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IMPLICATIONS OF NEW BIOTECHNOLOGIES FOR THE INTERNATIONAL UNDERTAKING

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I. INTRODUCTION

1. "New biotechnologies" is a portmanteau term, covering a wide range of techniques, including plant tissue culture, microbial and plant gene manipulation, the production of monoclonal antibodies, protoplast fusion and other methods of crossing distant species, the sequencing of protein and nucleic acids, and the *in vitro* synthesis of secondary metabolites and pharmaceuticals; it is widely believed that such biotechnologies will be the technical force most affecting world agriculture over the next two or three decades.

2. Biotechnology offers, or promises to offer, techniques to considerably speed up plant breeding and control breeding processes more precisely; most significantly, it makes possible the transfer of genetic material between unrelated species. There are thus significant possibilities for the more efficient use of the world's genepool. At the same time, these techniques might allow the better conservation of genetic resources in some instances.

3. The new biotechnologies will not replace the more traditional methods of crop improvement, but will complement them. It should be clear that, although different methodologies may be used, the same raw material, or germplasm, will provide the building blocks for plant improvement, whether by classical plant breeding, modern biotechnologies, or, more commonly, a combination of both. The International Undertaking on Plant Genetic Resources, which was adopted by the FAO Conference in 1983, aims to provide a mechanism to ensure the safe conservation of these plant genetic resources and to guarantee their free exchange.

4. Developing biotechnologies have several implications for the implementation of the principles contained in the Undertaking, and for the conservation and exchange of genetic resources in general. The type of impact these biotechnologies have will result both from their intrinsic nature, and from the social and economic context in which they are applied, disseminated and commercialized.

5. This first report on various technical aspects of the new developments in biotechnology, which makes preliminary observations on some legal implications which these may have for the implementation of the principles contained in the International Undertaking on Plant Genetic Resources, is not intended to be exhaustive, and it may need to be followed by others on the same subject at subsequent sessions of the Commission.

II. BIOTECHNOLOGY AND THE CONSERVATION OF PLANT GENETIC RESOURCES

6. One of the most basic features of the new agricultural biotechnologies is the culture of plant cells, tissues and organs in artificial media, *in vitro*, so as to stimulate them to grow into whole plants. Such tissue cultures can he stimulated to regenerate whole plants, a technique often referred to as "micropropagation", which opens a whole range of new possibilities for plant breeding and the conservation of genetic resources, because it makes possible the quick vegetative propagation of plants that would otherwise be difficult to multiply, or which, like trees, take a long time to reach sexual maturity.

7. *In vitro* techniques open up many possibilities for the conservation of plant genetic resources. The currently most widely used method for conserving genetic resources in genebanks is seed storage, but, for a number of crop species, seed storage is difficult or impossible: the domesticated cultivars of some species, such as banana, do not produce seed; there are species, such as most of the temperate fruit trees, that produce highly heterozygous and segregating seed, and others, such as cocoa, that produce "recalcitrant" seed which quickly degenerates under normal genebank storage conditions.

8. To circumvent these difficulties, tissue culture techniques are being developed for germplasm collection and conservation. For example, CIAT, in Colombia, is now establishing a collection of cassava clones, and holds about 3 000 accessions *in vitro*. CIP in Peru is working to transfer its potato and sweet potato germplasm to tissue culture. In several national biotechnology programmes, tissue culture is being applied to the conservation of other crops; by 1984, it had already been used to propagate various species of more than 40 families of ornamentals, vegetables and fruits, not to mention orchids, where *in vitro* preservation and propagation have long been practiced. Because of the great promise that *in vitro* techniques hold for the conservation of germplasm, IBPGR has recommended the further development of *in vitro* conservation techniques for important and difficult-to-store crops, including cassava, sweet potato, banana, coconut and cocoa.

9. Apart from allowing the storage of germplasm that cannot normally be stored as seed, tissue culture makes possible the elimination of viral pathogens and the virus-free storage of the germplasm of crops, such as potato, that otherwise have many viral problems; there is the additional advantage that the risk of the introduction of pests and diseases by germplasm exchange is greatly reduced. Other techniques derived from recent developments in immunology (monoclonal antibodies) and recombinant DNA research (nucleic acid hybridization probes) will greatly facilitate testing for viruses, and thereby speed up quarantine operations which often slow down the movement of

genetic resources.

10. There are, however, some serious limitations to, and dangers in, the *in vitro* conservation of germplasm. It is now widely accepted that genetic modification can occur during the process of tissue culture; the phenomenon, called "somaclonal variation", derives from changes in the plant's genomes, chromosomes, genes, cell organelles, and so-called epigenetic changes. In celery, for example, some 30 percent of the plants regenerated by tissue culture have been reported to show striking differences to the mother plant from which the tissues were cultured. The mechanisms leading to somaclonal variation are not yet fully understood, so it is not known whether somaclonal variation can be controlled; it could therefore limit the practical use of tissue culture for the *in vitro* conservation of germplasm. However, because somaclonal. variation is more prevalent in unorganized cultures, such as protoplasts, cells and callus, it can be avoided, or greatly reduced, by concentrating on shoots, meristems and embryos. Shoot cultures are generally the system of choice for conservation, and practical considerations lead to the use of slow growth conditions so that culture transfer intervals can be extended to between one and two years. A number of institutes, including CIP, CIAT and IITA use slow growth for their collections of root and tuber crops. CIAT, in collaboration with IBPGR, is testing standards for *in vitro* genebanks, using cassava as a model.

11. In addition to the storage of shoot cultures in slow growth, another useful biotechnology for the conservation of germplasm is cryopreservation, that is storage in liquid nitrogen at -196 degrees Celsius. This method is routinely used in microbiology and animal husbandry, and has already been successfully applied to a number of plant species. It permits the safe storage of genetic material almost indefinitely.

III. BIOTECHNOLOGY AND THE UTILIZATION OF PLANT GENETIC RESOURCES

12. If tissue culture techniques offer possibilities for the conservation of plant genetic resources, the prospects in the field of germplasm utilization are even more promising. Tissue culture, alone or combined with such techniques as the electrophoresis of isozymes and other proteins and the RFPL (restriction fragment length polymorphism) analysis of nucleic acids, can speed up plant selection, evaluation and breeding, especially with slow-maturing crops. Tissue culture might reduce the time necessary to develop a new oilpalm variety by a factor of thirty. Although there' are as yet few concrete examples, the advantage of screening germplasm in culture for desired traits, rather than having to wait until the plant grows out, is obvious, and the somaclonal variation that occurs in tissue cultures, while a disadvantage for the conservation of germplasm, is a potentially useful tool for the plant breeder interested in crop

genetic variation.

13. Two very powerful genetic engineering techniques are protoplast fusion and direct gene transfer, which enable scientists to overcome species barriers and cross species that could never cross sexually. It has also become possible directly to insert selected genes from other plant and animal species and microbiota into cultivated plants by using bacterial plasmids and viruses as vectors. However, although protoplast fusion and direct gene transfer open the possibility of bridging all existing gene pools, these techniques are still in their infancy, and formidable technical problems must be solved before they can be widely applied.

14. Other important techniques, are the in vitro culture of gametes, mainly through anther culture, that permit varietal improvement through the rapid production of homozygous diploids, and induced mutation in cell or tissue cultures in vitro, which can produce useful genetic variants: the latter technique is of special value in the case of asexual crops, or crops that are difficult to breed sexually.

15. It must be stressed that these techniques do not create genetic diversity at gene level, except perhaps in the cases of favourable somaclonal variation, although they do so at genotype level by rearranging and transferring existing genes and gene complexes across the natural barriers that have limited traditional breeding efforts. They nonetheless increase the potential and value of the world's existing plant germplasm, further underlining countries' interdependence in this matter, and the need for conservation and free exchange of genetic resources which FAO promotes.

16. At present, the most practical application of biotechnology to plant production is by cloning genotypes, that is, vegetatively propagated crops such as strawberry, oilpalm and cocoa, in which a selected genotype can be rapidly and economically multiplied into hundreds of thousands of identical individuals ready to be transplanted to the farmer's field.

IV. BIOTECHNOLOGY AND THE FREE EXCHANGE OF PLANT GENETIC RESOURCES

17. Article 1 of the FAO Undertaking which aims to ensure that plant genetic resources are freely available for plant breeding and scientific purposes, will perhaps be the most affected by the new biotechnologies. This article is the most controversial part of the Undertaking, as it includes "special genetic stocks" and finished varieties within its ambit. A number of industrialized countries have expressed difficulty in accepting this, as their national legislation provides for proprietary rights to crop varieties through the recognition of plant breeders' rights; on the other hand, many developing nations have argued that as such

varieties derive largely from germplasm which originated within their boundaries, these genetic resources should be freely available.

18. In this context, the FAO Commission on Plant Genetic Resources, at its Second Session in 1987, considered the Concept of "farmers' rights", that is, the formal recognition of the important role that the farmers of the developing countries have historically played in the conservation and development of germplasm. A number of countries expressed the view that this concept would parallel and complement plant breeders' rights. The Commission suggested that the International Fund for Plant Genetic Resources, established by FAO in 1987, might provide a mechanism which could help to realize the farmers' rights to benefit directly from the increased agricultural production resulting from varietal improvement.

19. Plant breeders' rights, as they exist in many industrialized countries, recognize the breeder's monopoly for a limited period over the new crop varieties he produces, subject to the following important limitations: these rights cover only the variety in question, and not the genetic material it contains, so that any breeder may use the germplasm of a protected variety to develop a new one; and farmers may use the harvest from protected seed for their next years' sowing. Furthermore, plant breeders' rights do not protect the breeders' techniques per se.

20. The emerging biotechnologies could put a severe strain on the system of plant breeders' rights as their products lend themselves to more absolute forms of proprietary protection, especially industrial patenting. Breeders using direct gene transfer and similar techniques have an interest in legally protecting genes and gene complexes themselves, rather than the finished crop varieties. To afford such protection, industrial "utility patents" have been extended to plants, and even animals, in some industrialized countries. This more restrictive regime recognizes the legal ownership of single genes, gene complexes, genetic characteristics and specific techniques used to produce new crop varieties. In contradistinction to plant breeders' rights, industrial patents prevent plant breeders using each others' varieties freely, as part of the germplasm contained in these varieties has been recognized as anther's exclusive property. To be able to use patented material or techniques, the plant breeder must obtain a license from the patentee; in some countries, the patentee has the right to refuse such a license. Patenting also makes it illegal for farmers to sow seed they have harvested from varieties that contained patented material.

21. The extension of industrial patents to plants and animals in some industrialized countries is recent and highly controversial. In 1980, the Supreme Court of the United States of America first ruled that man-made living organisms were patentable (Chakrabarty case); in 1985, the United States' Board of Patent Appeals specifically ruled plants patentable. The first plant patent was

granted in 1986 (Hibberd case) and the first animal patent in 1987. The Commission of the European Communities is currently preparing a Community directive on patenting that embodies similar concepts, the European Patent Office granted its first plant patent in 1988.

2.2. A crucial difference between industrial patents and plant breeders' rights is that the former may afford considerably broader protection including proprietary rights over characteristics. A case in point is the Hibberd patent, which was granted for a maize seed, plant or tissue with an increased tryptophan content: in another case, the American biotechnology company, Sungene, was granted a patent for a sunflower variety with a high oleic acid content, thereby protecting a special characteristic, and not specific genes. Both cases might he interpreted to mean that a patent holder could prevent others from undertaking competing research, even though different genes were involved, and other techniques used.

23. Another factor that must be considered is that there will be a tendency for the more commercially valuable patented genes and gene complexes to accumulate in new varieties. This implies that increasing royalty payments will be required from breeders, which they will recoup through higher prices to be paid by the farmer and ultimately the consumer. The higher costs may weaken the competitiveness of small breeders and companies.

24. Not only is it possible that private companies will be unwilling to share their proprietary genetic material with public sector plant breeders, but public breeders will hesitate to share their material with the private sector, because of a fear that it may become private property through patent, and therefore unavailable to other breeders, thus undermining public sector seed production and distribution.

25. It is clear that plant patenting has serious implications for the Undertaking's objective of ensuring the free exchange of plant genetic resources. If the patenting of genetic material or plant characteristics is widely accepted in the industrialized world, then part of the germplasm contained in all categories of plant genetic resources listed in Article 2.1.(a) of the Undertaking could be subject to proprietary protection.

V. SECONDARY EFFECTS OF BIOTECHNOLOGY ON PLANT GENETIC RESOURCES AND AGRICULTURAL DEVELOPMENT

26. The new biotechnologies are also likely to affect genetic diversity for a number of social and economic reasons. One important factor is that the advent of the new biotechnologies may well result in more private sector participation, particularly by large international firms, in international agricultural research than was the case during the "green revolution" of the 1950s to the 1970s.

27. In terms of the market, the major current demand for improved seeds is in the developed economies, and there presently seems to be less commercial interest on the part of large companies in selling seeds to the developing countries than there was in the early 1980s. The next decade, however, will probably see a renewed interest in this market as technical problems are solved, and as market saturation for the products of the new biotechnologies occurs in developed economies.

28. The commercialization of biotechnology has increased the impetus for large chemical and pharmaceutical companies to diversify into agricultural biotechnology and to purchase seed companies. Seed companies are attractive because they provide marketing outlets and expertise in seed production and plant breeding, and the sale of seeds promises to be a major source of profit from the new biotechnologies. Moreover, the synergy that is likely to develop between the agricultural and nonagricultural (pharmaceutics, energy, chemicals) applications of the new biotechnologies will further increase the tendency for large international companies working on the latter applications to diversify into plant breeding and seed production.

29. Current plant genetic engineering activities aim to produce not only pest and disease resistance in agricultural crops, but also tolerance of herbicides. Research is well advanced in programmes to introduce virus resistance genes in crops; to produce pest-resistant cultivars through the incorporation of a Bacillus thuringensis gene: and to introducing genes that confer resistance to the herbicide, glyphosate. Herbicide-resistant crops are expected to be among the first commercially available genetically engineered plants, which some feel will lead to an intensified herbicide use.

30. With the increased proprietary rights over germplasm and the growing role of the private sector in plant improvement, there is likely to be an increasing genetic uniformity in cultivars and the development of cultivars with very wide adaptation. Moreover, biotechnology makes it possible to develop homozygous varieties more rapidly. Although genetic engineering can make better use of the available genetic diversity, by transferring genetic material. between species, the same techniques could result in increased genetic uniformity, if a limited number of genes of major commercial interest are bred into commercial varieties of a large number of different crop species.

31. Uniformity may also result from the spread of hybrid varieties. Industry is currently financing a good deal of biotechnological research for the commercial production of hybrid seeds of some major crops; the development of hybrid varieties is especially attractive, because proprietary protection is biologically enforced, since the seeds harvested by the farmer are not suitable for sowing. On the other hand, biotechnology may permit the multiplication of hybrid genotypes through cloning in tissue culture without having to buy fresh hybrid seed from the

owners of the parental lines for each planting. It remains to be seen if this technique will prove to be economically valuable for the developing countries.

32. Biotechnology is also making it possible to produce substitutes for certain tropical commodities in the laboratory. An example is vanilla flavouring, on which some 70,000 farmers in Madagascar alone depend. Efforts are also underway to produce cocoa butter either in factories, or from crops other than cocoa in the field. The substitution of sugar by biotechnologically produced sweeteners is also a major research thrust.

33. Shifts in cropping patterns due to an altered climatic adaptation of certain temperate and tropical crops, together with increased yields and decreased costs of production, may also seriously effect the current agriculture commodities trade, to the detriment of the developing countries in the tropical zone. Some commentators have drawn the conclusion rather dramatically: for example, the European Economic Community's Proposal for a Research and Development Programme in the Field of Science and Technology for Development (1987-1990) states:

> "Recent major advances in biotechnology pose a new threat to the Third World.
>
> Thanks to biotechnology it will gradually become possible to replace tropical agricultural commodities such as palm oil or manioc with products grown in the Community and other industrialized countries.
>
> This could considerably upset agricultural commodity markets and spell disaster for Third World countries dependent on them if nothing is done."
>
> In order to prevent a further widening of the gap between North and South, therefore, no time must be lost in developing tropical biotechnology so that the developing countries can benefit from the advances being made in this field." (COM(86) 550 final/2 of 17 November 1986, which lead to Council Decision 87/590/EEC of 14 December 1987.)

34. In developed countries, the most controversial aspects of biotechnology policy relate to environmental and health regulations, particularly for the field-testing, and release into the environment, of genetically engineered organisms and plants. It is generally recognized that there is a lack of scientific data on such environmental risks, and the regulations adopted so far have generally reflected a necessary caution. Nonetheless there is as yet no international agreement covering this subject, and countries that fail to adopt adequate regulatory policies may become increasingly attractive as sites for firms and other entities that wish to test genetically modified organisms and plants in ways which are forbidden in their home countries.

VI. THE NEED FOR APPROPRIATE BIOTECHNOLOGIES FOR CONSERVATION OF GERMPLASM

35. There is no doubt that the new biotechnologies hold much promise for increased production and for support to the development of sustainable agriculture for the small farmer in the often marginal agroecosystems of the developing world. Some researchers, particularly in universities and public institutions, are already working to develop such appropriate biotechnologies. There is great potential, though little has been yet concretely achieved. It is important, however, not only to directly address these problems, but to be aware of the possible effects of research generally.

36. There is a growing recognition that the research community should take into account the impact its discoveries are likely to have, and should consider the possible social and economic consequences of new technologies when formulating research priorities and goals. The new biotechnologies should be evaluated for this impact both on the long-term security of the world's plant germplasm, and on the farmers and citizens of the developing countries.

37. The new biotechnologies in themselves neither favour nor disfavour the maintenance of continued genetic diversity, but, depending on by whom, for whom, and how they are developed and employed, they may affect continued diversity. Moreover, it is evident that not all nations will have equal access to the new biotechnologies; even leaving aside questions of proprietary ownership, some are very capital-intensive, and difficult to disseminate to the developing countries.

38. Most research on plant engineering has been carried out in the developed countries and has concerned crops for which there is a good potential market. As this is not the case of tropical staple foodcrops, they have tended to be neglected, as the likely returns on investment do not appear to the private sector to justify substantial research expenditure; ways should therefore be sought to ensure that these crops benefit fully from the new technologies.

39. If the major result of the introduction of plant biotechnologies were increased product uniformity and the large-scale commercial dissemination of uniform and widely adapted cultivars, then the new biotechnologies would increase genetic erosion. If greater effort is put into raising productivity in response to increased levels of agricultural inputs, rather than producing varieties exhibiting greater stability and tolerance in the context of the environmental stresses of marginal agroecosystems, small farmers of developing countries are likely to be disadvantaged, and may be unable to preserve the wide range of germplasm for which they are currently responsible. If this happens, humanity in general will in the long term be the final loser.

40. In recent years, biotechnologies that address mainly the needs of the developed countries, that are capital intensive, and that favour large-scale genetic homogeneity, have received by far the greatest attention. It is now important, and in the general interest, to promote the development o f new appropriate biotechnologies which take into account the needs of the small farmer. These technologies should be applicable on a small scale, and usable by the scientific personnel and the public and private sectors of the developing countries.

41. Above all, it is imperative to ensure that the new biotechnologies support the development of sustainable agriculture in the developing countries. This means an agriculture that does not degrade the local environment, and that is not dependent on high levels of expensive and often imported agricultural production inputs. In such a context biotechnology can, for example, contribute to the development of more pest-resistant varieties and thereby reduce the need for pesticides. It will be necessary for such biotechnologies to be developed in the areas in which they will be used, since they must, in each case, be appropriate to the ecosystems, crops and cultural practices, and the needs of the society in question.

42. If developing countries are to increase their capacity to utilize the new biotechnologies, they will need to increase substantially the skills of their scientific communities and acquire new scientific equipment. Cooperation between developing countries, and between developing and developed countries, will be crucial, as it will not be possible for a single country to cover its research needs entirely. International cooperation will also be essential for the transfer of these technologies, through training, to the developing countries. Strategies must be identified that enable the scientifically best-endowed countries to make the optimal use of their research capacity and to enable the least-endowed to expand their ability to make use of research undertaken elsewhere. This might be done within the framework of the International Undertaking on Plant Genetic Resources, through the kind of cooperative arrangements envisaged in its Article 7.

43. In the current state of world agricultural development, and given the rapidity of genetic erosion, and the incompleteness of international efforts to preserve plant germplasm in genebanks and formal in situ systems, the small farmer growing traditional crops under marginal conditions, and with a low level of inputs., has an important role to play, and is making an important contribution to the world's long-term agricultural potential. Thus far, the biotechnology industry has not generally borne the costs of conservation of germplasm that is the basis of their breeding efforts: these costs, which are considerable, are usually underwritten by the public sector and, above all, by the rural population existing on traditional subsistence in areas of high genetic diversity.

44. Farmers in the developing world at present maintain a great

deal of genetic diversity within their traditional farming systems. It is in the interest of all, including the private sector in developed countries to assist these countries to develop and apply biotechnologies appropriate to their needs. These should increase their crop production in a sustainable manner, while at the same time conserving their rich and continually evolving inheritance of genetic resources, to the benefit of present and future generations. The International Fund for Plant Genetic Resources may provide a mechanism to channel such assistance to where it is most needed, in support of the programmes proposed by the Commission.

45. It is possible that the products of the new biotechniques may seriously upset the stability of the current world trade in agricultural commodities. In such cases, measures must be taken) to buffer the weaker tropical. economies in the period of transition, until they too can benefit fully from technical advances in this field.

VII. IMPLICATIONS OF THE NEW BIOTECHNOLOGIES FOR SPECIFIC ARTICLES OF THE INTERNATIONAL UNDERTAKING ON PLANT GENETIC RESOURCES

46. The proliferating new agricultural biotechnologies have a number of major implications for specific articles of the Undertaking on Plant Genetic Resources.

47. Because of its increased commercial potential, many industrialized countries will not find it acceptable to consider plant germplasm, including special genetic stocks, as humanity's common heritage, and hence freely exchangeable. The new biotechnologies may make it yet more difficult for such countries to accept Article 1 (and Articles 2. 1(a)(v) and 5) of the Undertaking.

48. It remains to be seen whether the new biotechnologies will change the social and commercial context of the exchange of plant genetic resources sufficiently to require amendments to the Undertaking, but it does not seem that this will be necessary, as the Undertaking, as currently formulated, promotes the widest possible free exchange of plant genetic material between all areas of the world. An agreed interpretation of specific articles may be sufficient to cope with the changing situation.

49. A further question is whether Article 2.1, in which plant genetic resources are defined, adequately covers the genes derived from non-cultivated plants (or even micro-organisms or plants) that will become more important with the advent of the new biotechnologies. The article defines plant genetic resources traditionally as the cultivated varieties, obsolete cultivars, primitive cultivars, wild and weedy relatives, and special genetic stocks of crop plants; it does not specifically cover the genetic materials of the nontraditional plant species from which

particular gene sequences may become more important to plant breeding as a result of the new biotechnologies. Nonetheless, Article 2.2, which states that "this Undertaking relates to the plant genetic resources ... of all species of economic and/or social interest, particularly for agriculture at present or in the future, and has particular relevance to food crops", appears to be sufficiently broad to fully subsume such nontraditional species within the ambit of the Undertaking. However, it should be kept in mind that the new biotechnologies are increasingly allowing non-plant genes to be incorporated in plants, and that the latter do not seem to be covered by the Undertaking. The genepools of species, genera, families and kingdoms can now be bridged: increasingly, all biological diversity can be considered as a single genepool.

50. The rapid development of the new biotechnologies has implications for the international arrangements for the implementation of the Undertaking envisaged in its Article 7, which must be interpreted to take these advances into account. In particular, the international network of base collections covered in Article 7.1(a) should also now cover in vitro germplasm storage, and gene libraries; the global information system referred to in 7.1(e) should also include information on the development of the new technologies themselves; and the early warning system mentioned in 7.1(f) should also cover potential threats and hazards resulting from unexpected harmful effects of the introduction of genetically modified plants and microorganisms. It will be important to ensure that arrangements are made for developing countries to be able to adopt and develop valuable new biotechnologies for germplasm of especial interest to them, especially through training.

51. With the development of transgenic plants and micro-organisms, many questions regarding proper legal controls for their testing and release into the environment have been raised, and controversies have occurred in a number of countries. It has been suggested that Article 10 of the Undertaking, which bears on phytosanitary measures, might be interpreted to cover the release of transgenic plants and micro-organisms.

Conclusions

52. The new biotechnologies are powerful tools that can he made to serve a variety of priorities and goals. They hold considerable promise of increased efficiency in the conservation and utilization of plant genetic resources, thereby potentially facilitating the realization of the principles contained in the International Undertaking. There is uncertainty about their possible effects on the current world balance of agricultural production and trade. It is likely that the new technologies will be used largely in developed countries: it should therefore be a deliberate priority for the international community to foster the development of appropriate technologies to ensure that tropical staple crops, and the small farmers that grow them, also benefit

from scientific advances in this field. In terms of the International Undertaking, there are challenging legal, social, economic and political implications, but these can be dealt with within the framework of the International Undertaking, though agreed interpretations of certain articles may be needed to cover specific new developments.

53. FAO will, within the limit of its resources, closely monitor new biotechnological developments and their implications, in particular, for developing countries: it will report on such matters to the Commission. FAO will also assist developing countries to identify possibilities for profiting from new biotechnologies, and to acquire those necessary, and will promote international cooperation to this end, as envisaged by Section II of the Undertaking.