DIVERSITY

2.1 Overview of impacts

22. While modern agriculture has brought huge gains in food production, it has been responsible for considerable damage to biological diversity through land-use change, the introduction of alien species, and chemical pollution. Concern over these impacts has increased over the decades as agricultural production has been intensified. Agenda 21, Chapter 14.1, notes that: "Agriculture has to meet this challenge, mainly by increasing production on land already in use and by avoiding further encroachment on land that is only marginally suitable for cultivation." Such marginal land generally includes forests, wetlands, wildlands and other important sites of biological diversity. Hence the possibility of conserving biological diversity in general will depend in great part on the success in meeting human food needs from the land currently devoted to agriculture. This interdependence between biodiversity and agricultural productivity must be taken into consideration in the development of measures to conserve agricultural biological diversity.

23. Agricultural activities have three main types of impacts on biological diversity: (a) on the genetic variability of the managed plant or animal species; (b) on the natural ecosystems where agriculture takes place (or which it has displaced); and (c) through off-site pollution or alteration, such as by siltation, chemicals or invasive species. Land uses may be intermixed sufficiently to be described as an agroecosystem experiencing both of the latter two impact types.

24. In respect of genetic variability, agricultural biological diversity exists primarily at the intra-species level. No new crop or livestock species has been domesticated from the wild in recent times. However, new varieties of traditional crops and domesticated animals continue to be developed through traditional and modern breeding and genetic engineering. This has resulted in the creation of thousands of new varieties of single plant species, and greatly enhanced diversity in certain animal species. An intensified effort in plant and animal breeding over the past four decades has resulted in greatly increased yields from certain varieties and breeds. This is due to the adoption of modern agricultural systems that optimise the productivity of these new high-yield varieties of crops (particularly cereals) and livestock. This has been accompanied by the adoption of agricultural methods that rely on commercial inputs such as fertilisers, pesticides and antibiotics.

25. Many of the production gains made were due to these modern systems replacing traditional agricultural systems. This had a major impact on biodiversity because the traditional systems incorporated significantly more intra-specific and inter-specific diversity, as well as landscape heterogeneity than the modern ones. This transition took place in the developed countries and those areas in the developing regions that had suitable infrastructure and environmental conditions. Since the high-yield varieties and breeds required both a high level of capital input and favourable environmental conditions, they were not suited to areas with low incomes or harsh environments. The uneven development of modern agriculture has resulted in uneven access to its produce.

26. Furthermore, the benefits of modern agriculture have not always been experienced equally among farmers and pastoralists; wealth differentiation has often been exacerbated by the capital-intensive methods and varying degrees of market integration. While the agricultural output per unit area has increased over time, the rate of growth is now declining. Much of the initial growth in production was due to the conversion of traditional agricultural systems to modern systems. The areas suitable for such conversion are now dwindling and provide less hope for continued gains. It is estimated that 20% of current world food production is from traditional multi-cropping systems.

27. The conversion of the agricultural sector from traditional systems to modern systems has come at a cost to biological diversity. The adoption of high-yield varieties has displaced the use of many traditional varieties. For example, in Sri Lanka the number of rice varieties decreased from 2,000 in 1959 to 5 in 1992, and in the United States 50% of all wheat is now produced from only 9 varieties. At the landscape level, modern farming has brought irrigation, tillage, plantation and monocropping technologies, which have substituted large-scale uniformity for the traditional patchwork of small-scale intercropped management units. This has homogenised the traditional agricultural landscape, which was typified by a variety of fallow and successional stages, retention of landscape features such as water courses, refugia in groves and hedgerows, and topographic complexity. The result has been a loss of the variety of ecological niches that encouraged biological diversity.

28. Extending modern agriculture to land occupied by traditional systems cannot continue at the same rate, and expansion into non-agricultural lands may not be desirable in terms of conserving biological diversity. Future increases in agricultural production are likely to continue to be derived from the development of new plant varieties with desirable characteristics and from the more effective use of commercial inputs. In order for new varieties and breeds to be able to contribute to increasing productivity, they will need to be adapted to harsher environmental conditions, such as salinity and drought, and require fewer capital-intensive inputs, such as fertilisers, pesticides and medicines. This will enable the marginal areas to be more productive and ensure that production in areas already under intensive management is sustainable. Given the urgent need to ensure the sustainability of agricultural systems rather than their short-term productivity, domesticated species should be developed and managed within the larger context of better natural resource management to minimise the negative side-effects of agriculture and to enhance long-term food security.

2.2 Crop and livestock genetic diversity

28. Although less publicised than the loss of wild animal species, the genetic erosion and genetic vulnerability of agricultural species have severe implications for global food security. This situation is occurring through the replacement of a broad range of traditional varieties and breeds by a few modern ones. The improved yields of modern varieties and breeds were built on the broad genetic

diversity present in farmers' landraces and in their wild and weedy relatives. Genetic diversity is declining within domesticated species, and species diversity is declining within farming systems. Many areas that are home to the wild relatives of food crops are also under threat. The prevailing models and policies of agricultural research and development of the Green Revolution, along with market pressures for standardised characteristics, have encouraged this erosion.

29. This decline in genetic variability is a concern for three main reasons. First, genetic diversity helps provide stability for farming systems by including a range of inter- and intra-specific characteristics. Losses suffered by one variety or breed can be compensated for by continuity or gains in another. Second, genetic diversity provides insurance against changing environmental conditions that may be anticipated for the future, such as through resistance to new diseases or adaptability to changed climatic conditions. Third, genetic diversity embodies characteristics that are potentially valuable, but not yet exploited.

30. The erosion of genetic diversity is in part due to monocultural farming systems replacing traditional polycultural systems that incorporated both intra-specific and inter-specific diversity. In the Philippines, the introduction of HYVs has displaced more than 300 traditional rice varieties that had been the principal source of food for generations. In India, as early as l968, HYV seed had replaced half of the native varieties. The HYVs were not "high-yielding", however, unless they incorporated high fertiliser inputs and irrigation. Thus, the expected productivity increases were not always realised.

31. The replacement of traditional polycultures with HYVs is occurring globally, often resulting in increased food insecurity. For example, a traditional Senegalese cereal staple fonio (Panicum laetum), which is highly nutritious as well as robust in lateritic soils, is under risk of extinction due to displacement by modern crop varieties. Evidence from Europe shows similar trends for flax, wheat, oats and rye, as well as for legumes, fruits and vegetables. Uniform varieties are also common in export crops of coffee, bananas, cacao and cotton.

32. Livestock is also suffering genetic erosion; the FAO estimates that at least one breed of traditional livestock is lost every week. Of the 3,831 breeds of cattle, water buffalo, goats, pigs, sheep, horses, and donkeys that have existed this century, 16% have disappeared, and a further 15% are rare. Over 30% of all remaining domestic animal genetic resources are now at risk of extinction. It was estimated in 1992 that 50% of indigenous goats, 30% of indigenous sheep and 20% of indigenous cattle breeds in India were threatened. An estimated 80% of poultry in India is now of exotic breeds.

33. Traditional animal breeds are being displaced by highly specialised intensive production systems, such as ranches and farm-factories that rely on high-output exotic breeds. These new systems also render traditional breeds obsolete by replacing their multi-purpose functions with mechanised traction and chemical fertilisers. The loss of traditional breeds has been the highest in Europe and North America, where a few highly productive breeds now dominate milk and meat production. The change has been slower in developing countries. There, the large proportion of the population engaged in food production tends to rely more heavily on multi-purpose livestock and lacks the capital investment needed to modify the physical conditions to provide for intensive rearing. The 80 breeds of cattle still found in Africa represent adaptation to various harsh local conditions, such as lack of water, extreme temperatures, diseases, and low-value forage and browse. Their replacement by a few exotic breeds weakens both the agriculturalist's ability to utilise marginal areas for food production, and the potential for breeding programmes to improve livestock hardiness.

34. One of the main concerns arising from over-reliance on modern varieties is the increased vulnerability to pests and diseases. Vulnerability is due to two factors: the relative areas devoted to each variety, and the degree of uniformity (relatedness) between varieties. A plant pathogen can be devastating if it infests a uniform crop, especially in large plantations. History has shown many cases of catastrophic losses from relying on uniform varieties grown in monocultures. Among the renowned examples are: the potato blight (Phytopthora infestans) in Ireland in 1845-48, which led to the death of 1.5 million people; the winegrape blight (Phylloxera vitifoliae) that destroyed four million acres of French vineyards in the last century and a variant of the blight that currently threatens vineyards in the United States; a virulent disease that has repeatedly devastated banana plantations in Central America since the 1930s; and molds and blights that have destroyed HYV maize in Zambia and the United States, respectively, since the 1970s. In the case of Zambia, while some 20% of the HYV maize crop was lost, the impact on traditional maize varieties was negligible. In 1972, following the widespread adoption of uniform wheat HYVs, Brazil lost a large proportion of its national wheat crop when it was attacked by a disease that it was not able to withstand.

35. After having uprooted millions of dollars of vines, California winegrape growers have now diversified their varieties and use non-chemical soil and crop-management methods to avoid another blight. Unfortunately, in many cases the mistakes of relying on genetically uniform monocultures have been continually repeated. Scientists and government agencies have acknowledged the vulnerability of uniform stock. As early as the l970s, the US National Academy of Sciences warned of the emerging problems in a publication entitled Genetic Vulnerability of Major Crops; the FAO also called attention to this threat. These problems illustrate the importance of retaining the genetic stock necessary to incorporate diversity into crops and livestock.

36. In considering what type of diversity to incorporate, the diversity within the genetic make-up of a crop may be a more relevant measure of the evolutionary resilience of that crop than the diversity of obvious morphological characteristics. It has been assumed that the morphological diversity of crops seen on-farm assures a broad genetic variation; while the uniform morphology of improved varieties is the result of a narrow genetic base. Diagnostic surveys of genetic variation and genetic distance between varieties are urgently needed in order to accurately assess the importance of morphological diversity vis-à-vis genetic diversity and to create more useful measures of functional diversity. This can also assist in ensuring that breeding intentionally widens the genetic base rather than narrows it.

37. Well-developed methodologies for characterising wild biological diversity exist, as practised in the discipline of conservation biology. This is not so for agricultural biological diversity. Agreed scientific principles and practice for on-farm genetic resource conservation are lacking. In addition, attempts to describe this important aspect of agricultural biological diversity are seriously constrained by the lack of a generally usable classification and nomenclature system for landraces. One of the key scientific obstacles to progress in conserving valuable agricultural biological diversity is the lack of methodology for characterising landrace diversity. This may require that a taxonomic framework is developed before studies of the evolutionary history, function, and ecogeographic distribution of variation within a crop can be undertaken.

2.3 Agroecosystem diversity

38. The loss of diversity within crops and livestock is also associated with the reduction in the diversity of species and genera found in farming systems. Many traditional practices are being lost

before they have been adequately studied. The introduction of modern agriculture has increased overall food yields and raised local income levels, but at the same time led to overall increases in socio-economic and ecological vulnerability.

39. Farming-system-level diversity is particularly important to small-scale farmers who depend on their farming system for their food security and economic security. The adoption of modern farming systems has often resulted in the reduction of species, activities and landscape features within the agroecosystem. The traditional mixtures of staple crops, vegetables, fruits, medicinal plants, and wild or semi-domesticated species that are either cultivated or condoned provide a resilient production system. Multipurpose trees, for example, are often used in complex agroecosystems in hedgerows or alleys, for fruit, wood, green manure, erosion control and other services. Wild plants that grow within other field crops may be important sources of vitamins. The emergence of wild plants and animals used as critical famine foods depends on the continued existence of wildlands in the proximity to act as refugia. The stability and adaptability of these farming systems depends on the existence of biological diversity represented by these “minor” crops and breeds, and by semi-domesticated and wild species at the agroecosystem level.

40. The reduction of diversity in the farming system and its associated lands reduces the opportunity for continued breeding and selection by farmers. Larger fields with monocropping regimes and reduced rotations and fallows greatly reduce the number of crop landraces and wild relatives available to the farmer for cross-fertilisation. Gene flow from wild relatives to crops is used by plant breeders to introduce useful characteristics. On-farm crossing of varieties by farmers also transfers “wild” genes and enriches useful on-farm diversity. The loss of on-farm diversity stalls the process of crop development at the farm level and replaces it with breeding and genetic engineering in the laboratory. The selection process is then separated from the practical needs and actual environmental conditions experienced in the farming system. There may be “keystone” landraces that have important practical qualities, or are the basic stock from which farmers derive other varieties.

41. The movement of genes and varieties into and out of cropping systems, both temporally and spatially, is inadequately understood. It is important to understand the causes of loss or rejection of some varieties or characteristics in order to design effective monitoring, conservation and utilisation methods.

42. Along with the erosion of diversity in domesticated species, is the related loss of biological diversity in agricultural soils. The great natural diversity and abundance of soil organisms maintain soil productivity. Soil organisms and micro-organisms maintain nutrient cycling, soil structure, moisture balance, and the fertility of soils. Mycorrhizae, fungi that live in symbiosis with plant roots, are essential for nutrient and water uptake by plants. Yet this rich resource is largely invisible and unrecognised by the public. Increasingly, agricultural systems are losing this diversity, undermining soil fertility and leading to productivity losses. The main reasons for decline in soil biological diversity are the management practices of modern agriculture, including: (a) the heavy use of agrochemicals, particularly pesticides, soil fumigants, and chemical fertilisers; (b) the uniformity of crops over time and space; (c) intensive tillage practices (mainly with machinery) that disrupt soil structure; and (d) a decline in the use of animal manure, crop residues, intercropping, cover crops, crop rotation and other methods that increase the organic matter content of soils and reduce their exposure to erosive forces.

43. Another area of concern at the agroecosystem level is the erosion of the diversity of insects. Insects pollinate, contribute to biomass and natural nutrient production and cycling, and are natural enemies to crop pests and diseases. The reduction of insects leads to increasing costs and declining

productivity. The dependence of modern agriculture on agrochemicals, and particularly on the heavy application of pesticides, has been largely responsible for this problem. Agrochemicals generally kill beneficial insects as well as the target pest. Pesticides may affect a wide range of susceptible species in the ecosystem and also alter the normal structure and function of the ecosystem itself.

44. This disruption in the agroecosystem can lead to problems of pest resurgence, resistance to pesticides and outbreaks of new pests. This problem is particularly well known for causing major losses in cotton and banana production in Latin America, and of rice in South-East Asia. The reliance on monocultures and the decline of natural habitat around farms also contribute to the loss of beneficial insects. Improving the sustainability of agroecosystems will require methods of maintaining healthy populations of beneficial insects and soil micro-organisms while strengthening the resistance of crop plants and livestock to pathogens.

2.4 Impact on non-agricultural ecosystems

45. When done in appropriate areas and ways, agricultural development does not necessarily result in negative effects on natural systems. However, agricultural practices result in biodiversity losses within and beyond the natural habitats where they take place. This can result in losses of species and ecosystem functions, and in internal losses to production.

46. In many parts of the world, the spread of agriculture has contributed to the fragmentation of natural habitats, particularly of forest areas, grasslands and wetlands. This occurs mainly through extending farming systems into frontier zones, accompanied by clearing forests or natural vegetation. Some kinds of agricultural practices, such as polycultural and agroforestry systems or certain pastoral practices, conserve some natural species and functions while adding new ones, resulting in an increase in diversity and low impacts on the surrounding areas. However, the large-scale conversion to monocultural farming systems can seriously erode the diversity of naturally occurring organisms and habitats far from the original site.

47. Soil erosion inland may affect coral reefs near river outlets to the sea. The intensive use of pesticides can disrupt and erode biodiversity in natural habitats near and far from agricultural areas as they accumulate in the food chain. Pesticides and their residues inevitably drift into the air, water and soils. Only a minute percentage of pesticides sprayed reach the target pest, estimated at 0.1% for many insecticides. As a result, diverse insects and other flora and fauna are killed or harmed by the chemicals. The heavy use of chemical fertilisers usually results in run-off into neighbouring soils and water supplies. This pollution often damages these ecosystems by promoting eutrophication and can harm human health if it enters drinking-water supplies.

III. AGRICULTURAL BIOLOGICAL DIVERSITY AND THE CONVENTION

3.1 Objectives and scope of the Convention on Biological Diversity

48. The Convention on Biological Diversity provides a legally binding framework for the conservation and sustainable use of agricultural biological diversity in particular and the transition towards sustainable agriculture in general. Its scope and the comprehensive nature of the objectives of the Convention lay the foundation for effecting such a transition. Article 1 sets out the objectives of

the Convention to be "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding".

49. These objectives are set against the general principle regarding the "sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction" as articulated in Article 2. The jurisdictional scope of the application of sovereign rights covers components of biological diversity in areas within the limits of national jurisdiction as well as processes and activities regardless of where their effects occur, carried out under the jurisdiction or control of states, within the area of their national jurisdiction or beyond the limits of national jurisdiction.

50. The Convention sets out general measures for the conservation and sustainable use of biological diversity in Article 6(a) and calls upon each Party to "develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, inter alia, the measures set out in this Convention relevant to the Contracting Party concerned." In Article 6(b) the Convention outlines the sectoral basis for its implementation and invites each Party to "integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies". Article 6(b) provides the legal basis for focusing on sectoral issues such as agricultural, forest and marine biological diversity, among others.

51. The second meeting of the COP adopted a series of measures aimed at implementing Articles 6 and 8 (on in situ conservation) of the Convention on general measures for the conservation and sustainable use of biological diversity. Decision II/7 on the consideration of Articles 6 and 8 of the Convention emphasised "the importance of capacity-building as well as the availability of adequate financial resources to assist Parties in the implementation of Articles 6 and 8 of the Convention, and in this context requests the interim financial mechanism under the Convention to facilitate urgent implementation of Articles 6 and 8 of the Convention by availing to developing country Parties financial resources for projects in a flexible and expeditious manner".

52. The decisions of the COP in regard to Articles 6 and 8 have so far focused on national strategies, plans and programmes. But Article 6(b) envisages that future work will be implemented through "relevant sectoral or cross-sectoral plans, programmes and policies". It is from this perspective that the emphasis on sustainable agriculture in general and agricultural biological diversity in particular becomes an urgent matter for the Convention. It can be argued from this perspective that the Convention seeks to promote the integration of biological diversity into development objectives as a fundamental goal.

3.2 In situ conservation for sustainable agriculture

53. Article 8 of the Convention lays the basis for the in situ conservation of biological diversity, which is set out as the most fundamental approach under the Convention. It is notable that Article 9 on ex situ conservation is aimed at complementing in situ conservation. Although the Article is largely devoted to conservation outside agricultural areas, its provisions apply to emerging considerations of the conservation of agricultural biological diversity. The key element here is the integration of

biological diversity into agriculture as a way of effecting the transition towards sustainable agricultural production.

3.2.1 Traditional and on-farm practices

54. Traditional farming systems are characterised by dependence on high degrees of plant diversity manifested as polycultures and agroforestry. In addition, traditional farming systems also rely on high levels of genetic diversity in animal breeds. Many of these traditional farming systems are located in the centres of genetic diversity of major crops identified by the Russian botanist Nikolai Vavilov. One of the key features of traditional farming systems is the interaction between domesticated varieties and their wild relatives. Such cycles of natural hybridisation and introgression have, over time, increased the genetic diversity available to farmers. The importance of introgression in promoting genetic diversity in traditional farming systems calls for measure that promote synergy between the in situ and ex situ conservation of genetic resources. But more importantly, it is crucial to view traditional farming practices as part of an open system that promotes diversity in agroecosystems. Discussions of agroecosystems therefore need to go hand-in-hand with the recognition of associated local knowledge, innovations and practices.

55. The necessary policy and institutional measures needed to promote traditional farming systems should be part of broader discussions on incentive measures under Article 11 of the Convention on Biological Diversity, as may be discussed at the third meeting of the COP.

56. Other practical issues, such as establishing community seed banks, strengthening traditional animal husbandry, promoting agroforestry, establishing cultivar registry systems and maintaining uncultivated strips, could be encouraged as part of a larger initiative to promote and enhance sustainable production in traditional farming systems.

57. It should be noted that many of the pressures that lead to the disappearance of traditional farming systems come from outside the agricultural sector. These pressures, often referred to as “root causes”, can only be effectively addressed using broad policy and institutional policy reforms. Discussions of the use of such policy considerations can be taken up by the COP under the various policy items on the agenda. Traditional farming systems are themselves constantly evolving and incorporating new ideas. The penchant for experimentation among farmers world-wide makes it possible to integrate new techniques into traditional practices, thereby increasing the diversity of agroecosystems.

58. In Mexico, researchers have worked with the local people to re-establish chinampas (multicropped, species-diverse gardens developed from reclaimed lakes), which were native to the Tabasco region of Mexico’s pre-Hispanic tradition. Similar efforts in Veracruz also incorporated the traditional Asiatic system of mixed farming, integrating chinampas with animal husbandry and aquaculture. These gardens are rich in crop and non-crop species. They also make more productive use of local resources, and use organic waste as fertilisers. A project in Bolivia has introduced the wild Lupin (Lupinus mutabilis) into the agropastoral systems to reduce the use of chemical fertilisers. Similar projects, which blend traditional farming systems with new practices, have been widely reported in recent years and they underscore the dynamic nature of these systems.

59. The blending of traditional and modern methods to support on-farm conservation efforts is not restricted to developing countries. As part of the transition towards sustainable agriculture, a number of industrialised countries are starting to formulate enabling legislation and provide financial

assistance for such activities. For example, the European Union (EU) provides financial support to farmers for a wide range of “agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside”. Furthermore, the EU provides grants to farmers who embark on five-year programmes to cultivate and propagate useful plants, adapted to local conditions, that face the threat of genetic erosion. In another regulation, the EU established a scheme for certifying the origin of certain agricultural products made from landraces and old cultivars.

60. Among the main features of in situ conservation are the generation and diffusion of the knowledge, innovations and practices of indigenous and local communities. The Convention has recognised this in Article 8(j) and called upon each Party, subject to its national legislation to “respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilisation of such knowledge, innovations and practices”.

61. Article 8(j) is particularly relevant for agricultural biological diversity because of the dominant role of farmers in the generation of intra-specific diversity in crops and breeds and in the accumulation of specialised knowledge associated with these activities. Since the 1980s, FAO and the Commission on Genetic Resources for Food and Agriculture have served as a forum for promoting the recognition of such knowledge, innovations and practices under a cluster of ideas referred to as “farmers’ rights”. A number of countries are seeking to give “farmers’ rights” the normative standards that would enable them to have standing in national law. It may also be argued that many of the elements that constitute “farmers’ rights” can find legal expression in the provisions of the Convention and existing property-rights regimes after their specific normative features have been identified.

62. The role of the in situ conservation of biological diversity and its relevance to agricultural production are starting to be given their proper recognition at the international level. Article 8 of the Convention on Biological Diversity provides a broad basis for in situ conservation. The 9,800 protected areas around the world (covering some 926.35 million hectares) also include a wide range of species of importance to agriculture. A number of countries, including Germany, Bulgaria, Turkey, Sri Lanka, Ethiopia, Brazil and Mexico, have conservation activities of relevance to agricultural biological diversity in protected areas.

63. Interest in such activities may provide a basis for giving greater significance to activities such as the Man and Biosphere (MAB) Programme of the United Nations Scientific, Educational and Cultural Organisation (UNESCO). Already, the MAB Programme has been integrating the conservation of wild relatives of major crops and cultivars into its conservation activities. The COP may wish to consider requesting UNESCO, in cooperation with the FAO and other institutions such as the International Plant Genetic Resources Institute (IPGRI), to develop this concept further and to formulate a comprehensive programme for the in situ conservation of agricultural biological diversity. This effort will need to be carried out in conjunction with conservation institutions at the national level. New areas that will need to be taken into account include game ranching, which seeks to expand the food base through the sustainable use of wildlife.

3.2.2 Modern agriculture

64. While it is relatively easy to integrate biological diversity considerations into traditional agriculture, it is more challenging to do so in modern commercial agriculture. There are two challenges that have to be faced in this regard. The first is that traditional agroecosystems are currently being converted to modern commercial agriculture at a rapid rate. Most countries around the world have established institutions and legal systems whose aim is to modernise traditional agriculture. The challenge is how to increase yields in the traditional systems while retaining a certain measure of their integrity. In other words, how to achieve sustainable intensification. The second area of concern is how to integrate biological diversity into existing modern commercial agricultural systems.

65. The overall strategy for dealing with the latter challenge includes adopting a two-pronged approach: conserving large tracts of natural ecosystems that contain wild relatives of crops and livestock, and on-farm conservation of cultivars and breeds as well as their wild relatives.

66. On-farm conservation of biological diversity is often associated with small-scale farming. There is ample evidence that the adoption of conservation methods on large commercial farms may promote biological diversity. Techniques such as crop rotation, intercropping, cover crops, integrated pest management, and green manures are the most commonly used methods in larger commercial systems. These practices are used to promote sustainable intensification. Tea and coffee plantations in the tropics, and vineyards and orchards in temperate zones, provide examples of these practices. In most of these cases, the change from monocultural to more complex cropping may entail transition costs, and sometimes trade-offs or profit losses in the initial years. But after the initial transition, farmers have found that the shifts are profitable and ecologically sound.

67. One of the main features of modern commercial agriculture has been the risks associated with the introduction of genetically modified organisms and alien species into the environment. These issues are addressed in Articles 8(g) and 8(h), respectively. Article 8(g) urges each Party to establish “or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health.” Considerable progress has been made in this respect with the finalization of the Technical Guidelines on Biosafety formulated by the United Nations Environment Programme (UNEP). Decision II/5 of the second meeting of the COP asked UNEP to finalise the guidelines. The third meeting of the COP will discuss this matter. The second meeting of the SBSTTA is considering these issues related to capacity building for biosafety.

68. The issue of alien species is addressed in Article 8(h), under which each Party is called upon to “prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”. This issue has already been addressed by the COP in relation to marine and coastal biological diversity, but may require special attention in connection with agricultural biological diversity. This is mainly because modern agricultural production relies heavily on the introduction of alien species. These issues are addressed under Article 8 of the Convention and should be pursued as one of the main causes of the loss of biological diversity. The results of the UN/Norway Conference on Alien Species, held under the auspices of the Trondheim Conferences on Biodiversity in July 1996, provide a suitable basis for a comprehensive approach to the issue.

3.3 Ex situ conservation

69. The Fourth International Technical Conference on Plant Genetic Resources held in June 1996 in Leipzig, Germany, dealt extensively with the ex situ conservation of plant genetic resources for food and agriculture. The Global Plan of Action (GPA) adopted by the conference set out the following priorities for ex situ conservation: (a) sustaining existing ex situ collections; (b) regenerating threatened ex situ accessions; (c) supporting the planned and targeted collection of plant genetic resources for food and agriculture; and (4) expanding ex situ conservation activities. The GPA notes that existing collections are under serious threat due to the lack of funding and the deterioration of facilities, resulting in a backlog of accessions in urgent need of regeneration. The long-term aim is to develop an efficient and sustainable system with strong cooperation among national programmes and international institutions within the context of national sovereignty over plant genetic resources for food and agriculture.

70. The COP may wish to build on these priorities and extend the coverage to include the ex situ conservation of other components of agricultural biological diversity, including animal and microbial genetic resources. It should be stressed that in doing so, the Convention envisages in Article 9 that ex situ conservation is “predominantly for the purpose of complementing in-situ measures”. The Article puts particular emphasis on ex situ conservation “in the country of origin of genetic resources”. The need for providing financial support for ex situ measures is articulated in Article 9(e), which calls for “cooperation in providing financial and other support for ex-situ conservation ... and in the establishment and maintenance of ex-situ conservation facilities in developing countries”.

3.4 Sustainable use

71. Article 2 of the Convention on Biological Diversity takes the term “sustainable use” to mean “the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations”. In setting out the principles that guide the implementation of this objective, Article 10 of the Convention provides five central elements that need elaboration. These are: the integration of considerations of biological resources into national decision-making; the adoption of measures that avoid or minimise adverse impacts on biological diversity; the protection and encouragement of customary uses of biological resources; support to local communities to implement remedial action in degraded areas where biological diversity has been reduced; and encouraging cooperation between the public and the private sectors in promoting the sustainable use of biological resources.

3.4.1 National decision-making

72. In promoting the sustainable use of components of agricultural biological diversity, the Convention expects each Party to integrate the conservation and sustainable use of biological resources of relevance to agriculture into national decision-making. This cannot be undertaken in isolation from the broader goals of sustainable development set out in Agenda 21, particularly Chapter 8, which outlines programmes for integrating environmental and developmental concerns into national decision-making.

73. In this chapter, Agenda 21 notes that the "prevailing systems for decision-making in many countries tend to separate economic, social and environmental factors at the policy, planning and management levels. This influences the actions of all groups in society, including Governments, industry and individuals, and has important implications for the efficiency and sustainability of development". The chapter suggests that an "adjustment or even a fundamental reshaping of decision-making, in the light of country-specific conditions, may be necessary if environment and development is to be put at the centre of economic and political decision-making, in effect achieving a full integration of these factors".

74. This integration can take place at the policy, planning and management levels. Such integration will need to be supported by effective legal and regulatory frameworks, as well as by the use of incentive measures (which include economic instruments and market and other incentives). Finally, agricultural biological diversity will need to be featured prominently in the systems of integrated environmental and economic accounting needed for the implementation of sustainable development.

3.4.2 Minimising adverse impacts and remedial action

75. Article 8(f) calls upon the Parties to "rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies". Unsustainable agricultural practices have resulted in ecosystem impacts such as soil erosion and water pollution, which threaten biological diversity. It is estimated that about 25% of the world's cropland is affected by soil erosion. However, a number of measures can be effective in reducing these problems.

76. Advances in integrated pest management (IPM) are providing new opportunities for reducing the use of chemicals while maintaining high yields. There is a significant increase in the use of IPM in industrialised and developing countries. A number of Asian countries, including Indonesia, the Philippines and Bangladesh, have successfully applied IPM, and others are learning from their experiences. Similar IPM successes have been recorded in Peru, Mexico and Cuba.

77. Revegetation is emerging as one of the ways of managing the impacts of agricultural production. Revegetation may be a slow process, involving trials with different species and microenvironmental conditions. The evidence available on this process is patchy and more work needs to be done to document the available examples and their implications for the conservation and sustainable use of agricultural biological diversity. Revegetation activities may have a number of economic and social trade-offs.

3.4.3 Customary use and traditional cultural practices

78. Over generations, local communities have evolved customary practices that are compatible with the conservation and sustainable use of agricultural biological diversity. The need to give legitimacy to such practices is articulated in Article 10(c) of the Convention, which requires each Party to "protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements". This provision recognises the close link between customary practices and the sustainable use of biological diversity. There are numerous examples around the world that support this view. It can indeed be

further argued that many traditional rituals, beliefs and myths are related to the links between cultural evolution and biological diversity.

79. This provision needs to be considered in conjunction with Article 8(j) as well as Articles 18(4) and 17(2), which deal with different aspects of the knowledge, innovations and practices associated with indigenous and local communities. So far, the COP has not considered the subject of traditional and customary practices that are compatible with conservation or sustainable use requirements. Implementing this Article will require that issues of “compatibility” and “conservation and sustainable use requirements” be given careful consideration.

3.4.4 Cooperation between government and the private sector

80. The COP is starting to consider the issue of agricultural biological diversity at a time when most governments are putting more emphasis on private-sector activities. In promoting policy reforms that create space for market-based activities, governments are also conscious of the importance of encouraging cooperation between governmental and private- sector activities. The Convention, in Article 10(e), calls upon each Party to “encourage cooperation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources”.

81. The field of agricultural biological diversity offers numerous examples of cooperation between governmental authorities and the private sector. In many countries the ministries of agriculture have worked closely with the private sector, especially through the provision of infrastructure, extension services, credit and other inputs necessary for the effective functioning of the agricultural sector. As many countries redefine the role of state institutions, the nature of cooperation between governmental authorities and the private sector will also change. Each country will therefore be expected to design modes of interaction that are consistent with national realities.

82. One of the areas that might require closer cooperation between governmental and private-sector activities is the promotion of under-utilised crops and breeds. It may be possible to consider introducing technology-cooperation programmes that deal specifically with such crops and breeds. Other areas that may require such co-operative programmes may include the development of “green products”, involving the production of crops using low external-input agriculture. The COP may wish to explore ways of providing incentives to encourage the private sector to contribute to the implementation of the Convention through the development of new technologies (including biotechnologies) that promote the transition towards sustainable agriculture.

3.5 Fair and equitable sharing of benefits

3.5.1 Access to genetic resources

83. The issue of access to genetic resources is a central theme in the Convention. Indeed, the Convention is largely a basis for relating access to genetic resources on the one hand, and access to technology on the other. Article 15(1) sets out that “the authority to determine access to genetic resources rests with the national governments and is subject to national legislation”. However, the Convention did not intend such legislation to hinder access to genetic resources and called upon each Party, in Article 15(2), “to create conditions to facilitate access to genetic resources for

environmentally sound uses by other Contracting Parties and not to impose restrictions that run counter to the objectives of this Convention". The arrangements for such access are deemed to be "on mutually agreed terms" and "subject to prior informed consent of the Contracting Party providing such resources, unless otherwise determined by that Party".

84. The Convention, in Article 15(6), calls upon each Party to "endeavour to develop and carry out scientific research based on genetic resources provided by other Contracting Parties with the full participation of, and where possible in, such Contracting Parties". The COP has given priority to the issue of access to genetic resources and a number of relevant decisions have already been adopted at its first and second meetings. Equally relevant is the work of the SBSTTA on the valuation of biological diversity (see document UNEP/CBD/SBSTTA/2/9).

85. The field of agricultural biological diversity lends itself to different kinds of approaches related to the issue of access to genetic resources. The interdependence of the international community on a limited number of species of relevance to food and agriculture is being discussed under the FAO and the results of such discussions will be considered at the third meeting of the COP. Other proposals have also been put forward on how the issue of interdependence could be handled. These proposals include the Multilateral System of Exchange (MUSE) developed by the International Plant Genetic Resources Institute (IPGRI).

86. In addition to these proposals, many countries are now in the process of formulating legislation regarding access to genetic resources in general (UNEP/CBD/COP/2/13). It is too early to assess how these initiatives will affect agricultural biological diversity. In this regard, the COP, may wish to take into account recent activities related to access to genetic resources that are being carried out under the auspices of the Convention in various countries.

3.5.2 Development and transfer of technology, including biotechnology

87. The issue of access to and transfer of technology is a central aspect of the Convention. According to Article 16(1) of the Convention, each "Party, recognising that technology includes biotechnology, and that both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention, undertakes subject to the provisions of this Article to provide and/or facilitate access for and transfer to other Contracting Parties of technologies that are relevant to the conservation and sustainable use of biological diversity or make use of genetic resources and do not cause significant damage to the environment".

88. For purposes of realising this goal, this Article needs to be read in conjunction with Article 18(2), which calls upon each Party to "promote technical and scientific cooperation with other Contracting Parties, in particular developing countries, in implementing this Convention, inter alia, through the development and implementation of national policies. In promoting such cooperation, special attention should be given to the development and strengthening of national capabilities, by means of human resources development and institution building". As requested by the COP at its second meeting, the clearing-house mechanism for promoting scientific and technical cooperation envisaged in Article 18(4) is being developed and a pilot phase has already been launched.

89. The COP has made the issue of technology development and transfer, as envisaged under Articles 16 and 18, one of the main items on the agenda. However, consideration of this issue has so far been on general principles that are yet to be linked to a particular sectoral application. The field of agricultural biological diversity offers opportunities for the COP to propose ways of consolidating the

work that is currently being undertaken on the issue of technology and to relate it to agricultural biological diversity. Such an effort would build on the work already being undertaken by a wide range of international institutions and the private sector.

90. The COP way wish to consider establishing a working group to explore the prospects of promoting a major international initiative on Articles 16 and 18 with specific reference to agricultural biological diversity. Such an effort will need to build on the work currently underway in institutions such as the FAO, the World Bank, the CGIAR, UNESCO, UNIDO and many other international institutions. Such an initiative would also need to be linked to the current work of the COP on incentive measures for conservation and sustainable use as envisaged in Article 11.

3.5.3 Benefit-sharing

91. The implementation of the third objective of the Convention, regarding the fair and equitable sharing of the benefits arising from the sustainable use of genetic resources, poses a number of operational difficulties. The other two objectives are based on terms that are clearly defined by the Convention. The fourth meeting of the COP will be considering this issue in detail. One of the issues that might need to be considered then is the operational definition of the "fair and equitable sharing of the benefits".

92. Some of the operational elements are stated in Article 19. Article 19(1) states that each "Contracting Party shall take legislative, administrative or policy measures, as appropriate, to provide for the effective participation in biotechnological research activities by those Contracting Parties, especially developing countries, which provide the genetic resources for such research, and where feasible in such Contracting Parties." Furthermore, the Convention calls upon each Party to "take all practicable measures to promote and advance priority access on a fair and equitable basis by Contracting Parties, especially developing countries, to the results and benefits arising from biotechnologies based upon genetic resources provided by those Contracting Parties. Such access shall be on mutually agreed terms".

93. Agricultural biological diversity offers opportunities for elaborating on the concept of benefit-sharing. This is mainly because of the high level of interdependence among nations on a narrow range of plant genetic resources for food and agriculture. A number of proposals have been put forward on how to maintain this system of interdependence and give it legitimacy under the Convention on Biological Diversity. Progress on this front, however, will depend on the extent to which the COP is able to elaborate the concept of "benefit sharing" and it give it operational value and, where appropriate, to confer upon it the necessary normative standards.

94. The COP might be able to offer ideas of how benefit-sharing in the field of agricultural biological diversity can be advanced, especially in the context of partnership as well as scientific and technical cooperation. In addition to the various partnership programmes implemented by most industrialised countries and international organisations, there are numerous efforts in this field that have been launched by the private sector to promote scientific and technical competence among developing countries. The concept of benefit-sharing can therefore be given operational value through the sharing of experiences in the field of agricultural biological diversity.

3.5.4 Handling biotechnology

95. Handling biotechnology as part of the sharing of benefits arising from the use of genetic resources has been a subject of much debate under the Convention. This issue is of particular relevance to agricultural biological diversity because of the potential benefits that can be derived by developing countries from modern biotechnology. Article 19(3) requires the Parties to "consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity".

96. The Open-ended Ad Hoc Working Group on Biosafety established by the second meeting of the COP in decision II/5 seeks solutions to the concerns associated with safety in biotechnology "through a negotiation process to develop in the field of the safe transfer, handling and use of living modified organisms, a protocol on biosafety, specifically focusing on transboundary movement, of any living modified organism resulting from modern biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity, setting out for consideration, in particular, appropriate procedure for advance informed agreement". The outcome of the process will be of relevance to agricultural biotechnology, especially in light of the growing interest among developing countries in investing in new technologies for agricultural production.

IV. SCIENTIFIC, TECHNICAL AND TECHNOLOGICAL CONSIDERATIONS

4.1 Assessments of the status of agricultural biological diversity

98. The COP may wish to start its work on agricultural biological diversity by requesting the SBSTTA to initiate a selected number of assessments of the status of agricultural biological diversity. A number of international institutions such as the FAO have already carried out a series of relevant assessments. However, the SBSTTA has already begun a process to review of these assessments in order to identify relevant gaps and the nature of the work that should be carried out under the Convention. Recommendation I/2 made a number of observations about the importance of assessments in implementing the provisions of the Convention. This meeting of the SBSTTA may be considering the issue in more detail under the item 3.1 and 3.2 of the provisional agenda, The Notes prepared by the Secretariat to support the consideration of these items provide further detail (see documents UNEP/CBD/SBSTTA/2/2 and UNEP/CBD/SBSTTA/2/3). For purposes of promoting sustainable agriculture, the SBSTTA may wish to consider carrying out work on the identification and classification of agricultural systems in order to understand their implications for the conservation and sustainable use of biological diversity.

99. The SBSTTA may wish to initiate, in close cooperation with the relevant international organisations, the process of identifying and monitoring components of agricultural biological diversity. The SBSTTA may wish to recommend that such efforts be linked to the consideration being given to Article 7 of the Convention, which deals with identifying and monitoring components of biological diversity. Annex I of Article 7 deals with ecosystems and habitats as well as species and communities of agricultural or other economic value. Such an effort could be linked to the work of the FAO as identified in the GPA, as well as the work of the IPGRI.

100. Under the GPA, the FAO will seek to identify, locate, inventory and, as feasible, assess any threats to those species, ecotypes, cultivars and populations of plants relevant to food and agriculture, especially those that are of anticipated use. Annex I of Article 7 of the Convention on identifying and monitoring components of agricultural biological diversity also deals with the description of genomes and genes of social, scientific and economic importance. The SBSTTA may wish to support work in the field of genetic mapping and promote the development and transfer of technology in this field. This effort can build on the initiative under the GPA to characterise available genetic resources so as to facilitate their use.

101. Most accessions in gene banks have not been adequately characterised and evaluated. According to the GPA, plant “breeders and most other users are interested in having a manageable number of genotypes that possess or are likely to possess the traits needed in their breeding programmes. Identification of those traits through characterisation, and the establishment of core collections (a subset selected to contain the maximum available variation in a small number of accessions), are measures that can encourage greater and more efficient use of collections. Evaluation can also aid identification of germplasm of potential for more direct use by farmers”. This initiative can complement the work of the COP in the implementation of Article 7.

102. The SBSTTA may also wish to consider biodiversity assessment in areas such as animal and microbial genetic resources to complement the work that is current being undertaken by the FAO. In carrying out these assessments, the SBSTTA may wish to take into account the work on animal and microbial genetic resources being undertaken by the FAO, UNESCO, UNEP and the World Federation of Culture Collections (WFCC), among others. The SBSTTA may also wish to take advantage of the cooperation between the Secretariat of the Convention on Biological Diversity and other biodiversity-related conventions to recommend further cooperation between these bodies in their assessment efforts.

4.2 Assessments of the effects of types of policy measures

103. The COP has started to promote certain policy measures aimed at promoting the implementation of the Convention. These measures are reflected in the decisions so far taken by the COP at its last two meetings. It is too early yet to assess the effectiveness of the types of measures so far taken under the Convention. However, an important measure in this regard will be the identification of indicators that might be used to assess the effectiveness of the types of measures taken under the Convention. Indicators in general have been considered in some detail in document UNEP/CBD/SBSTTA/2/4. The SBSTTA may also consider indicators under item 3.3 of the provisional agenda. The SBSTTA may wish to consider focusing their work on indicators thematically in order to better support their work in this area.

104. In furthering the development of such measures, the COP may wish to promote the sharing of experiences in the effectiveness of measures taken under other conventions and relevant international programmes with the view of assessing the usefulness of such measures for the Convention. Such sharing of experiences could be limited to measures taken under those conventions that deal with issues related to agricultural biological diversity. This work could be undertaken by the SBSTTA as part of its work on the effectiveness of measures taken under the Convention.

105. One of the issues that could be considered by the COP is the sharing of experiences in the application of certain incentive measures for the conservation and sustainable use of agricultural biological diversity. The basis for this is provided in the consideration by the third meeting of the

COP of Article 11 of the Convention on Biological Diversity on incentive measures. The sharing of experiences in incentive measures may provide the COP with indications of the effectiveness of measures that could be taken under the Convention.

4.3 Identification and transfer of state-of-the-art technologies

106. The COP has so far maintained the issue of technology development and transfer on its agenda. The discussions have focused on general considerations of technological capacity building. The current consideration of agricultural biological diversity by the COP provides an opportunity to focus discussions on technology development and transfer on a specific area of interest to the majority of the Parties. The guiding principle here is that agriculture has been a source of a large number of environmental concerns. However, many of the solutions to these concerns are technological in character and could be addressed through concerted efforts involving cooperation between governmental, non-governmental and private-sector actors.

107. Such efforts are already envisaged in Article 10(d), which calls upon each Party to “encourage cooperation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources”. Emerging technologies of relevance to sustainable agriculture may require special attention from governments and the private sector in a way akin to the efforts now being made under the Montreal Protocol to reduce the use of ozone-depleting substances. Technologies that reduce the use of potentially harmful substances should be identified through the compilation of inventories to enable the COP to establish how to promote their diffusion.

108. Already, there are a number of “orphan technologies” developed by the private sector that possess novel traits and that can be used in the sustainable intensification of agriculture in developing countries. Such technologies, often associated with the use of modern biotechnological techniques, have yet to be identified and promoted through mechanisms that encourage public and private-sector cooperation.

109. There are a number of areas of technological development that could lend themselves to such international cooperation. The first is the general area of using emerging technologies for improving and promoting the use of under-utilised or marginal crops. The other area that has received little attention is that of the application of bioremediation technologies. These may include the use of biotechnology-based solutions for the conservation and sustainable use of biological diversity. Such technologies may include the genetic characterisation of strains of micro-organisms that can be used as inoculants for restoring lands that have been degraded through intensive cropping.

110. The SBSTTA may wish to consider how it could support the third meeting of the COP consideration of such issues. For example, it could start the process of identifying state-of-the-art technologies of relevance to agricultural biological diversity and to suggest ways to promote their transfer and further development. Such studies should also take into account the provisions of Articles 20 and 21 of the Convention regarding financial resources and mechanisms. In addition, the inventories should also take into account the role of the private sector in the development and diffusion of technologies. In this respect the SBSTTA may therefore wish to recommend that its work under item 3.5 of the provisional agenda be focused on technologies specifically relevant to agriculture.

4.4 Scientific programmes and international cooperation in research and development

111. There are numerous scientific programmes and international cooperation arrangements in research and development of relevance to the conservation and sustainable use of agricultural biological diversity. Many of these programmes are administered through the various United Nations agencies as well as other international and regional organisations. The COP may wish to identify some of these programmes through relevant surveys and to determine the kinds of guidance that could be given to them so they can be more supportive of the objectives of the Convention. The work of the CGIAR and other activities under the auspices of the FAO form a suitable basis for such support from the COP. The SBSTTA may wish to consider how it might provide scientific and technical guidelines to the COP on identifying relevant processes.

112. There are, however, other activities that are the subject of on-going international negotiations that deserve the continued support of the COP. For example, the GPA is an important initiative that may need to be supported by the COP. Other initiatives need to be identified and given support. For example, the work carried out under the auspices of a number of international institutions to promote low external input agriculture, especially IPM, deserve the support of the COP. One way that the COP wish to consider supporting such activities is through the provision of scientific, technical and technological advice. The SBSTTA may therefore wish to consider whether there are any particular areas where such advice and support from the Convention is appropriate.

113. The COP may also wish to consider linking the work on agricultural biological diversity directly to the provisions of Articles 16 and 18 of the Convention on technology development and technical cooperation, especially in the context of joint ventures and joint research activities. There are a number of scientific programmes and co-operative arrangements of relevance to the provisions of Articles 16 and 18 of the Convention. In addition, such considerations could be pursued in the context of capacity building arising from international cooperation in research and development. In light of the consideration of item 3.5 of the provisional agenda on technology transfer the SBSTTA may wish to consider how it could support the COP consideration of linking these areas of work.

114. The COP may wish to adopt measures to encourage the private sector to contribute to the implementation of the Convention through the development of new technologies (including biotechnologies) that promote the transition towards sustainable agriculture. The COP may wish to promote the establishment of industry-based technical working groups to contribute to the identification of technologies that promote the conservation and sustainable use of biological diversity.

V. OPTIONS FOR ACTION

115. On the basis of the above assessment and the issues raised in this note, the SBSTTA may wish to consider:

(a) Elaborating activities in the field of agricultural biological diversity taking into account the outcomes of the 4th International Technical Conference on Plant Genetic Resources as well as other activities undertaken by other international institutions. The activities may include:

(i) undertaking scientific, technical and technological assessments on the status of agricultural biological diversity, especially in the less-documented areas such as animal and microbial biological diversity;

(ii) developing and promoting technical guidelines for the conservation and sustainable use of agricultural biological diversity, as well as criteria and indicators for sustainability in agriculture;

(iii) identifying indicators for assessing the effectiveness of measures taken under the Convention for the conservation and sustainable use of agricultural biological diversity as well as indicators and criteria for sustainability in agriculture;

(iv) identifying and assessing, in conjunction with the private sector, technologies of relevance to sustainable agriculture, and the promotion of partnerships for technology cooperation and benefit-sharing;

(v) compiling case studies and sharing experiences in the field of low-external-input agricultural production systems and making such information widely available, including through the clearing-house mechanism;

(vi) adopting measures and incentives that encourage the private sector to develop and transfer environmentally sound technologies relevant for the conservation and sustainable use of biological diversity; and

(b) Further supporting the efforts currently underway to revise the International Undertaking on Plant Genetic Resources and to request that the results of the effort be submitted to the COP for consideration as soon as possible.

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[1] This figure excludes many of those domesticated by traditional and indigenous communities (UNEP, 1995).
[2] UNEP (1995).
[3] UNEP (1995), Global Biodiversity Assessment, p. 744.
[4] Hammond (1996).
[5] FAO (1996c).
[6] FAO (1996c).
[7] IFOAM (1994).
[8] Plucknett & Horne (l992), Smith (l996).
[9] Scherf (1995).
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[11] FAO (1996c).
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[13] WRI (1994).
[14] IPGRI (1996).