

**FAO International Technical Conference
on Plant Genetic Resources**

**CONSERVATION AND
SUSTAINABLE UTILIZATION OF
PLANT GENETIC RESOURCES IN
INDIAN OCEAN ISLANDS**
Sub-Regional Synthesis Report

**Annex 1 of the Report of the
Sub-Regional Preparatory Meeting for
Eastern Africa and Indian Ocean Islands,
Nairobi, Kenya
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This Sub-Regional Synthesis Report was endorsed by the Sub-Regional Meeting for Eastern Africa and the Indian Ocean Islands, Nairobi, Kenya, 12-14 September 1995, preparatory to the FAO International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17-23 June 1996, as a useful input for the preparation of the Report on the State of the World's Plant Genetic Resources. It constitutes Annex 1 of the Report of the Preparatory Meeting. The Report is being made widely available by FAO as requested by the International Technical Conference.

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I. INTRODUCTION

A. The Sub-region and Its Agricultural Sector

1. The Indian Ocean African Islands region referred to in this report consist of five tropical countries: Madagascar, the largest island in the region, the Seychelles archipelago comprising between 90 and 100 islands, the Federal Islamic Republic of Comoros consisting of three major islands (Grande Comores, Anjouan and Mohéli), the Mascarene islands made up of the Independent Republic of Mauritius which also includes Rodrigues island and the French Departement, Réunion island. All these countries lie between 4 degrees and 27 degrees south of the equator in the western part of the Indian Ocean and covers a total land area of some 591,500 km² (Appendix 1).

Agricultural sector

2. Agriculture has a major role to play in the economy of the countries of this region. Madagascar, Rodrigues and Comores are heavily dependent on agriculture with 80 to 83% of their labour force engaged in agricultural activities (Appendix 1). The other islands, Seychelles, Mauritius and Réunion have more diversified economies, but agriculture still remains an important sector. In Mauritius and Réunion, sugar cane is the principal cash crop grown, occupying around 88% of cultivable land in Mauritius and 65% in Réunion. Other export crops, in Mauritius, include cut flowers, fruits, pineapples, vegetables, as well as tobacco, vanilla and coffee in small quantities. In Réunion, perfume plants (*geranium* and *vetiver*), vanilla and tobacco are mostly exported. A diverse range of crops is grown for local consumption in both countries. The Seychelles offer a quite different agricultural perspective due to its large number of small low rising islands except for the granitic islands of Mahé and Praslin, which limits its agricultural potential. The Seychelles used to have an agro-economy based on copra, cinnamon, vanilla and clove exports. Agricultural development is solely in the hands of the private sector and produces 60% of the national consumption in fruit and vegetables. The rest has to be imported.

3. Among the countries of the region, Madagascar has the greatest agricultural potential in view of the diverse agro-climatic zones which exist in this country. Nevertheless subsistence agriculture in the form of the "tavy" (slash and burn agriculture) is generally practised by the population, leading to serious erosion problems which threatens the country's agricultural potential. Rice is the staple food and is cultivated by 80% of the farmers. Several wild varieties are found on the island. Some of the other most important crops cultivated are cassava, maize, cowpeas, coffee and beans (*Phaseolus*). Vanilla and coffee are the two main cash crops of the country with vanilla as the



country's primary source for foreign currency. Madagascar is also an important centre of diversity for coffee. More than 50 wild coffee species, belonging to the *Mascarocoffea* section, are endemic to the island.

4. Similarly, Comoros has depended to a large degree on the export of specialised agricultural crops chiefly vanilla, cloves, coconuts and ylang ylang which occupy about 37% of the arable land. Like Madagascar the peasants rely on subsistence agriculture to meet their basic needs in food. A wide range of subsistence crops are grown: taro, bananas, sweet potato, yams, cassava, maize, groundnuts, pigeon pea, cowpea, green grams, sorghum and millets (Kamau, 1987).

Forest resources

5. The region possesses a rich diversity of forest resources in terms of endemic species of timber such as ebony, rosewoods and others as well as medicinal plants and other forest products. These resources are steadily and rapidly diminishing due to extensive conversion of forest land to agricultural uses. In Madagascar alone 200,000 to 300,000 hectares of forest disappear every year due to slash and burn agriculture practices. During the last 300 years, the native forest areas on Mauritius and Seychelles have declined to occupy between 2 and 10% of the total land area and the situation is much worse in Rodrigues and Comoros, where practically no native vegetation is left. Much of the existing native vegetation in the region is seriously being threatened by invasive introduced species.

6. In all the countries, reforestation efforts have been made to replace the cleared forest areas. But the forest plantations were made largely from imported exotic species like *Pinus* spp., *Eucalyptus* spp. and *Casuarina* spp. in Mauritius and Madagascar; *Cinnamomum zeylanicum* and coconut in Seychelles. Mangroves, another type of forest which thrives in the coast area of most of the islands of the region, are important sources of wood for fuel and building materials for local inhabitants. In the region they are particularly abundant along the west coast of Madagascar, east of Mauritius and around many islands of the Seychelles. Some mangroves also exist around the coast of Réunion.

B. Plant Genetic Resources of the Sub-region

7. In the Indian Ocean African Islands region, with the exception of coffee, there are no endemic crop species of great economic importance. With a few exceptions, all the cultivars to be found in the region, be they food crops or industrial plants of value, have been introduced, principally during the past century, from which local landraces have evolved. The following describes



some of the most important crop genetic resources in the region, principally local varieties, land races and cultivars.

Coffee

8. The region of Madagascar and neighbouring islands (Mauritius, Comoros and Réunion) is the centre of diversity for wild coffees belonging to the group of *Mascarocoffea*, characterised by the absence of caffeine in the beans. Most interspecific diversity is found in Madagascar with about 50 species, three species occur in Mascarene and one in Comoros. There is also a wild form of *Coffea canephora* believed to have been introduced to Mauritius from Uganda by the early plantation workers in the nineteenth century (Damania, 1985). Coffee was grown in Réunion and Mauritius in the eighteenth century and the well known Bourbon variety of *Coffea arabica* originated in Réunion island.

Sugarcane

9. A form of sugar cane, *Saccharum spontaneum* (Spontaneum Mauritius), is known to occur in the wild in Mauritius (Ramdoyal and Domaingue, 1995), but it is believed to be close to the Coimbatore local from India (Stevenson, 1940).

Rice

10. In respect to rice, Madagascar has a good diversity of rice germplasm. Local varieties are of the type *indica* and *javanica*. There exist also some wild varieties of rice such as *O. longistaminata* and *O. punctata*.

Leguminous crops

11. Two wild species of *Vigna* (*Vigna vexillata* and *V. angivensis*) grows spontaneously in Madagascar. In Mauritius, *Phaseolus glabreus*/*Vigna glabreus* Roxburg is believed to be unique in its kind and has been used in the breeding of cowpea (*Vigna unguiculata*). Also two wild forms of broad bean (*Phaseolus lunatus*) were identified in Mauritius and Rodrigues.

12. Among beans (*P. vulgaris*) two landraces, local red and navy bean, are still cultivated in Rodrigues, while in Mauritius, there is an old cultivar known as Long Tom. Similarly, there is one old cultivar of cowpea, Long yard bean (*Vigna unguiculata* cv *sesquipedalis*).

13. Several indigenous types of legumes have been reported in Comoros (Kamau, 1987). These include four types of Pigeon pea (*Cajanus cajan*), one type of Cowpea (*Vigna unguiculata*) and green grams (*Phaseolus aureus*) and four types of leaf vegetables.

Maize



14. In Mauritius and Rodrigues, Some 41 ecotypes of maize (*Zea mays*) were collected by the MSIRI in 1970, 1980 and 1985, in an attempt to preserve the germplasm and to use them in breeding programmes. In Comoros one indigenous type of maize (Tama la Kingazija) has been reported (Kamau, 1987).

Vanilla

15. Vanilla is believed to have been introduced in the early part of the nineteenth century to Réunion island. From there, it has been distributed to Seychelles, Madagascar, Comoros and Mauritius. Wild varieties of Vanilla are known to occur in Madagascar and Seychelles.

Root crops

16. Many old cultivars of sweet potato (*Ipomoea batatas*) and cassava (*Manihot esculenta*) still exist in Mauritius. Six different indigenous types of sweet potato have been reported from the Comoros (Kamau, 1987).

Other crops

17. Several local varieties of onion, *Allium cepa*, are known; the "local Red" in Mauritius and "Chateauvieux" and "Véronique" in Réunion.

18. In tomato (*Lycopersicum esculentum*), one species *L. esculentum* var. *tallerelli* has been located in the wild in Mauritius and one wild type in Comoros (Kamau, 1987). Two species of egg plant (*Solanum* spp) are found in the wild in Mauritius - *Solanum torvum* having white flowers and *S. indicum* having violet flowers. *S. auriculatum* is also found in the wild in Mauritius.

Fruit crops

19. Among fruit trees, 62 cultivars of mangoes (*Mangifera indica*), 3 cultivars of litchis (*Litchis sinense*), and 18 cultivars of banana (*Musa* spp.) are grown in Mauritius. In addition, many old cultivars are still grown, some for commercial exploitation and some just form part of the local landscape, e.g. Jack fruit, Bread fruit etc. A wild species of pineapple, *Ananas bracteatus*, and wild banana, *Musa perrieri* in Madagascar and "banane la grain" in Mauritius can also be encountered in the region. In Madagascar, fruits from local trees such as *Uapaca bojeri*, *Adansonia* spp., *Terminalia*, *Strychnos*, *Physalis* and *Opuntia* are local fruit genetic resources used by the local inhabitants.



Indigenous forest genetic resources

20. The region as a whole has one of the most diverse flora in the world, particularly Madagascar which has been considered as one of the seven major world centres of biodiversity (IUCN, 1992). The species richness of the region is provided in Table 1.

Table 1: Species richness and endemism in higher plants

Country	FP	GP	Ferns	Endemic	% Endemic
Comoros	600	1	60	136	18.9
Madagascar	8,000 - 10,000	5	500	5,000 - 8,000	68.4
Mauritius	700	0	178	329	37.5
Réunion	750	0	240	175	17.7
Seychelles	1,139	1	500	250	15.2

Source: World Conservation Monitoring Centre, 1992

FP = Flowering plants; GP = Gymnosperms

21. The indigenous flora of the region consists of many potentially useful species. In Madagascar, some 20 forest species are exploited for their timber; these include *inter alia*: *Dalbergia spp.*, *Commiphora spp.*, *Cedrelopsis grevei*, *Manilkara louvelii*, *Eugenia spp.*, *Ocotea spp.* In the other small islands, few indigenous forest species are utilised commercially, although many of them undoubtedly have very good timber characteristics, once providing some of the finest timber in the world, e.g. *Diospyros spp.* (Ebony), *Mimusops spp.* (Makaks). The reason for this is because most of the indigenous forest species of the islands have been reduced to such small populations due to heavy exploitation during their colonisation period, that there cannot be any sustainable utilisation of these species any more. Nevertheless on Réunion some native species *Acacia heterophylla*, *Mimusops spp.* and *Labourdonnaisia spp.*, are managed for timber production. The following provide a list of some of the native species which constitute important forest genetic resources in the region, due to their good timber characteristics: *Elaeodendron orientale*, *Stadtmannia oppositifolia*, *Diospyros spp.*, *Mimusops spp.*, *Securinega durissima*, *Foetidia mauritiana*, *Sideroxylon spp.*, *Labourdonnaisia spp.*, *Acacia heterophylla*, *Camptosperma seychellarum*, *Vateriopsis seychellarum*, *Drypetes riseleyi*, *Dillenia feruginea*, *Northea hornei*, *Hernandia nymphaeifolia*, *Hertiera littoralis*, *Syzygium wrightii*, *Instia bijuga*, *Calophyllum inophyllum*, *Canarium madagascariensis*, *Terminalia mantaly*, *Khaya madagascariensis*.



22. Many plants are also used medicinally in all the islands. Some 20% of the indigenous plants in Madagascar are used in traditional medicine, while in Mauritius and Rodrigues 600 plants have been inventoried as being medicinal and aromatic. In the Seychelles, 75 species of plants are used medicinally. Many of these plants are endemic to the region. A study in Madagascar has revealed 52 aromatic plants representing 19 families, of which 31 species are cultivated and 21 species are naturalised. In addition there are 62 indigenous species representing 26 families which constitute a unique genetic stock of aromatic plants. Many of these plants are used commercially; the most commonly used and exported plants include *Catharanthus roseus*, *Drosera madagascariensis* and *Centella asiatica*. Both in Comoros and Réunion island there are several aromatic plants which are exploited, but none of them are indigenous to these countries. These are principally, ylang ylang (*Cananga odorata*), geranium (*Pelargonium*) and the vetiver (*Vetiveria* sp.). A wide diversity of indigenous plants in Réunion have medicinal values and are exploited, often illegally and to the detriment of the flora, by local inhabitants.

23. Much of the indigenous plant genetic resources of the region are considered as threatened. The list is too long to be included here. The reasons for the native flora of the various islands being endangered are quite varied. Perhaps the most common factor to all of the countries in the region is the invasion of introduced species which are displacing the native species in their natural habitats. The alien species differs from island to island: *Ligustrum robustum*, *Psidium cattleianum* and *Hiptage benghalensis* in Mauritius, *Cinnamomum zeylanicum* and *Albizia falcataria* in Seychelles, *Rubus alceifolius*, *Solanum auriculatum*, *Lantana camara* in Réunion. The clearing of forests for shifting cultivation, the collection of firewood, burning to provide for pasture land and excessive collection of plants either for medicines or ornamental trade, are some of the main causes of destruction of the native flora, particularly in Madagascar and Comoros.

II. ASSESSMENT OF PGR PROGRAMMES AND ACTIVITIES

A. National Programmes, Policies and Legislation

24. In all the countries of the region there are no national programmes *per se* for the conservation and utilisation of plant genetic resources, but each department or institution may have a policy and programme, which partly addresses the conservation of plant genetic resources. The goals of each institution differ from one another depending upon their mandate. In most countries, PGR activities are widely spread between different ministries and



institutions. In general the responsibility for PGR issues falls under Ministries of Agriculture, as in the case of Mauritius and Seychelles or Ministry of Research and Development in the case of Madagascar. In most countries, there are a number of National Research Institutions, Universities and Non-governmental Organisations which carry out activities related to PGR.

25. In Madagascar, the main institution engaged in PGR work is FOFIFA, the National Centre for Research and Development, attached to the Ministry of Applied Research and Development. It has several departments of which the Department of Agronomic Research, Rice Research Department and the Department of Forestry and Fisheries Research are mostly involved with PGR activities. Other departments such as "Direction des Eaux et Forêt", "Centre National d'Application des Recherches Pharmaceutiques", and the "Centre National de la Recherche" are also involved.

26. In Mauritius, the responsibility for plant genetic resource activities falls under the Ministry of Agriculture and Natural Resources. The Mauritius Sugar Industry Research Institute (MSIRI), the Food and Agriculture Research Council (FARC) and the University of Mauritius are also involved in PGR activities. The Ministry is presently re-structuring its Agricultural Service, with the creation of a Directorate of Agricultural Research and Extension (DARE). This new unit has recently been transferred under the FARC, whose objective is to promote research in agricultural fields including PGR and especially in the use of biotechnology. DARE is still in its initial stages of development, but is setting up a section which will be responsible for PGR activities. They are presently elaborating on a working plan which will include the conservation and characterisation of some key crop for which they are mandated, in particular, banana and pine apples. However, the Agricultural Services is still involved in PGR albeit on a small scale. The MSIRI is mostly involved with sugarcane germplasm for which it holds a collection. In line with the diversification policy of government, it also undertake research on some other crops which are grown interlined in sugarcane fields, in particular maize, groundnuts and potatoes.

27. There is, in general, a lack of coordination between all the institutions involved in PGR activities. One means of catalysing cooperation and interactions between them has been the holding of National Plant Genetic Resources Workshops. To date, only two countries in the sub-region, Mauritius and Madagascar, have held national workshops, each sponsored by IPGRI. In Mauritius no national programme specific to plant genetic resources exists as yet although recommendations were made to develop one at the national workshop on the subject in 1993 (Dulloo & Dulyamode, 1995). The same has been the outcome of the Malagasy national workshop held recently at Mantasoa (February 1995). In Madagascar, however, a commission consisting of three Ministries has been set up to study and



examine all research programmes pertaining to the conservation of flora and fauna, but not specifically plant genetic resources issues. A new committee, COBIO ("Comité d'Orientation et de suivi de la politique de gestion sur la Biodiversité"), is in the process of being ratified by the Malagasy Parliament and will replace the tripartite commission. Madagascar is also setting up an Environmental Action Plan with the help of the World Bank, and is developing a national monograph on the status of biodiversity in the country.

28. Most of the countries of the region have developed National Conservation Strategies aimed principally at conserving their natural resource base. In Mauritius a National Conservation Strategy was developed in 1985 based on the World Conservation Strategy (Ministry of Agriculture, Fisheries and Natural Resources, 1985). This strategy is presently being reviewed with the help of UNEP and the Biodiversity Convention secretariat for the preparation of a National Biodiversity Strategy and Action Plan. It has also an approved forest policy, under which the state forest estate is managed. It aims inter alia to reserve forest areas which will supply in perpetuity all forest produce required by the people for agricultural, domestic and industrial purposes, and to plan cooperatively with other land interests for the successful management of the forest estate (Forestry Service, 1990). With the help of the World Bank, the Mauritian Government has developed a National Environmental Action Plan (NEAP) covering all the key sectors of the country. A White paper on National Environment Policy and a comprehensive Environment Investment Program (EIP) to address the key issues of the NEAP have been developed (World Bank, 1990). One of the components is to set up the country's first National Park (Black River Gorges National Park) to conserve endangered endemic species of flora and fauna; FAO carried out the feasibility study for the setting up of the National Park and the project was subsequently funded by World Bank. Also, with the assistance of UNDP, Mauritius has initiated a National Long-Term Perspective Study (NLTPS) which seeks to look into the development prospects of the country in 2020.

29. In Seychelles, the government produced its white paper on conservation policy in 1971, stating that examples of natural habitats must be preserved for the people of the Seychelles, and that appropriate areas should be protected and developed for public recreation and enjoyment. It further mentioned several national parks that were to be given priority, and listed several areas deserving of protection. The White Paper was replaced in 1990 by the Environmental Management Plan (IUCN, 1992).

30. In some of the countries of the region, particularly in Mauritius and Madagascar there is a strong involvement of NGO's in the implementation of national conservation activities. In Mauritius, the government has signed a memorandum of agreement with a number of international NGO's (the Jersey



Wildlife Preservation Trust (UK), Peregrine Fund (USA), World Wide Fund for Nature (WWF), Kew Garden, Flora and Fauna Preservation Society) and the local NGO Mauritian Wildlife Appeal Fund (MWAF). These organisations are committed to the funding and execution of many conservation projects on the island. Similarly, in Madagascar there are l'Office National sur l'environnement (ONE), L'Association Nationale pour la gestion des aires protégées (ANGAP), Le WWF, l'Association Nationale pour l'aménagement de l'environnement (ANAE), Conservation International and others, which are involved in *in situ* conservation activities.

National legislation

31. Although none of the countries under review have specific national legislation with regard to plant genetic resources, there are a number of laws and decrees that protect areas of conservation value. In Madagascar several decrees provide for the creation of protected areas and for designation of land within the forest domain and thereby protect the wild indigenous plant genetic resources they contain. These are Decree No. 60-242 of 1966, Decree No. 58-07 of 1958, Decree No. 62-371 of 1962 and Décret Forestier du 25 Janvier 1930. In Mauritius, the *Forest and Reserves Act 1983* and the *Wildlife and National Parks Act 1993* are the main pieces of legislation which provide for the protection of the flora and fauna of the island and the creation of protected areas. In the Seychelles, a National Parks and Nature Conservancy Ordinance (1969) and a Forest Reserves Ordinance (1955) provide protection to a network of protected areas and forest areas. The second ordinance also gives complete protection to woody vegetation and to forest produce on the islands.

32. There are also in all the countries stringent quarantine regulations. In Madagascar, the law relative to quarantine, "Loi 86-017 of 1986", provides regulations for the importation and exportation of plant material and its products, including plant genetic resources. The Mauritius National Plant Protection Legislation is embodied in the *Plants Act 1976*, presently being reviewed. Provisions of the Act are in line with the recommendations of the International Plant Protection Convention (Rome, 1951 as subsequently amended in 1977) of the FAO, to which the country is signatory. In the Seychelles as well there are strict quarantine laws in force. All the countries allow the transfer of clean plant material from the phytosanitary point of view, and there is no restriction on the importation and exportation of *in vitro* plant material. Although quarantine laws are very stringent, there are uncontrolled introductions of various plant materials, particularly in Madagascar where law enforcement in the country is a major problem and the control of plant introduction is difficult in view of the large size of the island.



33. None of the countries has any laws relating to Intellectual Property Rights, although in Madagascar, the question is being considered. It is believed that the absence of such laws is prejudicial to developing countries not only in relation to the preservation of their genetic resources per se but also to the research accomplished by nationals. Further the traditional knowledge on plants possessed by local people are often exploited to the benefit of foreign companies who then hold patents for particular plant produce. The countries in general feel that the rights of their people to their traditional knowledge on indigenous plants have to be safeguarded. They strongly adhere to the concept of 'Farmers Rights' and argue that a workable system should be worked out for farmers and peasants with traditional knowledge on use of indigenous plants to obtain royalties from the exploitation of plant genetic resources that they have helped to conserve over many generations.

Exchange of germplasm

34. There are no policies governing the exchange of germplasm in any of the countries. Exchange is effected on a case by case basis. Each institution may have its own exchange programme depending on the nature of the plant genetic resources on which they are working. For example, in Mauritius, the current policy, with regard to noble canes, is to encourage a free exchange of basic species and commercial varieties on a reciprocal basis between cane breeding stations. In the Seychelles there is no networking and exchange, but the Seychelles works in close collaboration with Tropical Agricultural Institutions from where they derive much of the materials they require. Plant materials are generally exported freely as long as demands can be met. In Madagascar, also plant materials are usually exported freely with bilateral arrangements, but such exports are effected according to specific criteria set up by the authorities.

35. There is no legislation which restricts the planting out of imported genetic resources and no incentive is given to farmers for the conservation of traditional varieties. In general, farmers conserve their own genetic resources and are encouraged to do so by government extension workers.

36. There is no legislation that governs sale and distribution of seeds, except in Madagascar where a law on seeds is in the process of being ratified by the Malagasy Parliament. This legislation provides for the promotion of effective activities in the production and commercialisation of quality seeds and for the control of national trade.



B. Sub-regional Programmes and Networks and International Collaboration

37. In the sub-region, there has been a number of regional initiatives to protect the biological resources of the countries of the region. The five countries of the sub-region (Comoros, Madagascar, Mauritius, Seychelles and Réunion) constitute the Indian Ocean Commission, whose aim is to promote the socio economic development in the sub-region. The IOC has initiated a number of regional projects. Mention can be made of the EDF-IOC PLARM project on medicinal and aromatic plants and the Indian Ocean Regional Environment project which has a major component on the preservation of the threatened plants of the region.

Table 2: FAO programme activities in the sub-region

Project Code	Countries	Project title
UNDP/MAG/87/001	Madagascar	Promotion des cultures Oléagineuse
TCP/SEY/2252/T	Seychelles	Improved vegetable production
TCP/COI/4451/A	Comoros	Floriculture tropicale
UNDP/MAG/82/016	Madagascar	Assistance au service semencier pour l'organisation et la coordination de la production semencier
UNDP/MAG/84/015	Madagascar	Assistance au service de la quarantaine végétale
UNDP/MAG/86/003	Madagascar	Projet de renforcement au service semencier pour l'organisation et la coordination de la production semencier
UNDP/MAG/86/005	Madagascar	Projet de développement agricole intégré de la région du lac Itasy
UNDP/MAG/87/003	Madagascar	Réhabilitation des plantations de caféiers et de poivriers dans la région Toamasina
TCP/MAR/0152/T	Mauritius	Mushroom production
TCP/MAR/86/002	Mauritius	Assistance to agricultural sector



38. All the countries of the sub-region are members of FAO but only Madagascar and Mauritius are members of the FAO Commission on Plant Genetic Resources and have adhered to the International Undertaking on Plant Genetic Resources. The representation for FAO in the sub-region is located in Madagascar. FAO has assisted countries in various projects, some of which have plant genetic resources components. Table 2 provides a list of FAO projects in the region.

39. Most of the countries have good working relations with a number of International Agricultural Research Centres, in particular IITA, CIP, CIAT, CIMMYT, ICRISAT, IPGRI, INIBAP, ICRAF and AVRDC. It is felt that the CGIAR centres should become more active in farming and research in genetic engineering. The countries also hope that IPGRI with its new mandate, will work with FAO to ensure that the world's genetic resources will become more readily available to developing countries and that no individual developed country restrict germplasm flow or institutes morally unacceptable plant protection rights or barriers.

40. Mauritius and the Seychelles have been the first two countries in the world to have ratified the Convention on Biological Diversity and are fully committed to the preservation of the biological diversity of their respective countries. Mauritius is already collaborating with the Secretariat of the Convention on Biological Diversity to develop a National Biodiversity Strategy and Action Plan. Madagascar has yet to ratify this Convention. All three countries are also members to the CITES Convention and to the OAU Convention for the Protection of Nature and Natural Resources. Only Madagascar and Seychelles have ratified the Convention concerning the World Cultural and Natural Heritage and none of the countries are party to the Ramsar Convention on Wetlands of International Importance. Appendix 3 gives a summary of the status of international conventions and agreements to which the countries in the region are members.

41. In addition to cooperation with international organisations, some of the countries have developed bilateral relations with friendly countries. Mauritius, for instance have links with India for the free exchange of sugarcane germplasm between MSIRI and Coimbatore. Bilateral relations also exist with France (CIRAD) and China in the field of medicinal plants. Madagascar on its part has very strong relations with France (CIRAD and ORSTOM) and the USA (USAID).



C. Conservation Activities

In situ conservation

42. The predominant approach to *in situ* conservation is the reservation of natural areas in protected areas such as National Parks, Nature Reserve etc., where indigenous species often including wild relatives of crops receive protection. All the countries of the region, with the exception of Comoros, have a good network of protected areas. Table 3 gives below gives the number of protected areas set up in the five countries of the region. Seychelles has the largest percentage of protected areas relative to size in the region. In all the countries under review, there have been recommendations for additional sites of conservation interest to be included in the protected area system (Langrand, 1989; Bolton 1990, Stuart *et.al.*, 1990).

43. Within protected areas, there is a gradation of *in situ* techniques based principally on the degree of management. In Mauritius, for example, natural areas within protected areas are intensively managed. The management techniques used very much depend on the threats to the conservation areas in question. One common problem facing all the countries is the invasion of a wide range of exotic plants which are threatening the native species and degrading the natural ecosystems. The situation is particularly bad in Mauritius and the Seychelles. In order to alleviate the problem, Mauritius has set up intensive *in situ* conservation activities in designated Conservation Management Areas (CMA), established in the different vegetation types of the main island and on inshore islets.

Table 3: Number of protected areas in the Indian Ocean African islands

Country	NP	SNR	NR	OR	Total	% of land area*
Comoros	-	-	-	-	-	0.0
Madagascar	6	10		23	36	1.9
Mauritius	1		17		18	3.7
Réunion				2	2	0.2
Seychelles	6	1	1	3	11	30.0**

* Calculated from data contained in IUCN (1992). ** Estimated for land reserves only.
NP= National Park; SNR= Special Nature Reserves, NR= Nature Reserve;
OR= Other Reserves.

44. In the Seychelles, a programme has been drawn up for dealing with the problem of invasive plants, but no action has been undertaken yet. The Conservation and National Parks (CNP) of Seychelles is implementing a monitoring programme to explore the natural distribution of the endemic and threatened plant species of the granitic islands. Seychelles, however, lacks



expertise to document these resources and suggest that a consultant be appointed to document fully the natural plant genetic resources of the country.

45. In Madagascar, few *in situ* conservation activities have been undertaken. Established Reserves and Botanic gardens ensures the *in situ* conservation of its indigenous plant genetic resources. Forest study areas have been established in four vegetation types viz. forest of Mahatsara, Tampolo, Bezaha Mahafly and Marofandilia. In these areas seed germination, regeneration are monitored and some enrichment planting have also been undertaken.

46. A very different type of *in situ* conservation is on-farm conservation of local landraces and cultivars by farmers. This form of *in situ* conservation is possibly the most widely spread method of conservation of local PGR in the region. In spite of the efforts to increase their productivity by cultivating improved varieties, farmers carry out on-farm conservation of local varieties, land races and cultivars as for example rice, maize, tomatoes and beans, either as part of their tradition or as a security against the failure of introduced varieties offered to them by breeders. However, no formal on-farm conservation programmes have been established in the region.

***Ex situ* conservation activities**

Ex situ collections

47. The most important collections of international importance in the sub-region include the rice and coffee collection in Madagascar, sugarcane collection in Mauritius and the litchis germplasm collection in Réunion. The Seychelles also hold an important collection of tropical fruit trees mainly mangoes, avocado, guava, annona, banana, and passion fruit. Besides these each country holds working collections of a diverse variety of plant genetic resources. Table 4 provides a summary list of the main plants which are held in collections in the countries of the sub-region.

48. The major collections of crop genetic resources of the sub-region are held mainly by governmental and parastatal organisations. Some collections are also maintained by Universities. In Madagascar, the major conservation activities have been restricted to a few crops: rice, legumes, maize and coffee. Few collection trips have been undertaken. The participants at the national workshop held at Mantsoa in February 1995 were unanimous in saying that one of the priorities is to organise prospection missions for the key crops, in particular legumes, rice and coffee, as well as for some underutilised vegetables and local fruits. However some collections have been undertaken under the aegis of the FAO for rice, leguminous crops and coffee, following rigorous planifications: Systematic collection at farmers level for rice, sampling of



markets and in farmers fields for legumes and prospection in the wild for coffee.

Table 4: *Ex situ* collections in Indian Ocean African Islands sub-region

Countries	Crops
Madagascar	Rice, Wheat, Triticale, Oats, Barley, Maize, Cassava, Potatoes, Sweet Potatoes, Legumes, Cotton, Sugarcane, Coffee, Pepper, Vanilla, Fruit trees, Vegetables, Forage, and Aromatic plants
Mauritius	Sugarcane, Maize, Fruit trees (Mango, Banana, Litchis), Pineapple, Coffee, Cassava, Amaranthus, Allium, Brassica, Lycopersicon, Phaseolus and Solanum .
Seychelles	Tropical fruits (Mango, Avocado, Guava, Annona, Banana, and Passion fruit) and root crops (Sweet potatoes, Cassava, Yam and Taro)
Réunion	Maize, Sugarcane, Aromatic plants and Fruit trees including litchis, Avocado, Banana, Strawberry, Mango, Eriobotrya and Citrus spp.,

49. FOFIFA maintains most of its collection in the field at different agricultural stations throughout the country. The main living collection of food crops is located at CALA. In addition to the above, collections of other crops exist at Tamatave for pepper and fruit trees, Ilaka East for coffee, Tulear for cotton, Antalaha for vanilla and Ankivanja for coconut. Most of these collections are held under poor environmental conditions and this has led to a deterioration of the Malagasy germplasm. The main reasons for this state of affairs are: lack of financial resources, lack of qualified personnel, lack of adequate equipment, lack of maintenance of existing facilities and lack of transport. Other institutions which hold working collections of crop plants, include FIFAMANOR, a bilateral cooperation between Madagascar and Norway, mainly food crops (wheat, triticale and potatoes and sweet potatoes), and SMV "Service de multiplication des végétaux", mainly for seed production.

50. At the MSIRI, there is a sugar cane collection which contains 1,841 accessions, comprising of basic and allied species as well as commercial hybrids and F1, BC1, BC2 interspecific and intergeneric hybrids (Ramdoyal and Domaingue, 1995). This collection is presently threatened by diseases and it is important that ways and means be found to clean up the collection. It would then be desirable to conserve them by cryopreservation. Presently, the conservation activities of these *Saccharum* spp. and allied species are conducted exclusively by vegetative means, which makes them vulnerable to diseases. A few collections of fruit species are maintained on government



stations. These collections include mango (62 cv/ecotypes), banana (8 cv), pine-apple (3 cv), litchis (3 cv), coffee (13 cv) and cassava (18 cv). A small collection of bananas is also maintained by the Faculty of Agriculture University of Mauritius.

51. Several institutions (Ministry of Agriculture, FARC, MSIRI) have developed *in vitro* facilities principally for the large scale propagation of tissue cultured plantlets. The facilities could be used for short term or medium term storage of plant genetic resources. The MSIRI is investigating the feasibility of cryopreservation of sugar cane germplasm currently threatened by diseases. The field collection is also proving to be too expensive to maintain mainly because of lack of land and is very labour intensive.

52. A collection mission was carried out in Mauritius and Rodrigues by the Ministry of Agriculture and IPGRI and a total of 122 samples of various crops were collected and conserved in genebank at Barkly Experimental Station and 24 samples were despatched to the Royal Botanic Gardens Wakehurst Place U.K. for forwarding to designated IBPGR base collection (Damania, 1985). Further in 1989, a programme for the collection of wild species and land races was undertaken by the Agricultural Services. However, the programme was discontinued because the trained officers were transferred to other services. The programme has remained at a stand-still. However some 228 accessions have been collected and characterised. The samples are principally seeds of *Amaranthus* spp., *Allium cepa*, *Brassica* spp., *Lycopersicon esculentum*, *Phaseolus* spp., *Solanum* spp., and *Zea mays*. Due to staff limitations, these collections have been held in freezers and no germination tests, nor any regeneration work, have been carried out on these collections. The seed bank contain only samples of crop plants and there is no collection of any indigenous plant material. There is a need to develop a project for seed conservation of threatened native species. However, many aspects of seed conservation of these native species will need to be studied. There has been no research undertaken on the seed physiology and it is highly probable that many of these native species have recalcitrant seeds. There is an urgent need to carry out an inventory of plant genetic resources throughout country and this will help to identify gaps in the existing collection.

53. In the Seychelles the national plant genetic resources collection is composed essentially of two types of crops - tropical fruits and root crops. The collection is a living collection based at the Grande Anse Agricultural Research Station of the Ministry of Agriculture and Marine Resources. The total number of accessions is 263 of which 187 are of tropical fruits (mango, avocado, guava, annona, banana and passion fruit), and the rest are root crops (sweet potato, cassava, yams and taro). Among the fruits, over 100 varieties of mango and avocado mostly as introduced varieties are available. However, this



is not representative of the diversity existing in the field and there is a need to conduct more collection trips to obtain new varieties for their collection.

54. In Réunion, CIRAD manages working collections for a number of crops mainly maize, sugarcane, fruit trees and aromatic plants. CIRAD-CA maintains a maize collection of some 300 accessions, the evaluation of which has proved to be useful in the identification of varieties resistant to the maize streak virus. There is also a sugarcane collection composed of 732 clones. This collection was initiated in 1929 and the center imports many cultivars for their improvement programmes. Currently some clones are also conserved *in vitro*.

55. CIRAD-FLHOR has a large collection of fruit trees. Germplasm collections have been carried out in 10 species, namely: avocado, banana, strawberries, litchis, orange, mandarins, mango, *Eriobotrya*, peaches and other *Citrus* species. The collection of the Litchis germplasm was made under the aegis of IPGRI and is of international importance. CIRAD-FLHOR also maintains an important collection of aromatic plants. This department has all the facilities (laboratories and expertise) for the evaluation of essential oils in the aromatic plants of importance to the region. In collaboration with FOFIFA, Madagascar, CIRAD is involved in the maintenance and evaluation of the upland rice collection and is also engaged in various improvement programmes of broadleaf forest species, in particular *Eucalyptus*, *Acacia*, *Casuarina*, *Tectona*, and *Cedrela* (CIRAD/FOFIFA/FED project).

Storage facilities and regeneration

56. None of the countries in the sub-region hold a national genebank. There is, in general, poor storage facilities for the conservation of crops germplasm. Only the Rice Research Centre at Mahitsy, Madagascar, has a cold room which was funded by USAID. IRRI helped to establish this rice centre and IPGRI provided equipment for the cold store; but there are, presently, major problems with it. It operates at 18° C and between 40 and 60% RH. The centre has no seed dryers and are using a seed germinator with a dehumidifier inside to dry seeds. IPGRI and IRRI have both donated deep freezers, but both are not functioning normally. There are often electricity cuts and the facility lacks standby generators.

57. In Mauritius, a small facility exists for the storage of seeds at the required temperature and humidity at Ministry of Agriculture and Natural Resources. This includes basic cold room facilities, cabinets, driers and other equipment donated by IBPGR in 1986 to facilitate conservation of germplasm. However, for large scale collections, the existing storage facilities are not adequate; a more elaborate system has to be put into place to be effective. Sugar cane seeds obtained from intraspecific hybridisation are also stored at MSIRI with a view to preserving the species as genes rather than as



genotypes. Facilities exist to dehydrate and store seeds according to IPGRI norms, but improvements are necessary to enable seed storage at lower relative humidity and temperature.

58. Because of poor storage facilities, regeneration of material is required more often. In all countries, this poses lots of problems because of lack of land, finance, labour and trained personnel. In Madagascar, due to the high regeneration cost, the recommended regeneration cycle is often not respected and this leads to genetic erosion. FOFIFA and FIFAMANOR maintains *in vitro* cultures for root crops such as cassava, potatoes and sweet potatoes.

59. In the Seychelles, there is only a field collection and given the size of their collection the setting up of genebanks, other than maintaining the field collection, is not justified. By and large regeneration is practised fairly regularly, especially for root crops. Sweet potato cannot be regenerated satisfactorily as it loses its characteristics through vine cuttings. However, all materials are maintained as far as possible and are replaced from the original source. For other crops regeneration is satisfactory, but some technical guidance may be required to improve procedures.

Evaluation and characterisation

60. In Madagascar, evaluation work has been carried out mainly on rice, coffee, coconut, vanilla, banana and some fruit trees which has led to the development of promising varieties. These evaluations are mainly done with the participation of farmers for the principal crops. Characterisation work is done by a team comprising the collectors and geneticists working on the different crops. The recommended characterisation descriptors are utilised only in the case of rice and these are sometimes modified to suit practical circumstances. The unique coffee diversity in Madagascar was first characterised in 1978 (Charrier, 1978) and subsequently a phytochemical evaluation of the coffee germplasm was effected as part of a Ph.D. thesis in France (Rakotomalala, 1993).

61. In Mauritius, evaluation work is undertaken mainly at the MSIRI for sugarcane, maize, potatoes and groundnuts. With regard to sugarcane, evaluation is carried out to find the inherent characteristics of clones and the breeding potential. The imported commercial clones are evaluated for a series of morphological and flowering traits as well as for their agronomic performance. Every year an average of 2,500 crosses, representing 400 to 500 genetic combinations are performed. The progeny is evaluated on single stool of brix, vigour and cane number. In maize, evaluation is carried out on growth cycle, grain yield, biomass production, mean stalk weight, resistance against maize rust (*Puccinia polysora*); maize chlorotic stripe viruses and tolerance to pests etc. The MSIRI also carried out evaluation on potatoes and



groundnut for a number of traits, in particular on resistance or tolerances to diseases (Damania, 1985). At the Government Experimental Stations, evaluation of the national collection has been undertaken for some crops, but this has been discontinued due to transfer of staff and lack of qualified personnel. IPGRI is presently sponsoring a study of the genetic variability in the wild *Coffea* species in the Mascarenes, which involves an ecogeographic survey of the genus *Coffea* in Mauritius and Réunion and makes use of the RAPD molecular techniques for analysing genetic diversity within and between populations of *Coffea*. The latter work is being carried out at Birmingham University, U.K.

62. In Seychelles, evaluation is considered as more important than characterisation. Only 5-10% of the national collection is characterised, while 90% have undergone preliminary evaluation. The main characteristics evaluated are yield, disease and pest tolerance and adaptability to climate and soil. As there is no specialised staff on plant genetic resources in the Seychelles, the evaluation and regeneration works are undertaken by agronomists, as well as farmers in the case of evaluation.

Documentation

63. None of the countries in the sub-region has any computerised documentation systems, with the exception of Mauritius where some form of computerised databases exist for sugarcane and *Phaseolus* spp. Passport data for other crops have been prepared and are kept in manual form. *In situ* conservation activities are not well documented, except for Mauritius, where the National Parks and Conservation Service (NPCS) has set up databases for the threatened endangered plants and for *ex situ* propagation of these species. In Seychelles, only about 20% of the collection is fully documented. Some evaluation work that have been undertaken on tropical fruits and all the sweet potato varieties have been catalogued. The cataloguing of the cassava collection is planned.

64. A well developed herbarium and Mascarene region and surrounding islets, exist in Mauritius and is housed at the MSIRI. It holds more than 25,000 sheet mounted specimens including many type specimen. The herbarium also contains a collection of publications, manuscripts, original sketches, maps, charts and paintings relating to the regional flora of the Western Indian Ocean.. However, no computerised documentation for the collection exist and it would be highly desirable to develop one for the herbarium.



D. Uses of Plant Genetic Resources in the Sub-region

65. Regarding the uses of plant genetic resources, the same scenario more or less exists in all the countries. All genetic resources are utilised locally by the research institutions and government services either to develop improved varieties through breeding, as in the case of Mauritius, or to make available good cultivars to the planting community for commercialisation. It is fair to say that the greatest use of PGR in the region is by the farmers community. Farmers participate in the breeding programmes by evaluating the materials in the field, but are otherwise not involved in breeding works *per se*.

66. In Madagascar, the aim of their national research programme is based on the policy of food self-sufficiency. The objective is thus to look for better performing varieties, adapted to local conditions, that would increase productivity and hence help to alleviate hunger and poverty. The Strategy has been to select from local varieties and/or imported varieties which are adapted to local conditions. The most utilised crop plant germplasm collections in Madagascar include rice, maize, and cassava. Other crops, such as legumes (*Phaeolus*, *Vigna*, and *Arachis*) are used to some extent in breeding. Essential oils, extracted from some aromatic plants such as ylang ylang, cloves, geranium, vetiver, and peppermint are exported in significant amounts. Vanilla and cinnamon are also extensively utilised, but there is no extraction of their essential oils in the country. Traditionally these commodities have been exported raw and represent a very important foreign exchange earner for the country.

67. In Mauritius, the germplasm utilisation depends on the breeding policy and philosophy. In the cases of *Saccharum* spp., *Z. mays*, *P. vulgaris* and *L. esculentum*, genetic materials are used for breeding purposes to meet the aspirations of the planting community. The objectives are multi-purpose - high yielding, resistance to common diseases, adaptation to various agroclimatic conditions and to widen the genetic base. But on account of the country's limited size and market, breeding is not practised for vegetables.

68. In the Seychelles there is no breeding programme, but the Ministry of Agriculture and Marine Resources introduces high yielding cultivars, varieties adapted to agroclimatic conditions and good pest tolerance. Some 50% of the plant genetic resources samples in the national collection are used in commercial activities. The objective is to increase local food production to meet national food needs.



69. Seed production and distribution in the sub-region is the responsibility of the governmental extension services. In Madagascar the Extension Service works in close collaboration with research officers and helps in the distribution of seeds of improved varieties to farmers. However, the high costs of agricultural inputs and access to credits prohibits somewhat the use of the such varieties in Madagascar; A high percentage of farmers, particularly in Madagascar and Comoros, have to rely upon their own seed sources for growing their next season crops.

70. In Mauritius the Ministry of Agriculture and Natural Resources has a seed unit where seeds of the main food crops are produced for sale to the planting community at much subsidised prices, while in the Seychelles, there is no local production of seeds; improved seeds are always imported from international seed firms. For forest species, some countries prefer to import improved forest seeds from abroad to supplement their own sources of forest seeds for reforestation. However, in Madagascar, the "Silo des Graines Forestières" (SNFG) is capable of providing high quality seeds for different categories of forest species including hard woods, softwoods ornamentals, palms, and species useful in agroforestry systems.

71. In the region, Mauritius has one of the best facilities for applying biotechnology in the field of plant genetic resources. The MSIRI has established a biotechnology division with well trained staff and undertakes (1) tissue culture (rapid micropropagation, disease-free plantlets, germplasm conservation, transformation); (2) disease diagnosis and variation in pathogens (DNA technology, monoclonal antibody production); (3) crop improvement (molecular markers for sugarcane disease resistance, fingerprinting etc). Also FARC helps the planting community by providing planting materials. It makes use of biotechnology for the *in vitro* propagation and multiplication of imported germplasm of several crops including banana, pine apples, coffee and flowers of horticultural value.

72. With regard to the use of forest genetic resources, only Madagascar is still allowing the exploitation of some of its indigenous forest species. Some 60,000 ha of natural forest are being exploited giving 400,000 cubic metres of hardwood annually. There are also many uncontrolled collection of plant species especially orchids, ferns and cactus and euphorbes from the forest of Madagascar which are depleting the forest genetic resources of the country. In the other countries of the region, Mauritius and Seychelles, no exploitation of the natural forest is allowed. Infact most of forests are included in protected area system. With the exception of Mauritius, collection of firewood is another major use of forest resources in the countries of the sub-region. There is also in the subregion good use of forest species in making artisanal products; for example in Mauritius leaves of Pandanus and vetiveria are used by local communities in the making of baskets and other arisanal products. The ship



model industry also use locally produced timbers such as *Juniperus* sp., *Tecoma pallida* and *Cinnamomun camphora*.

National and subregional capacities

73. The capacity to implement plant genetic resources programmes varies from country to country and from institution to institution. Many of the institutions in the region have the potential to undertake work on PGR conservation and utilisation, but the problem they are faced with is the maintenance and sometimes the financial burdens in running the facilities that have been donations from external sources. Others lack qualified staff to run their plant genetic resource activities effectively. Most of the institutions need to be strengthened and there is a need for the transfer of new technologies and training of staff in the use of these technologies.

III. IDENTIFICATION OF NEEDS, OPPORTUNITIES AND CONSTRAINTS AND PRIORITIES FOR THE GLOBAL PLAN

74. Based on the assessment made in the previous section, the following needs and constraints have been identified for the sub-region as a whole. It is important to realise that each country has its own specificities and the needs may differ from country to country; these are presented at the end of this section. In general it is felt that countries of the sub-region very often are not fully conscious of the importance for conserving plant genetic resources and such issues are not considered as a high priority in the country's development plans.

A. Needs and Constraints for the Sub-region

Policy level

75. Creation of coordination committees at National level. PGR activities in all the countries are strongly sectorialised and divided between several institutions. There is very little coordination between them. It is thus vital that a good broad-base National Committee with a well defined terms of reference be put in place to oversee all PGR activities in the respective countries. One of the major task of the committee would be to define a national programme for the plant genetic resources conservation and utilisation. Involvement of farmers organisations and/or cooperative associations should be encouraged at the national level.

76. Elaboration of National Strategies for the conservation and sustainable utilisation of plant genetic resources. This is required to obtain a firm and



unequivocal commitment of Governments to preserve and protect plant genetic resources in the region.

77. There is a need to enhance the use of local plant genetic resources in the national programme and in particular the indigenous land races and cultivar which are in general well adapted to local conditions.

78. Existing legislations do not adequately cover the plant genetic resources issues. It is important that either existing or new legislation for control on utilisation, exportation and importation of PGR of importance to the sub-region be strengthened or developed. Countries may require expert assistance for developing national legislation on Intellectual Property Rights including plant breeders and farmers rights and patents.

79. An education and awareness campaigns on the importance of plant genetic resources conservation and utilisation need to be carried out at all levels of the community - political, scientific, schools, farmers and public.

Institutional level and capacity building

80. The creation of a regional network for specific crops of interest to the region need to be developed. Each country would serve as the regional centre for conserving particular crops. One possible scenario would be for Madagascar to hold the regional collection of rice and coffee, Mauritius for sugarcane and legumes and Seychelles for fruits and rootcrops. This should be decided by mutual agreement between the countries.

81. There is a need to strengthen the capacity of countries in the region for *in situ* and *ex situ* conservation of PGR. Capacity building is also needed at all levels for the national programmes in the Seychelles and Comores. Existing institutions in Mauritius and Madagascar need to be strengthened. Training of technical staff in specific fields of plant genetic resources is required, in particular in collecting, characterisation, evaluation and *in situ* conservation. A major problem in most, if not all the countries, is ensuring that trained PGR staff continue to work on PGR related activities.

82. Development of a network in the region for the study and promotion of research on potentially useful plant genetic resources for increasing agricultural production in the region and for alleviating poverty.



83. Most of the countries in the sub-region lack the institutional capacity to analyse actual and potential economic benefits accrued from conservation and utilisation of plant genetic resources. The strategies for their conservation and use are not normally integrated in national development plans. Therefore:

- i) Appropriate mechanisms need to be developed for placing value on national plant genetic resources and integrate their actual and potential contribution in national economic development plans.
- ii) Conservation and utilisation of plant genetic resources should be well reflected and integrated in national development plans.

Technical level

84. There is a need to carry out inventories of existing PGR collection, *in situ* conservation sites, economically important species of the region in particular medicinal and aromatic plants as well as wild relatives of crops and plants threatened with extinction. This will help to identify major gaps in existing collections

85. Organisation and funding of new collecting missions for threatened plant genetic resources, in particular wild species coffee, but also for legumes, rice and underutilised vegetables and fruits. This should be considered urgently given the high rate of genetic erosion, both in terms of deforestation and replacement of traditional cultivars by new better performing ones.

86. Regeneration and duplication of the important *ex situ* collection available in the sub-region, in particular the sugarcane collection in Mauritius and the unique coffee field collection in Madagascar.

87. Development and strengthening of existing *ex situ* facilities (gene-banks, *in vitro* and cryopreservation laboratories etc.). Most countries lack the basic requirements for the proper conservation of their plant genetic resources. It is also important that once such facilities are created, the country is able to maintain the facility and keep it running under optimal conditions.

88. Characterisation of existing *ex situ* collections. It is highly probable that some of the existing collections may be unduly large and contain redundant accessions, which put undue strains on regeneration and maintenance. It is vital that all the collections be properly characterised and documented.

89. Evaluation of these resources is also needed to determine the most economically useful accessions in the collections that are most adapted to local agro-climatic conditions. This will pave the way to a better utilisation of germplasm by breeder in the region.



90. There is also a need to include use of local landraces and cultivars of germplasm in breeding programmes. The use of these local resources by farmers must be enhanced. Farmers should be encouraged to conserve and use these local varieties, particularly in marginal environments where the use of agricultural inputs would be prohibitive.
91. Transfer of new technology to countries of the region from the north and the training of local staff in the use of such technologies.
92. Undertaking of ecogeographic study of major crops of interest in the region (coffee, vanilla, rice, medicinal and aromatic plants) with a view of defining areas which hold important genetic variability for *in situ* protection.
93. Reservation of areas of biological richness in protected area system.
94. Development of control measures of exotic species threatening native species.
95. Undertaking of studies on the medicinal plants especially with regard to toxicology, propagation of rare endangered species of medicinal plants and marketing for potential medicinal and aromatic plant genetic resources.
96. The following are some specific needs of each of the countries under review in the sub-region:

Mauritius

- Strengthening of institutions engaged in PGR activities
- Development of an cryopreservation laboratory for the conservation of the threatened sugarcane collection at the MSIRI.
- The completion of the regional flora, Flores des Mascareignes.
- Investigation of seed conservation properties of indigenous plant genetic resources.

Madagascar

- Creation of genebanks at different locations for different crops in the short term and one central national genebank in the long term.
- Setting up of a National Coordination Committee for management and improvement of the national programme on plant genetic resources.
- Diversification of the agricultural sector for the valorisation of potentially useful plant genetic resources in particular, food crops, medicinal and aromatic plants.



- Strengthening of the research capabilities on evaluation and utilisation of PGR for the promotion of agriculture and sustainable rurale development.
- Reinforcement of quarantine control staff and to equip them with adequate means of control.

Seychelles

- Assistance in undertaking characterisation and evaluation work of the materials in the field collection, in particular tropical fruits and tropical root crops.
- Training in plant propagation techniques especially in such food crops as breadfruit.
- Assistance in the characterisation of all endemic plants with medicinal properties as well as to develop conservation strategies for the endangered endemic species.
- Acquisition of new and improved varieties of tropical fruits and root crop varieties from CGIAR centres.

B. Opportunities and Comparative Advantages

97. The sub-region is composed of two centres of plant diversity viz. Madagascar and the Mascarene Islands in the western Indian Ocean. The area is particularly rich in wild relatives of *Mascarocoffea* and is considered a centre of diversity for this genus. The area is very rich in endemic species, many of which have potential economic uses, particularly medicinal, pharmaceutical and aromatic uses.

98. The Indian Ocean Commission regroups all the countries in the region and this commission can also be very useful in promoting the conservation of plant genetic resources at the level of the sub-region. Already there are a number of regional inter-governmental thematic initiatives in the region working under the IOC. Also the Réunion, the French department in the region may constitute as a definite advantage for the sub-region, in that it can offer opportunities for capacity building, training, and research for the benefit of the countries in the sub-region. It could also help with the networking of plant genetic resource activities in the sub-region.



99. Some countries, particularly Mauritius and Madagascar, has some highly trained manpower with Ph.D. degrees which can be useful to the region as a whole. The Mauritius Sugar Industry Research Institute, with its new biotechnology division, has the capability of offering training opportunities to researchers from African countries in DNA technology for genetic diversity studies. Both Madagascar and Mauritius have Universities which are rapidly evolving and could in the near future offer possibilities for training PGR related subjects.

100. There is also a well developed herbarium in Mauritius which can provide good services for the identification of plants in the region.

101. There are also several local NGOs operating in the region, particularly in *in situ* conservation of native plants and also protected area system, such as ANGAP in Madagascar and the Mauritius Wildlife Fund and the Conservatoire et Jardin Botanique de Mascarin in Réunion. The experiences of these organisation in *in situ* management of genetic resources can be very useful to friendly neighbouring countries.

C. Suggestions for Global Plan of Action

102. The following should only be considered as possible recommendation for the global plan of action that will be detail discussed in detail at the sub-regional meeting:

- i) Strengthening of national programmes in developing countries should receive high priority in the global plan of action. Local institutions should be strengthened with well trained staff in specific areas of plant genetic resources conservation and utilisation as well as training at the management level. Also consideration should be given to the transfer of technology (biotechnology applications) from the north to south.
- ii) Regional or sub-regional programmes need to be developed in the Global Plan. In the Indian Ocean sub-region, the Indian Ocean Commission may be encouraged to act as the platform for developing a regional PGR initiative.
- iii) Strategic plans need to be developed in the region for identification of gaps in *ex situ* collections and *in situ* conservation sites and the set up and/or strengthening of *ex situ* conservation facilities at both national and regional levels.



- iv)** Areas containing centres of origin and / or centres of diversity for particular crops should receive high priority in the Global Plan of Action, especially if the resources are rapidly eroding. The Indian Ocean region is the centre of diversity for the *Mascarocoffea*. This wild coffee germplasm is fast eroding due to forest clearing and invasion by exotic species. It is, thus considered as a priority given the world wide importance of this crop and in particular given the potential of developing low caffeine cultivars from the *Mascarocoffea* group, that an ecogeographic survey and collection of wild coffee germplasm in the Madagascar and Mascarene region is undertaken.
- v)** Development of control measures for exotic species is required. This is considered as a serious threat to wild plant genetic resources. It is a world wide problem and is the cause for genetic erosion in plants occurring in the wild. The problem is particularly acute on small islands.
- vi)** Creation of a global network of Genebanks, building upon the FAO Global system on PGR. There should be strict control on the movement of PGR between countries and a mechanism implemented to ensure the fair and equitable sharing of benefits with countries of origin.
- vii)** The plan should include a mechanism where by the accessions of genetic resources collections from developing countries held in genebanks in the north become more readily accessible to those developing countries from which they originate.



APPENDIX 1 AREA AND POPULATION DATA OF INDIAN OCEAN ISLANDS

	Comoros	Madagascar	Mauritius	Seychelles
Area in sq. km	2,170	587,040	1,860	455
% arable land	35	4	54	4
Population	530,136	13,427,758	1,116,923	72,113
Population growth rate	3.55	3.19	0.92	0.84
Labour force in Agriculture	80	90	29	12

Source: FAO Statistics

APPENDIX 2 STATUS OF NATIONAL PROGRAMMES, POLICIES AND PGR LEGISLATION IN THE SUB-REGION

	Comoros	Madagascar	Mauritius	Seychelles
PGR Committee	no	no	no	no
National Programme on PGR	no	no	no	no
National Conservation Strategy	no	no	yes	yes
PGR Workshop	no	yes	yes	no
PGR Legislation	no	no	no	no
IPR Legislation	no	no	no	no

APPENDIX 3 SIGNATORY TO INTERNATIONAL CONVENTIONS AND AGREEMENTS RELATED TO PGR

	Comoros	Madagascar	Mauritius	Seychelles
FAO Commission on PGR	no	yes	yes	no
FAO Undertaking	no	yes	yes	no
Ratification of the CBD	no	no	yes	yes
Member of CITES	no	yes	yes	yes
Ratification of WCNH*	no	yes	no	yes

WCNH - UNESCO's World Cultural and Natural Heritage Convention



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ABBREVIATIONS

ANAE	Association Nationale pour l'aménagement de l'environnement (Madagascar)
ANGAP	Association Nationale pour la gestion des aires protégées (Madagascar)
AVRDC	Asian Vegetable Research Development Centre
CGIAR	Consultative Group on International Agricultural Research
CIAT	Central Internacional de Agricultura Tropical
CIMMYT	International Maize and Wheat Improvement Centre
CIP	Centro Internacional de la Papa
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CIRAD-CA	CIRAD - Culture Annuelle
CIRAD-FLHOR	CIRAD - Département des Productions Fruitières et Horticoles
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CNP	Conservation and National Parks (Seychelles)
COBIO	Comité d'Orientation et de suivi de la politique de gestion sur la Biodiversité (Madagascar)
EDF	European Development Fund
FAO	Food and Agriculture Organisation
FARC	Food and Agriculture Research Council (Mauritius)
FIFAMANOR	Bilateral cooperation between Madagascar and Norway



FOFIFA	Centre National de la Recherche Appliquée au Développement Rurale (Madagascar)
GDP	Gross Domestic Product
IBPGR	International Board for Plant Genetic Resources (now IPGRI)
ICPPGR	International Conference and Programme on Plant Genetic Resources
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for Semi-Arid tropics
IITA	International Institute of Tropical Agriculture
INIBAP	International Network for the improvement of Banana and Plantain
IOC	Indian Ocean Commission
IPGRI	International Plant Genetic Resources Institute
IRAT	Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières
IRRI	International Rice Research Institute
IUCN	World Conservation Union
MANR	Ministry of Agriculture and Natural Resources (Mauritius)
MSIRI	Mauritius Sugar Industry Research Institute
MWAF	Mauritian Wildlife Appeal Fund
NPCS	National Parks and Conservation Service (Mauritius)
OAU	Organisation of African Unity
ORSTOM	Organisation de Recherches Scientifiques et Techniques Outre Mers



PGR	Plant Genetic Resources
SNFG	Silo des Graines Forestières
UNDP	United Nations Development Programme
UNEP	United Nation Environment Programme
USAID	US Agency for International Development
WWF	World Wide Fund for Nature