NAMIBIA:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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Note by FAO

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CHAPTER 1
Introduction to Namibia and its Agricoltural Sector

1.1 GENERAL

Namibia is located on the south-western coast of Africa between latitudes 17.5° and 29° south and longitudes 11.5° and 25.5° east. Namibia borders Angola to the north, Zambia and Zimbabwe to the north-east, Botswana to the east, South Africa to the south and the Atlantic Ocean to the west. The Kunene, Okavango, Zambesi, Kwando-Chobe and Orange Rivers form part of the borders and are the only perennial rivers in Namibia.

The cold Benguella current along the west coast of the country contributes to the fact that Namibia is the most arid country in Africa south of the Sahara. Two important physiographic features of the country are the Namib Desert along the west coast and the Kalahari Desert along the eastern side. A prominent escarpment runs more or less parallel (north-south) to the coastline and divides the extremely dry coastal plains from the interior. This escarpment has a significant influence on the distribution of fauna and flora. The generally flat Namib plains are periodically interrupted by inselbergs presenting special habitats for fauna and flora. The Kaokoveld in the extreme north-west has high mountain ranges, again presenting special habitats with a high degree of animal and plant endemism. The central highland around the capital, Windhoek, with altitudes of around 2,000m, also houses several endemic species. Another area of importance is the Karstveld and associated mountains around Otavi/Tsumeb/Grootfontein. The remainder of the country is relatively flat and sandy in the east and north-east and rocky in the south.

Rainfall in Namibia occurs mainly during the summer months of December to March. Only the extreme south-western corner may receive rain during the entire year, and this has a significant influence on the natural vegetation of that area. The average annual rainfall pattern forms roughly diagonal NW-SE bands with an average of <50 mm in the southwest and along the coast to >700 mm in the north-eastern corner (Caprivi Strip). Average maximum temperatures during the summer months range from 31°C along the coast and on the central highland to >40°C in the lower lying central south. During winter,

average minimum temperatures range from <2°C in the central highland to >10°C along the coast.

The total surface area of Namibia is 824 295 km² (van der Merwe, 1983; Moorsom, 1984). The most recent population census figures available (1992) set the population at 1.4 million. The population growth rate is 3%, one of the fastest growing populations on the subcontinent. The average population density for Namibia is therefore 1.7 persons/km², but the distribution is uneven. The largest portion of the population is rural and is concentrated around perennial water sources while only the capital city, Windhoek, has a population of more than 100 000 (est. 170 000), the rest of the urban population being distributed in towns much smaller than this. Population density is highest in the northern central regions of Omusati, Oshana, Oshikoto and Ohangwena and the north-eastern regions of Okavango and Caprivi where it increases to about 4 persons/km². It is also in these areas that rainfall is highest and dryland crop farming is possible.

1.2 AGRICULTURAL SECTOR

Agriculture plays a major role in the economy of Namibia, second only to the mining sector in contributions to exports and GDP (10%) and is by far the greatest source of employment and/or subsistence for the majority of the population (+70%). Of the 82.4 million ha surface area, 15% is not suitable for farming; 15% of the surface area, mainly in the agriculturally unsuitable areas, is state owned (nature reserves, Diamond Area); 44% of the total area is farmed commercially and 41% is communal land. Only 34% of the available land is suitable for crop farming, but only 1.4% of this is actually utilized (Talbot, 1970; Anonymous, 1990; Appa Rao *et al.*, 1991). The largest part of Namibia is utilized by both commercial and subsistence farmers for livestock farming with the natural vegetation as grazing. Crop production is only possible in the north and north-east where rainfall is sufficient or at the few small irrigation schemes where permanent water is available. Once again, crops are produced by commercial as well as subsistence farmers. The carrying capacity in the northern communal regions of Namibia is estimated to be 0.1 to 0.5 persons per cultivated ha (Appa Rao *et al.*, 1991). The main crops in Namibia are pearl millet, sorghum, maize, wheat, beans, alfalfa and some fruit and vegetables (melons, grapes, tomatoes).

Agriculture in Namibia is based mainly on livestock farming. Since the natural vegetation serves as grazing, the type of livestock farmed differs between different parts of the country. In the south mainly sheep and goats are farmed by both commercial and communal sectors. The average size of commercial farms in this area is 7500 ha. In the higher rainfall areas in the north and centre, cattle are farmed. The average size of commercial farms here is 4,500 ha (Statistisches Bundesamt, 1992) but 7,000 to 9,000 ha is considered an economical unit in this area (H. Kölling, pers. comm.).

Agronomy plays a minor part in the Namibian agricultural sector in terms of contribution to GDP but a larger proportion of the population is involved in crop farming than in livestock farming (H. Thompson, pers. comm.). During 1988 only 2% of the sectoral GDP was contributed by commercial crop farming, i.e. excluding pearl millet subsistence farming (Statistisches Bundesamt, 1992). In the central-northern and north-eastern regions, where rainfall is sufficient, subsistence crop farming has always been practised. It is estimated that between 120,000 and 150,000 farming units exist in the subsistence sector (Statistisches Bundesamt, 1992). Land tenure in communal areas is on the basis of usufruct, with about 25% of household heads being female (J. Matanyaire, pers. comm.). Field size varies from 0.2 to 100 ha, but farmers typically cultivate about 2 - 4 ha (W. Lechner, J. Matanyaire, pers. comm., Yaron et al., 1992), mainly with pearl millet, *sorghum* or maize (or a mixture of these grains) and often some minor but very important crops like Bambara nut, groundnut, cowpea and melons. Yields for subsistence farmers of pearl millet vary from 100 kg /ha to 900 kg/ha whereas the potential yield in the area, under good management, using improved varieties and fertilizer, is 1,200 kg/ha (W. Lechner, H. Thompson, pers. comm.). A few commercial farmers produce crops in areas such as the "Maize Triangle" (Otavi-Grootfontein-Tsumeb), Hardap Irrigation Scheme, Stampriet area and the Noordoewer Irrigation Scheme. The acreage cultivated by these farmers varies greatly from about 4 to 5,000 ha (C. du Toit, pers. comm.). In the Maize Triangle lands are almost exclusively under maize production with some sunflower, cotton and drybeans (H. Thompson, pers. comm.). The smaller farms in the irrigation schemes are more diversified with crops such as wheat, grapes, sweet melons, watermelons, tomatoes, alfalfa, cotton, wheat and other minor vegetables and fruit. Yields for some crops of commercial enterprises average as follows: maize - 0.9t/ha; wheat - 2.8t/ha; sunflower seed - 0.9t/ha; cotton - 2.5t/ha; alfalfa - 13.9t/ha (Statistisches Bundesamt, 1992). The producer's prices for maize, sunflower and wheat are fixed annually and published in the official gazette (K. Kotze, pers. comm.).

Namibia can produce sufficient cereals to supply just over half of its domestic requirements (Table 1.1). The remainder is imported, mainly from the

Republic of South Africa. Most other food (about 40% of total) come from South Africa as well (AGRECONA, 1990). Some locally produced fruit is exported purely due to greater financial gain for the farmer. Only 10% of Namibian export earnings result from agricultural products, including animal products (Statistisches Bundesamt, 1992).

TABLE 1.1 DOMESTIC PRODUCTION AND CONSUMPTION OF CEREALS IN NAMIBIA.

CROP	DOMESTIC PRODUCTION (x 1000 t)	DOMESTIC CONSUMPTION (x 1000 t)	DOMESTIC PRODUCTION AS % OF DOMESTIC CONSUMPTION	DOMESTIC CONSUMPTION AS % OF TOTAL CEREAL CONSUMPTION	PER CAPUT USE (kg/yr)
Maize	45	106.8	42.1	45.5	59
Wheat	5.5	57.6	9.5	24.6	31
Millet/ sorghum	69.2	70.2	98.6	29.9	41
TOTAL CEREAL	**119.7**	**234.6**	**51**		**131**

Information taken from: Crop and Food Security Bulletin No. 2.95, February 1995 (Namibia Early Warning & Food Information System, 1995).

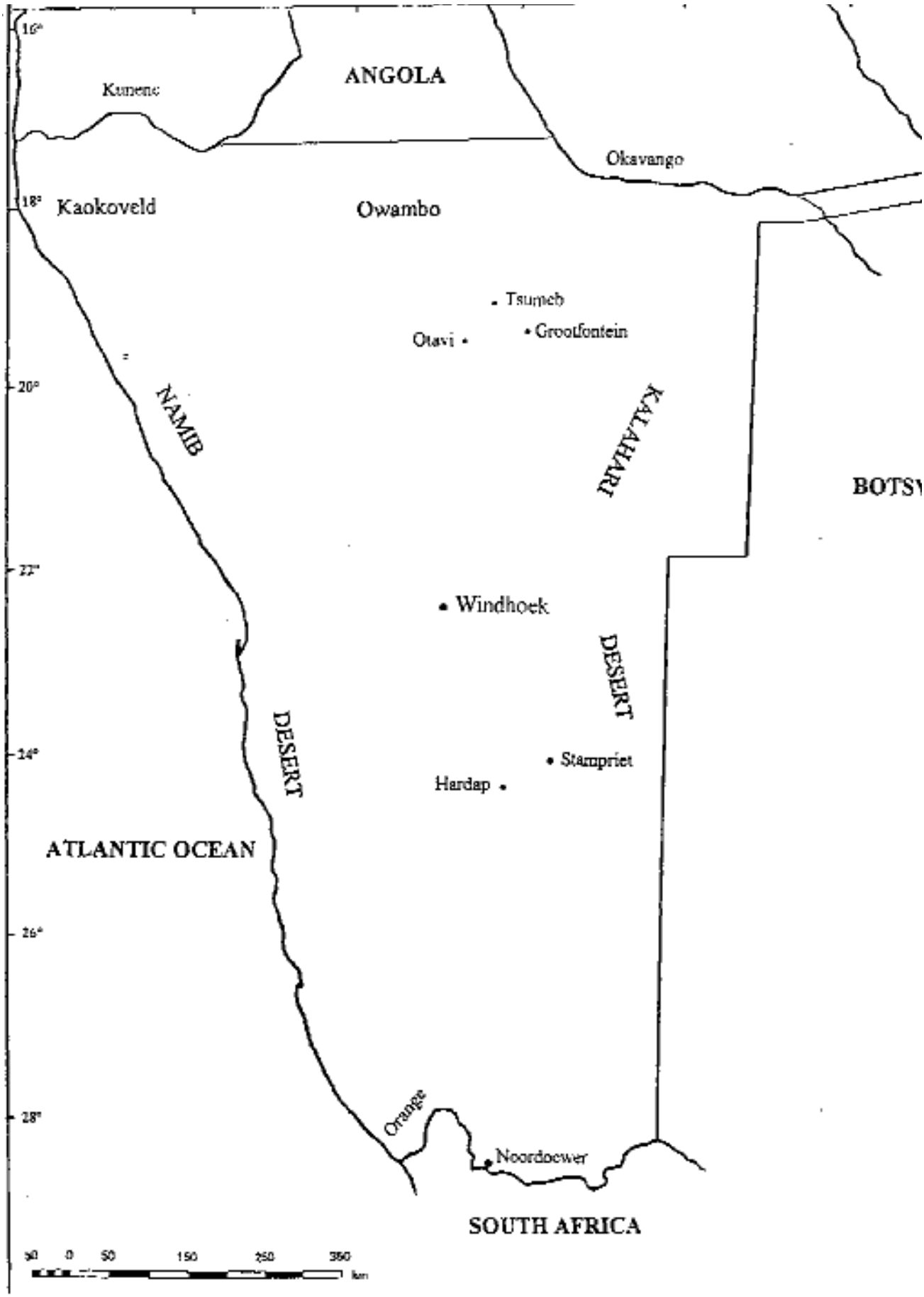
Subsistence farmers largely source their own seed or trade with neighbours (C. du Toit, pers. comm.), since the formal seed supply system is not yet fully developed in Namibia. Only recently has pearl millet seed become available through government research stations, extension offices and NGOs. The Ministry of Agriculture, Water and Rural Development (MAWRD) is also working towards establishing a formal seed testing and supply system. Commercial farmers, who cultivate commercially available varieties, obtain their seed through cooperatives (Agra-Namibia which supplies ex-South African seed) or seed suppliers in Zimbabwe or the Republic of South Africa (C. du Toit, pers. comm.). There are no commercial seed producers in Namibia at this stage.

Since Independence in 1990, the Government of Namibia has pledged to make agriculture, and in particular agronomy, a priority for development. With this attention given to agronomy, more farmers should venture into plant production in future, as seed and fertilizer supply and other support systems and extension work become developed and more accessible. Already the area under millet has increased from 77 000 ha in 1979 to 93 000 ha in 1990, but these figures are highly dependent on rainfall. During the same period average grain yield increased from 448 kg/ha to 699 kg/ha (FAO, 1991). The main reason for this trend is availability of the improved millet variety Okashana I since 1989 (W. Lechner, 1992; C. du Toit, pers. comm.). During recent years farmers have had low crop yields due to drought conditions. As a result, many commercial farmers have converted crop lands into planted pastures for their livestock in order to make livestock farming less dependent on climate

(H. Kölling, pers. comm.). There has been a decline in forest production due to agricultural expansion, uncontrolled fires and grazing, particularly in the communal areas in recent years (P. Keen, pers. comm.). Since drought is not merely cyclical but endemic in Namibia, research and development should in future be aimed at reducing the risks of losing entire crops due to low rainfall.

Major pests that affect crop production in Namibia are armoured cricket, army worm, queleas, stalkborer, locusts, stink bug and nematodes (Appa Rao *et al.*, 1991; C. du Toit & P. Barnard, pers. comm.). Fungal diseases common on cereals are downy mildew (*Sclerospora graminicola*), long smut (*Tolyposporium ehrenbergii*), smut (*Tolyposporium penicillariae*) and ergot (*Claviceps fusiformis*). In recent years, major outbreaks of army worm and locust devastated crops in the Caprivi and Okavango regions. Losses due to armoured cricket (*Acanthoplus discoidalis*) have increased in recent years. This can probably be attributed to overgrazing of natural vegetation surrounding pearl millet fields, since these insects will eat wild grass first before attacking pearl millet. A second factor contributing to the increase in this pest is the population decrease of the natural enemies (large birds) of armoured crickets due to habitat loss and hunting (W. Lechner & P. Barnard, pers. comm.).

MAP OF NAMIBIA SHOWING PLACES OF IMPORTANCE (MENTIONED IN CHAPTER 1)



CHAPTER 2
Indigenous Plant Genetic Resources

Indigenous plant genetic resources are extremely important to Namibia since the entire system of livestock farming, which is the major part of the agricultural sector and an important source of income for the country, is based on wild plant genetic resources. There also exists a wealth of indigenous crop landraces, especially of pearl millet, in the northern farming areas. These landraces are particularly well adapted to the relatively dry conditions under which they are grown. Information on the use of these landraces is not quantified or documented, but it is well known from experience that farmers still like to grow traditional varieties of pearl millet, mainly because not enough seed of improved varieties is available, because these varieties still yield sufficiently during normal years (C. du Toit, pers. comm.), confer stability (Appa Rao *et al.*, 1991) and farmers prefer some of their qualities, like taste, storability or stalk length.

2.1 FOREST GENETIC RESOURCES

See separate annex.

2.2 OTHER WILD SPECIES AND WILD RELATIVES OF CROPS

Table 2.1 lists the most important wild crop relatives and their importance/potential importance. Some more wild crop relatives are found in Namibia, but they would be too numerous to list here. At present all of these occur in the wild in what is presumed to be sufficient numbers and have a wide distribution, except possibly those indicated as "?" or "Y" in the column "Genetic Erosion". These latter taxa either occur in localised populations or are threatened by some human interference.

Wild relatives of crops found in Namibia have never been investigated as to their potential in improvement of cultivated varieties. One might however

assume that due to the arid environment in which these species occur, they may be useful in breeding for drought tolerance. A project to investigate the potential of indigenous Cucurbitaceae, funded by DANIDA, is presently being undertaken by the National Botanical Research Institute. The ultimate aim of this initiative is to improve the yield and quality of these foods through documentation, selection and breeding and to expand utilization through appropriate technologies (G.L. Maggs, pers. comm.). Namibia is a centre of diversity for watermelon. There are 42 species of wild melons found in the country, some of which are utilized from the wild. Six distinct local varieties of watermelon are identified by farmers in the Okavango and Caprivi regions. Commercial watermelon production in the country is however based on imported South African varieties (D. Cooper, pers. comm.).

There are also several wild species occurring in Namibia that are utilized, often quite extensively, on a local scale. According to preliminary results of the Namibia Household Income and Expenditure Survey 1993/94, 4% of total household consumption, for all households in Namibia, comes from wild food resources (including fish) and 8% of total household consumption for subsistence farming households (which are 41% of all Namibian households) comes from wild food resources. Although not commercialized, some species are available in local markets and generate cash income for some people, especially women (G.L. Maggs, pers. comm.). Most forest products, especially indigenous fruit trees are exploited on a local scale, especially during years of drought, but management is not sustainable (H. Thompson, P. Keen, pers. comm.). To make the use of these species sustainable, warrants serious investigation. One method could be to develop them into new, more widely used crops. Table 2.2 lists the most important of these species with a short summary of their uses or importance. There are many more valuable species utilized by local communities in Namibia for timber, building material, medicines, fencing, fuel and livestock feeds, but for practical reasons this list was limited to the most widely used taxa. An FAO consultancy on the value of traditional crops in Namibia and their significance to food availability was done in 1993 (FAO, 1993).

2.3 LANDRACES (FARMERS' VARIETIES) AND OLD CULTIVARS

Very little published information is available on the use of landraces, but according to experienced staff in the field, subsistence farmers still depend mainly on their local landraces for production. Only one improved variety of pearl millet is available to Namibian subsistence farmers. Some *sorghum*, cowpea and

Bambara nut landraces are still present and being maintained in subsistence areas. In the Kavango area alone there are close to 300 vegetable farmers with a collective area of +80 ha under production (H. Thompson, pers. comm.). These farmers use a mixture of landraces of crops like Bambara nut and cowpea, old varieties of some crops, e.g. groundnut and modern vegetable cultivars of which seed is available on the commercial market (mainly from South Africa). Commercial farmers on the other hand use only improved cultivars.

Not much information is available on the economic value of traditional varieties for the communal farmer. During good years about 98% of the harvest of communal farmers is for own use; the rest is traded in the area or even across the border to Angola (A. Botes, pers. comm.). Some farmers with larger fields who regularly produce more than they can consume, trade more regularly and trade larger proportions of their harvest. The policy of the government is to promote the production of cash crops to improve the production as well as the living standards of communal crop producers. Since no formal market for small scale producers exists in Namibia at this stage, the government is investigating the possibility of establishing such a system (W. Lechner, pers. comm.).

Farmers use old varieties for various reasons, like sufficiently high yield in normal seasons, adaptedness to local growing conditions, taste, storability, stalk length and quality (used for fencing) and availability of seed. Until seed supply systems are fully operative and more cultivars become available, farmers will probably keep their landraces. Namibian farmers need more improved varieties that are adapted to overcome a variety of problems, not only lateness of season as in the case of Okashana I. Indigenous germplasm could contribute to the development of such varieties. The whole process could however lead to an increased loss of genetic diversity of the crop in Namibia.

In general, crop farmers have a basic idea of the value of diversity which is implemented by them in multi-cropping systems. Pearl millet farmers are also aware of the value of diversity and tend to plant different varieties during different seasons and times of the year or on different areas of their lands. In a survey in the Kavango Region, farmers indicated their eagerness to try new varieties, but at the same time stated that they would not replace their local varieties, but rather plant them simultaneously with improved varieties (Ministry of Agriculture, Water & Rural Development, 1994). This perception may however change as soon as the improved variety proves itself in a certain area or under certain conditions. Every effort should however be made to prevent the total loss of local varieties through implementation of appropriate *ex situ* as well as *in situ* conservation strategies.

The Constitution of Namibia (Article 95(1)) protects natural resources in general and promotes their sustainable use, but no legislation exists to specifically protect landraces. This is an aspect that needs to be addressed. *Ex situ* conservation of these landraces is adequately covered by the national genetic resources programme, but *in situ* conservation still needs to be investigated and implemented.

Table 2.1 Crop relatives occurring in the wild in Namibia and their importance and genetic status

NAME	IMPORTANCE	genetic erosion
Amaranthus spp.	drought tolerance	N
Citropsis daweana	Collecting priority identified by the Working Group on Genetic Resources of Citrus, 1981	?
Citrullus spp.	drought tolerance disease resistance collecting priority acc. to IPGRI	N
Corchorus spp.	fibre yield & quality drought tolerance widening genetic base of crop	N
Cucumis spp.	resistance to: green mottle virus bean spider mite some nematodes white fly watermelon mosaic virus watermelon virus-1 fusarium wilt	N
Dioscorea spp.	unknown	?
Ficus spp.	unknown	N
Gossypium spp.	cytoplasmic male sterility earliness insect resistance	?
Hibiscus spp.	unknown	N
Ipomoea spp.	unknown	N
Lactuca spp.	drought tolerance survival on marginal soils	N
Momordica spp.	unknown	N
Nicotiana africana	unknown	?
Olea europaea subsp. africana	unknown	N
Oryza longistaminata	unknown	?
Pennisetum spp.	strong local adaptation	N
Sansevieria spp.	unknown	N

NAME	IMPORTANCE	genetic erosion
Sesamum spp.	unknown	N
Solanum spp.	drought tolerance	N
Sorghum spp.	strong local adaptation	N
Vigna spp.	Unknown collecting priority acc. to IPGRI	?

Table 2.2 Important wild plant species utilized in Namibia with potential for development

NAME	USE
Harpagophytum procumbens (PEDALIACEAE) Grapple plant, Devil's claw	medicinal: anti-arthritic secondary tuberous roots sliced & dried, exported to Europe for production of teas & other medicines
Tylosema esculentum (FABACEAE) Marama bean	large edible seeds rich in proteins and with good quality, high oil content edible tuberous roots rich in protein (see: National Academy of Sciences, 1979)
Citrullus lanatus (wild and semi-wild forms) (CUCURBITACEAE) Tsamma, Wild watermelon	seed oil used in production of cosmetics fruit flesh eaten & used as livestock feed
Acanthosycios horridus (CUCURBITACEAE) !Nara	edible melon with large, edible seeds with high oil content; was previously exported for confectionery market
Cleome gynandra (CAPPARACEAE)	leaf vegetable also known elsewhere in Africa
Sclerocarya birrea subsp. caffra (ANACARDIACEAE) Marula	large edible fleshy fruit used for juices, preserves and making alcohol protein and oil-rich nut some breeding work done
Berchemia discolor (RHAMNACEAE) Bird plum	medium sized tree producing large numbers of sweet, edible fruit possible use in agroforestry
Schinziophyton rautanenii (EUPHORBIACEAE) Manketti	large nuts with high oil content staple food during periods of drought in some areas
Strychnos cocculoides (LOGANIACEAE) Monkey orange	large edible fleshy fruits possible use in agroforestry
Vangueria esculenta (RUBIACEAE)	large edible fruits
Ximenia americana	large edible, fleshy, acidic fruits

NAME	USE
Commiphora spp. (BURSERACEAE)	aromatic gums and resins used in cosmetics
Ficus sycomorus (MORACEAE) Wild fig	edible fruit
Garcinia livingstonei (CLUSIACEAE) Mangosteen	large, edible fruit
Grewia spp.	edible fruit

CHAPTER 3
National Conservation Activities

Conservation of plant genetic resources is relatively new to Namibia. Only after independence in 1990, when Namibia became a member of SADC, was a National Plant Genetic Resources Programme initiated as part of the regional SADC Plant Genetic Resources Centre (SPGRC) Project. The utilization and development of indigenous plant genetic resources received hardly any attention in the country prior to independence. Namibia's capacity in this field is developing slowly, since most infrastructure and expertise has to be newly developed.

3.1 *IN SITU* CONSERVATION ACTIVITIES

Namibia is part of the SPGRC Project. The SPGRC project includes in situ conservation in its objectives, but because of lack of suitably trained personnel at the Namibian Centre and the relatively recent establishment of the project, little attention has yet been given to in situ conservation of plant genetic resources.

The only conservation that could be considered *insitu* in Namibia, is that of wild species present in nature reserves. Approximately 12% of Namibia's surface area is protected by legislation (Du Plessis, 1992), but these nature reserves were not established with plant genetic conservation in mind. Thus any species protected by these areas are included purely co-incidentally and their management is not directed. These areas could potentially play a major role in *in situ* conservation, since they cover large and diverse areas of the country and are generally managed by skilled personnel. However, if the distribution of existing nature reserves within the country is considered, it becomes clear that there is still much to be done. Only 8 of the 13 preliminary vegetation types identified by Giess (1971) are protected in conservation areas and some vegetation types have less than 5% of their surface area protected by reserves. Planning for any future reserves must take genetic conservation into consideration. An inventory of plant genetic resources in the presently protected areas needs to be drawn up in order to make decisions on their future management possible.

In situ conservation of cultivated species has not yet been considered, but the potential for on-farm conservation is certainly there. For various reasons many communal farmers still like to grow traditional varieties especially of pearl millet (C. du Toit, pers. comm.). Given the unpredictable nature of rainfall in Namibia, they recognize the advantage of planting a variety of pearl millets for harvest security. The fact that until recently (1989) no pearl millet seed of improved varieties was available commercially has also contributed towards farmers' use of old varieties. Many farmers prefer the taste, cookability and storage characters of traditional varieties to those of improved varieties and plant them for these reasons.

3.2 *EX SITU* COLLECTIONS

With independence in 1990, Namibia became a member of SADC and also joined the SPGRC project. The aims of this project are to conserve all plant genetic resources in the region and promote their utilization. The project was initiated because the threat of genetic erosion in the region was believed to be on the increase (SIDA, 1989).

Under this project a National Plant Genetic Resources Centre (NPGRC) was established under the auspices of the Ministry of Agriculture, Water & Rural Development (MAWRD) in Windhoek to house the national collection. The Government of Namibia provided the facilities to house the NPGRC by building a new complex which was completed in 1992. The curator for the NPGRC was trained under the SPGRC project to M.Sc. level and assumed duties in January 1993. Through bilateral agreement with SIDA, important equipment was donated to the Namibian NPGRC through the SPGRC Project. Running costs at the NPGRC are met by the MAWRD. For specific projects, funding may be obtained through the SPGRC project which in turn is funded by the 5 Nordic countries and since 1994 also by contributions from the SADC member states who are to assume full responsibility for the financing of the project in 2005. Collecting missions are often funded by foreign institutions requesting collection of certain germplasm. Five posts, 2 researchers, 2 technicians and 1 assistant, have been allocated by the MAWRD to the NPGRC. To date only one researcher and one technician are employed.

The collection at this stage contains only Namibian material, both of wild species and crops. The number of accessions at this stage stands at 1700. The majority of accessions consist of pearl millet, which is the main crop in Namibia. Most of these accessions were collected by ICRISAT in 1991. The

majority of the wild species accessions are of indigenous *Cucurbitaceae.* Most accessions are duplicated at the regional centre (SPGRC), in Lusaka, Zambia. Almost all the wild species in the collection were collected because requests for such material had been received. These requests are mainly from foreign scientists doing taxonomic research. Very few requests are received for wild material to be used in breeding projects or evaluation of their agricultural potential.

Locally, pearl millet and cucurbit germplasm is used by scientists employed by the MAWRD for the *Sorghum* and Pearl Millet Improvement Programme and research on potential of local cucurbits respectively. Agronomists working on crop variety evaluation and adaptation trials in the country, receive foreign germplasm directly from the collaborating institutes and scientists or buy them on the commercial market.

Since the collection is still very young, it is not yet representative of the country's diversity. The pearl millet collection of about 1000 accessions represents the available millet diversity relatively well, but is by no means complete. Many of the accessions also need to be multiplied or regenerated. All other species are still rather poorly represented. At present maintaining this collection is a problem due to staff shortage to manage the material. With the help of personnel in other sections of the MAWRD, this should however not be an insurmountable problem.

Collection of material in Namibia is done according to a list of priority species that have been identified by the NPGR Committee (Appendix A). This list contains wild as well as cultivated species that are considered to be of great value or face danger of genetic erosion. Collection is done either by the NPGRC or the National Herbarium, with which close collaboration exists. Any collecting missions launched by institutes from outside Namibia are obliged to deposit a subsample of each collection at the NPGRC. During the past 3 years 6 such collections were received by the national centre.

Collecting missions of crop species are carried out according to needs of agronomists, which meet once a month, and advise the NPGRC on these matters. Such missions will be directed at specific crops and/or areas. Random sampling techniques are employed wherever possible for both crops and wild species.

General collecting of wild species is mainly opportunistic. Since the development of vegetation and subsequent seed-set is very dependent on rainfall, missions are planned accordingly. To support the planning of such missions, the help of satellite imagery/remote sensing has been tested recently. The Meteorological Service in Windhoek produces Vegetation Index Maps by using information from the NOAA satellite (Weather Bureau, 1993). These maps

show the development of vegetation in the country in response to rainfall. A proposal for a project to develop this method fully in Namibia has been put forward by the Natural Resources Institute, U.K. for funding (Natural Resources Institute, 1993).

Small germplasm collections are held at the research stations of Mahanene and Uitkomst. These are collections mainly of pearl millet, *sorghum*, groundnut, sunflower, maize, cotton and vegetables and are used for plant breeding and variety testing. Collections used in the *Sorghum* and Pearl Millet Improvement Programme were collected in Namibia or obtained from other SADC countries. The varieties of other crops, tested in Namibia for their adaptation to local climatic conditions, are also received from SADC countries as well as through seed marketing companies (e.g. commercially available vegetable seed). The SADC Tree Seed Centre of the Directorate of Forestry, Ministry of Environment and Tourism, plans to hold small accessions of tree seed of both indigenous and exotic species for utilization in afforestation projects (See annex on Forest Genetic Resources).

At present no arboreta, field genebanks or botanic gardens are involved in genetic resource conservation in Namibia. Land for a small botanical garden (11 ha) has been allocated in Windhoek and will be developed by the NBRI and Ministry of Environment and Tourism as personnel and financial circumstances allow. This will complement conservation activities mainly by raising public awareness. The Namibia Root Crops Research Project of the MAWRD plans to establish field genebanks for cassava and sweet potato at Bagani. Both locally available germplasm and material from the SADC region will be held here.

3.3 STORAGE FACILITIES

The germplasm collection of the NPGRC is housed in a building newly erected for this purpose in 1992. The facilities include a documentation office, threshing room, laboratory and storage room. All rooms are fully airconditioned and a stand-by generator is permanently connected to the power supply.

Incoming material is kept in the storage room at about 15°C before being processed. The accessions are presently dried using silica gel (in the 15°C room), since the seed drier pledged to the project could not yet be delivered due to technical difficulties. Due to the lack of a seed drier, the capacity for seed drying is low. Depending on the seed moisture content of incoming material

and the size of the accessions, usually only 50 accessions can be processed every 8-12 weeks. Seeds are randomly tested for moisture content, since the NPGRC lacks the infrastructure to test all samples. Once the seed moisture content has reached about 5%, seeds are packed in laminated aluminium foil bags and stored at -20°C in domestic upright freezers. Where sufficient material is available, it is duplicated at SPGRC, which also accepts full responsibility for maintenance of that material.

At present the storage capacity of the NPGRC is almost filled. The project however intends to double the present storage space, which will mean the capacity is only half filled. The final capacity should take an estimated 3 years to fill up, since fewer collections will in future warrant storage. At present all germplasm is accepted for storage. Once a basic collection of important germplasm has been stored, the NPGRC will be more selective in accepting germplasm for storage. In future only local germplasm accompanied by sufficient passport information will be stored.

Germplasm collections at the research centres are stored either in cold rooms at 4°C (Mahanene) or at ambient temperatures in various containers ranging from glass and plastic jars to paper or cloth bags. Since these collections are only stored from one planting season to the next, these facilities are adequate. The NPGRC has made the offer to users of germplasm to store any material not used regularly (or not at all), under more favourable conditions for long term storage.

3.4 DOCUMENTATION

Accessions in the NPGRC collection are documented on a computerized database common to all NPGRCs in SADC. This was done with networking and easy data exchange between NPGRCs in mind, but to date the NPGRC of Namibia has not made use of this networking facility. The documentation programme was written by the documentation officer at SPGRC, Lusaka, and is based on dBase IV. The programme is not yet complete and several modules, e.g. for characterization data, are to follow soon.

Computerized documentation records are duplicated whenever a considerable batch of data has been entered or updated. Copies are made onto diskette to be kept in the same building as well as at another place outside the building. Back-ups of the entire database are to be sent to the regional facility (SPGRC) once a year.

Documentation of *in situ* resources has not yet been attempted. Drawing up an inventory of plant genetic resources present in reserves in the country would require extensive literature and herbarium searches and a lot of actual data collection or surveys in the areas. At present this is not possible with the limited staff available. Documentation of these *in situ* resources will be done in collaboration with other relevant institutions. Namibia is in the process of compiling its Biodiversity Country Study and this aspect will be addressed under this activity and follow-up programmes. The responsibility for compilation of the Biodiversity Country Study rests with the National Biodiversity Task Force, a multidisciplinary committee that is co-ordinated by the Directorate of Environmental Affairs within the Ministry of Environment and Tourism and on which the NPGRC has significant representation. During its activities a lot of information, also in computerized form, will become available as it is collected from within and outside the country. The computerized "Botanical Research and *Herbarium* Management System (BRAHMS)", developed by Oxford Forestry Institute, is to be implemented at the National Herbarium of Namibia during 1995. This will facilitate *in situ* conservation inventories as well as *ex situ* activities considerably.

Identification of wild species poses no problem to the NPGRC, as it works in close collaboration with the National *Herbarium* of Namibia (WIND) which is in the same umbrella institution as the NPGRC, the National Botanical Research Institute (NBRI). Any other institutions wishing to have wild species identified, can rely on the *Herbarium* for efficient identification. Most wild species in Namibia are well known taxonomically and their identification should not pose a problem to skilled taxonomists. There is however a lack of identification guides/literature that is understandable to laymen or scientists other than plant taxonomists. The lack of illustrated literature of wild Namibian species makes long-distance (e.g. by telephone or letter) delegation of germplasm collection for instance to extension workers, very difficult. If use could be made of personnel other than those at the NPGRC to collect specified germplasm for the national collection, the collection would become representative faster and at a lower cost since transport costs could be cut considerably.

3.5 EVALUATION AND CHARACTERIZATION

To date very little characterization of germplasm in the collection has been done. Some 23 pearl millet, 8 sorghum and 2 groundnut accessions have been characterized at SPGRC using IPGRI descriptors. However no data have yet

been received by the NPGRC regarding these characterizations. Some accessions of pearl millet and sorghum have been characterized by ICRISAT in Zimbabwe, but no feed-back has yet been received and no figures can therefore be supplied as to how many accessions are characterized and to what extent. Characterization of indigenous *Citrullus* (Cucurbitaceae) accessions is planned for the 1995/96 season. An attempt will also be made to characterize some 300 accessions of pearl millet and sorghum during the 1995/96 season by the NPGRC together with the Subdivision Agronomy.

Some 70 accessions of sorghum, groundnut and Bambara nut were evaluated as to their yield in single locations during 1992/1993 (sorghum at Mahanene, groundnut and Bambara nut at Uitkomst). The same accessions of sorghum were again evaluated during the 1993/94 season at 3 locations when yield as well as days to heading were assessed (Ministry of Agriculture, Water & Rural Development, 1992/93, 1993/94). This was done in the scope of the Sorghum and Pearl Millet Improvement Programme in northern Namibia. The NPGRC tries to utilize crop experts to carry out characterization and evaluations due to manpower shortage at the NPGRC.

When supplying any seed, the NPGRC makes it a condition, to be signed by the recipient, that any information obtained using the seed, should be fed back to the NPGRC. Since there is no legislation backing up this request, once-off users of the NPGRC can easily get away with never responding. A user requesting seed for a second or consecutive time will however only receive seed if feed-back on the previous request was obtained. Agreements or legislation to back up this aspect will have to be developed urgently.

3.6 REGENERATION

Since the national collection is relatively new, no regenerations have yet been done. The intention is that accessions are regenerated once their viability falls below 85% for crop species and below 65% for wild species.

The shortage of staff presently does not allow regenerations. Facilities are available in principle, but the labour and expertise are lacking. Once crop accessions have been tested for viability, multiplication and regeneration will be done in collaboration with SPGRC or the Subdivision Agronomy. A limited number of accessions, that are in most urgent need of multiplication, will be multiplied in the 1995/96 season.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

The plant genetic resources collection of the NPGRC has to date not been used extensively by local scientists. The main reasons for this being that the NPGRC is relatively new and unknown and that not much plant breeding, seed production or other agronomic research work is being conducted in Namibia at present.

4.1 USE OF PLANT GENETIC RESOURCES COLLECTIONS

The only germplasm used from the NPGRC collection is some accessions of pearl millet and sorghum for the Sorghum and Millet Improvement Programme. Some accessions of Bambara nut and groundnut were used once for yield potential determinations. Germplasm of indigenous *Cucurbitaceae* was requested for the first time during the growing season of 94/95. The number of accessions utilized are listed in Table 4.1.

TABLE 4.1 Accessions from the National Collection (NPGRC) utilized locally

Crop	No. of Accessions Used	Total no. of Accessions in NPGRC
Pearl millet	????	921
Sorghum	20	124
Bambara nut	29	23 (not all accessions received in NPGRC yet)
Groundnut	16	13 (do.)
Cucurbitaceae	20	71

The reason for under-utilization of local germplasm in Namibia seems to be

the lack of expertise in the country. Only two plant breeders are employed by the government. Two government employed agronomists/researchers are involved in evaluation of existing varieties for their suitability to Namibian conditions. One plant taxonomist is working on evaluation of wild *Cucurbitaceae* germplasm. No private enterprise is active in plant breeding and crop development or utilization of local plant genetic resources in Namibia.

Germplasm evaluated for its suitability to Namibian conditions originates from outside the country. Varieties of groundnut, cotton, beans, pigeon pea, cowpea, sunflowers, maize and vegetables tested in Namibia are all bred outside the country. The seed to be evaluated is supplied directly to the researchers concerned or is bought on the commercial seed market and does not pass through the NPGRC. Only a few local accessions of landraces are being used in the Sorghum and Millet Improvement Programme (+20 accessions of sorghum). Since there is such an extreme scarcity of personnel in agronomy, the Directorate of Agriculture Research and Training decided to concentrate on adaptive research. Rather than trying to breed own varieties of crops common to SADC, resources are concentrated on screening existing varieties for their suitability to Namibian conditions.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

There is only one formal crop improvement programme active in Namibia, viz. the Sorghum and Millet Improvement Programme (SMIP). This programme is a SADC project involving only government agencies (in Namibia) and its main function is the production of regionally and locally adapted improved varieties of sorghum and pearl millet. The objective of the programme in Namibia is to increase production in the subsistence farming sector for increased food security through multi-purpose millets with increased yield and yield stability. It is aimed at producing varieties suited for subsistence farmers in the dryland production systems of the relatively dry and climatically unpredictable northern areas of Namibia.

On an informal, unstructured basis, farmers are to some extent also responsible for crop improvement through selection of their own seed for the next season from individuals with superior (in the view of the farmers) performance. In certain cases, farmer selection could possibly be improved through a programme supporting this.

Results of research conducted are transferred to farmers by holding demonstration and field days at research stations and Agricultural Development Centres, involving farmers in the process by on-farm trials and research e.g. On-farm Pearl Millet Resources Management Research Programme (Ministry of Agriculture, Water & Rural Development, 1993/94). An extensive survey on the adoption of the Okashana I cultivar of pearl millet is presently being undertaken by ICRISAT. Results are expected to be available soon (J. Matanyaire, H. Thompson, pers. comm.).

A seed testing and distribution system is in the process of being established by the government. At this stage seed of Okashana I, the only improved variety of pearl millet available to Namibian farmers, is distributed on an ad hoc basis by extension workers, research stations and NGOs mainly during periods of seed shortage. Seed is produced on research stations and by selected farmers since 1994. The ultimate goal is to form a farmers' seed co-operative with government assistance in about three years' time. Seed is to be tested and certified according to international standards at the newly established seed testing station at Mahanene Research Station. The harmonization of seed laws in SADC is being undertaken. In future, similar production and supply systems for open pollinated maize and legume seeds are planned (W. Lechner, pers. comm.).

Lack of expertise and technical staff is the main constraint to plant breeding, seed production and crop improvement in Namibia. Until recently there was a lack of suitable university graduates who could take advantage of opportunities for further training that are offered to Namibians under various existing programmes. Plant breeding, or even agronomy, is not yet taught in Namibia at undergraduate (B.Sc. or B.Sc. Agric.) level, once again because of lack of lecturing expertise, finances and facilities. By establishing a strong agricultural faculty at the University of Namibia (UNAM) with specialization in agronomy, genetics and plant breeding, this problem could be overcome in the long term. Technical staff need to receive specialized training at agricultural colleges as well as on-the-job training in some aspects, as they are required. Once university graduates are more readily available, the shortage of lecturing staff should also be alleviated.

Adequate finances are the second most important constraint to effective utilization of local genetic resources. Due to restricted finances, only limited personnel posts can be approved in the government structure. The available funds have to be prioritized and research programmes therefore concentrate on the most important issues. The current economic climate is also the reason for the lack of private commercial companies dealing in agronomy in Namibia. It would not be viable for such companies to establish themselves in Namibia since there are only a few crop producers that would buy their products. The

costs of establishing such businesses in Namibia can also be prohibitive, with rainfall generally being too low and variable, irrigation water being a scarce and unpredictable commodity, and with generally poor soils and lack of infrastructure for crop production. Loan schemes for inputs for communal farmers have only been introduced recently (A. Botes, pers. comm.).

4.3 BENEFITS DERIVED FROM THE USE OF PLANT GENETIC RESOURCES

Up to now, local plant genetic resources have not been utilized extensively on a scientific basis and therefore their value is generally undetermined. From the limited knowledge available however, it seems that local material has great potential value from which profits could be derived in future. The landraces of pearl millet are well adapted to the conditions in the country, have extreme vigour and good grain quality suitable for commercial milling (Bidinger, 1992) and improving the yield, pest and disease resistance of these landraces would be all that is needed.

The wealth of indigenous wild species with often yet undetermined properties and potential, could greatly contribute towards diversification and extension of the Namibian agricultural sector. Amongst the wild species there may be crops that can be grown in areas that up to now could not be utilized for crop production. New sources of food, medicinal or industrial products are likely to be present amongst the wild genetic resources of Namibia. These could contribute to greater food security, an improved, diverse diet, cheaper or more effective medicines for the general public, a source of cash income to farmers or the establishment of industries around newly found products. Job creation and foreign exchange earnings through export, could be important spin-offs of the identification and subsequent utilization of indigenous wild crops.

The NPGRC keeps only local germplasm in its collection at this stage. Its policy is that no large samples of germplasm that is safely stored elsewhere (e.g. country of origin) or that is easily obtainable (e.g. on the seed market), be stored at the NPGRC. The problem of using valuable storage space to keep foreign germplasm for use locally is therefore not applicable. Collections of foreign germplasm at research stations are temporary.

Germplasm of the wild species in the collection was often collected and stored because of requests received from outside the country. Until now the country did not benefit directly from supplying this germplasm except that the costs of

obtaining the material are often borne by the requesting institute and material is obtained for the national collection. There are however indirect benefits to Namibia in that the scientific research done on its indigenous material enables the country to better understand and manage its indigenous plant genetic resources in the long term. Since the number of Namibian scientists and the aims and scopes of the research they do, are limited, assistance in research from outside the country can make valuable contributions to increasing our knowledge as long as it is controlled to benefit Namibia.

At present there are no agreements or memoranda of understanding (MOUs) between Namibia and any other party concerning the use of indigenous Namibian plant genetic resources. Even legislation protecting and governing the use of Namibian genetic resources is inadequate. If research on and utilization of local plant genetic resources is to be done by parties outside the country, these laws and agreements will have to be strengthened and their enforcement tightened up. For this reason the Ministry of Environment and Tourism is presently revising Namibian environmental legislation with input from the National Programme. This legislation should be ready for implementation by the end of 1997 (P. Barnard, pers. comm.).

4.4 IMPROVING PLANT GENETIC RESOURCES UTILIZATION

Since the concept of plant genetic resources conservation and utilization is very new in Namibia, the national programme presently concentrates on generating awareness amongst the general public and the scientific and decision makers communities.

There have been some minor achievements in that most scientists (agricultural and natural) in the country are aware of the programme and its functions. Botany students at UNAM receive a week-long course on plant genetic resources conservation and genebank management in their final undergraduate year. The Polytechnic of Namibia (Agriculture and Nature Conservation Diplomas) is very interested in presenting a similar course to its students. Politicians and decision makers within the MAWRD are aware of the programme and support it. Much work still needs to be done to raise awareness among the general public, especially in rural areas, and some scientists and decision makers in other Ministries.

The link between conservation of plant genetic resources and the utilization sector is presently not well defined and used. Since the establishment of the

Crop and Horticulture Working Groups, which hold monthly meetings, the national plant genetic resources programme is kept up to date with activities in the field of utilization and vice versa. In general, local plant genetic resources could be utilized far more extensively, but lack of researchers and crop improvement programmes limits their use.

In the near future the national programme sees its main role in promoting and doing research on improvement of traditional subsistence crops and the development of lesser known local crops or species that are utilized from the wild. This is seen as an important way of diversification of the Namibian agricultural sector that could increase food security and the living standards of the rural population in particular. The necessary expertise and facilities will have to be obtained first.

To achieve the goal of obtaining greater benefits from Namibian germplasm, documentation (inventories) of all local plant genetic resources is the first step. Once the possibilities are known, intensive characterization and evaluation of these resources is the only way towards better utilization. Since personnel and facilities are limited in the country, close co-operation between different projects and programmes, agencies and Ministries within the country is essential to achieve maximum results. Duplication of any work is something that cannot be afforded Namibia. Also on the regional and international front, co-operation is essential to utilize available resources (financial and facilities) most productively.

To improve plant genetic resources utilization in Namibia, local capacity building will be essential. Training of local staff, especially technical personnel is essential. If sufficient well-trained and experienced technical personnel is available, the few professional staff could achieve much more.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

Namibia is probably the only country in the world that specifically refers to biodiversity in its constitution:

"The state shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at the following: (i) maintenance of ecosystems, essential ecological processes and biological diversity of Namibia, and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, present and future."

In general however, Namibia urgently needs to look at the issues of policy and legislation. These are not well developed or are poorly implemented or enforced. In most cases South African laws are still applicable from the days before independence and these are often outdated and not specific enough for Namibian conditions.

5.1 NATIONAL PROGRAMMES

Plant genetic resources activities are organized into a loosely structured national programme co-ordinated by the NPGRC. The programme forms part of a SADC project with the Namibian part run mainly by government institutions. Activities at the NPGRC itself are mainly government funded. Some funds are obtained from SPGRC and other institutions requesting services or co-operation. Several projects contribute to the national programme e.g. research projects under the Subdivision Agronomy of the MAWRD, National Herbarium, NGO's, UNAM. Activities of the national programme are co-ordinated by the National Plant Genetic Resources Committee (NPGRCom) which consists of representatives from the different sectors of genetic resources activities. The national programme covers all aspects of plant genetic resources conservation and use. Conservation of plant genetic resources is carried out mainly at the NPGRC while use-related research is done mainly by the

Subdivision Agronomy of the MAWRD. *in situ* conservation has not been given serious attention yet, but it is envisaged that this will be done in collaboration with the Ministry of Environment and Tourism, NGOs and the Division of Rural Development of the MAWRD. No commercial firms are involved in the national programme since there are none active in this sector in Namibia.

By maintaining a national plant genetic resources programme, the Namibian Government wants to ensure protection, conservation and utilization of the country's indigenous plant genetic resources. There is legislation to govern collection of and research on wild plant material (natural resources) in Namibia which is administered by the Ministry of Environment and Tourism (Nature Conservation Act). At present, plant genetic resources collections are not fully protected by Namibian legislation. The collections are, however, in a sense also protected by the Namibian Constitution and the Biodiversity Convention to which Namibia is a signatory. The government is also committed to protecting indigenous plant genetic resources by signing the MOU for the SPGRC project.

The national programme operates by a policy which was formalized at the First National PGR Workshop in 1991 (Appendix B). Over the past two years it has become apparent that Namibia's plant genetic resources and information gained from using them, need to be better protected by legislation. Research data collected in Namibia or using Namibian material and any information gained as a result, should remain the property of the country and be freely available to it. Agreements will in future be signed to clearly spell out the obligations of the user and supplier of germplasm to ensure mutual benefit. Any patentable or commercially profitable products or uses derived from Namibian genetic resources should accrue legally-binding royalty payments to the Government of Namibia by the firms, research institutes or individuals patenting or profiting from these resources.

The activities of the national programme are co-ordinated by the NPGRCom. This committee consists of representatives from the following disciplines or institutions: Ministry of Environment and Tourism, Directorate Forestry, National Herbarium, University of Namibia, NPGRC, taxonomy, agronomy, rangeland science and plant ecology. The NPGRCom should be revised to include representatives from NGOs, extension and possibly private farmers. The purpose of this committee is to co-ordinate different activities taking place in the country that are related to plant genetic resources. The committee is also to advise the NPGRC on activities and policies. Meetings are held regularly at which the different aspects in which members are involved or have contact with, are discussed and future action is determined. The head of the NPGRC

is accountable to the Ministry of Agriculture, Water & Rural Development via the NPGRCom. Within the MAWRD the post of the head of the NPGRC is that of an agricultural researcher on par with all other researchers in other sections of the Ministry. The head of the NPGRC reports to the chief researcher of the National Botanical Research Institute (NBRI) which in turn falls under the Division Plant Production Research together with the Subdivisions Agronomy and Analytical Services.

The posts for the head and staff of the NPGRC have been approved by the Public Service Commission and ultimately by Cabinet. The posts are allocated to the NBRI as a whole and subdivision is left up to the institute. According to the newly approved structure, the NBRI was allocated 1 chief researcher, 7 researchers, 6 technicians, 4 technical assistants and 1 clerical assistant. Of these posts 2 researchers, 2 technicians and 1 technical assistant were allocated to the NPGRC. Six labourers are available to the NBRI as a whole. Posts for personnel in the Subdivision Agronomy, who are active in the utilization of genetic resources, are approved in the same way. Presently, provision is made in the Agronomy subdivision for 10 researcher posts of which 6 are filled and 36 technician posts of which 18 are filled (J.P. Venter, pers. comm.). A fairly large number of assistants and labourers is available.

As with the post structure, the genetic resources programme does not have its own budget line. The budget approved by the Director of Agriculture Research and Training is compiled by the various subdivisions to become part of the budget of the MAWRD. The ministerial budget is approved by the Minister of Finance and finally Cabinet. The national programme is therefore budgeted for under the Subdivision NBRI, with no further division for sole use by the NPGRC. The government is committed to provide funds for research which includes the NBRI. The commitment of the MAWRD to the plant genetic resources programme is underlined by its formal agreement, approved by Cabinet, to contribute financially towards the SPGRC project. A further sign of commitment by the Namibian government is the provision of new buildings to house the NPGRC. Other activities e.g. breeding and evaluation are provided for on the budget of the Subdivision Agronomy.

5.2 TRAINING

One of the main constraints to an efficient national programme in Namibia is the lack of adequately trained staff. The NPGRC is staffed with one researcher/curator trained to M.Sc. level and 1 technician (B.Sc.). In the sectors of plant genetic resources utilization, 10 researchers and 18 technicians (devoting at least some time to the national programme) are available. The number of assistants and labourers could not be obtained. The biggest problem in obtaining professional staff is the lack of local undergraduate training facilities/opportunities in agronomy and related subjects. At UNAM students are only trained up to B.Sc. level with botany as a major subject, however there are recent plans to establish a Faculty of Agriculture, hopefully by 1996. The position with technical staff is slowly improving as students from the various agricultural colleges graduate and take up positions. Their qualifications are however not very specific. Namibia's greatest training needs are therefore for undergraduate training. Post-graduate training can be obtained through various programmes at institutions outside the country. Financial constraints are also indirectly responsible for the lack of personnel. Salaries at government departments are not very competitive. Personnel leave for the private sector (usually into completely different lines of work) and are lost to the sector. Within the immediate national programme (NPGRC) staff turnover has not been high, but this cannot be seen as a general trend since the NPGRC is still young and did not really have any staff until 1994.

Skills available in the programme (in its widest sense) are agronomic evaluation, plant taxonomy (especially of indigenous species), rangeland management, data management, plant breeding, plant ecology and education through the members of the NPGRCom. The programme can however draw on expertise in various other fields like anthropology, habitat conservation, ethnobotany and plant physiology through close contact with other institutions and/or experts.

Within Namibia there exists only very basic training in fields related to plant genetic resources. UNAM offers a 3-year B.Sc. course in botany in which subjects like taxonomy and economic botany (including genetic resource conservation and genebank management) are offered. The NPGRC is involved in presenting this module. The Botany Department is presently devising a 4-year degree programme in which the above component would be expanded to allow for a more detailed course in genetic resources (A. Burke, pers. comm.). The Polytechnic of Namibia offers 3-year diploma courses in Nature Conservation and Agriculture with modules on habitat conservation, nature reserve management, plant taxonomy and agronomy. The School of Natural Resource

Management within the Polytechnic is very interested in including lectures on plant genetic resources conservation and utilization in their syllabus. The Agricultural College at Ogongo is the only college in Namibia geared towards training in agronomy related subjects. A 3-year diploma course is offered, touching on a wide array of subjects, including crop production.

With the exception of the NPGRC which could offer courses in genebank management and the NBRI which could offer plant identification and herbarium management courses, there are no other national institutions (other than the University or colleges) that could offer courses in plant genetic resources locally. Namibian scientists are quite knowledgeable in plant taxonomy and have a well equipped and well run *herbarium.* Courses in *herbarium* management could be offered with the appropriate financial assistance and, at least in the beginning, some additional expertise for lecturing. This would have to take the form of informal courses i.e. not leading to a diploma or degree. Input from IPGRI and SPGRC was received in 1993 to start the plant genetic resources course at UNAM. Given the shortage of suitable participants in Namibia, formal courses should probably not be a priority. Existing courses at UNAM, Technikon and Colleges should be extended to include such modules rather than starting separate new courses. What would be of greater value to the national programme is more informal training e.g. training of extension officers in germplasm collecting techniques. Such a course was held in 1991 in collaboration with IPGRI and ILCA. Unfortunately most of the personnel trained then, have resigned or moved to other positions. Repeated courses like this, say every 2 years, may be necessary. Informal, on-the-job training opportunities for existing staff in specific aspects of plant genetic resources may also be more useful. Given the small population, small size of the agronomy sector and limited jobs available in this field, regular, highly specific training would possibly not be viable since students/trainees would not be able to find employment.

Before the national programme can become really effective, awareness still needs to be raised among the general public, especially rural crop producing communities through public relations work, articles in newspapers and periodicals. Some decision makers still need to be sensitized as to the importance of a national plant genetic resources programme. This public relations campaign will have to become one of the priorities for the programme in the next few years.

When it comes to the involvement of Namibian personnel in international plant genetic resources training programmes, the choice of persons sent, is made solely on the suitability of the candidate for the course and the relevance of the training to their field of work. Such training opportunities are only

taken up if the need exists and only personnel that have already secured a job related to the national programme are sent for further training. Training serves no purpose if the trained person cannot contribute to the national programme because he/she cannot be employed in any sector where the knowledge gained can be applied to the advantage of the country.

5.3 NATIONAL LEGISLATION

Namibia does not have any phytosanitary legislation of its own. The South African laws that were applicable in Namibia before independence are still in force and will probably remain so until they are repealed to be replaced by our own legislation.

Namibia does not have any quarantine facilities. Plant material that is imported into Namibia is subject to issue of an import permit. Wherever possible, material that requires quarantine, is imported through the Republic of South Africa, where it will be quarantined. Any other plant material entering the country must comply with the import conditions stipulated on the import permit, including a phytosanitary certificate from the country of origin. Plant material may be detained by customs officials for inspection prior to entering Namibia. Plant material leaving Namibia must be issued with a phytosanitary certificate. It is up to the exporter to ensure that he complies with the import conditions of the destination country. Unfortunately, this section is hopelessly underdeveloped and understaffed. There is one phytosanitary control officer based in Windhoek; there are no plant inspectors, pathologists or quarantine officers. This situation demands urgent attention in Namibia. Some efforts have been made by FAO to develop the phytosanitary system in the SADC region and further help has been requested by the MAWRD. Because of the lack of strict import/export control, movement of germplasm is not affected seriously in any way at this stage.

Imported genetic resources may generally be planted freely in Namibia. More stringent control over this and any experimenting with introduced or genetically engineered germplasm is sorely needed. An aspect that should receive particular attention is the invasive character of some introduced species, since the potential for problems already exist in the country with such species (P. Keen, pers. comm.).

Government does not provide any incentives to farmers for the conservation of traditional crop varieties. The traditional varieties were probably saved by the

fact that until recently farmers in the subsistence sector, the main crop producers, did not receive any support in extension, research and development and did not have access to financial support in the form of loans or subsidies. The seed production and sale sector is also practically non-existent in Namibia. Legislation governing registration, import, sale and distribution of seeds is still that of the Republic of South Africa, but since pearl millet was not considered a crop in those days, no legislation exists for it. This is however something that the Agronomy Section of the MAWRD is looking into.

Intellectual Property Rights (IPRs) are not legalized in Namibia. The whole issue of IPRs needs to be debated amongst the different parties before a conclusion can be reached. At this time there is nobody within the country that has extensive knowledge or experience in this field. It is probably safe to assume that the full implications of IPRs (Namibia's lack of, as well as those existing in other countries) are not yet understood by local scientists. Namibia would definitely need assistance in legal matters pertaining to plant genetic resources in future.

During the first National PGR Workshop in 1991, a policy on germplasm collection and exchange was drafted (Appendix B). According to this policy, anybody wishing to collect germplasm or do any research on it in Namibia, must apply for a permit at the Ministry of Environment and Tourism. The application must be accompanied by a project proposal with full details of the work and parties involved. Such applications are forwarded to the NBRI for evaluation and recommendation or approval. In that way, any work to be done, will first be evaluated by the national programme. However, this only applies to wild plant genetic resources. Three conditions of the permit will be that local counterparts, approved by the NPGRCom, must be involved at all stages of collecting and further research; that subsamples, reference *herbarium* collections and information pertaining to the germplasm remain in the country and that any commercial benefit obtained by the collecting party be shared with Namibia. When germplasm is requested from the national collection, the recipient undertakes to give feedback to the NPGRC on any information obtained with the material. If larger projects, not purely for scientific-taxonomic research, are involved, such as screening of material for certain characteristics and ingredients or crop improvement, an agreement will be drawn up to be signed by both parties guaranteeing Namibia benefits from making its germplasm available to outsiders. Such a case has not yet been encountered.

The Department of Environmental Affairs of the Ministry of Environment and Tourism is formulating a policy to control access to biodiversity, including genetic resources in Namibian territory. The proposal will envisage a mechani-

sm for Namibia to extract a share of the benefits of products derived from Namibia's natural resources (D. Cooper & P. Barnard, pers. comm.).

The first factor influencing the decision to provide germplasm is availability . Secondly, the nature and extent of benefits to Namibia will be considered. Thirdly, the willingness of the requesting party to sign a mutual agreement will determine if germplasm is given out. The NPGRCom will advise the NPGRC in such cases.

5.4 OTHER POLICIES

The new Agricultural Policy for Namibia is being finalized and should be available before the end of 1995. The policy places heavy emphasis on sustainable use of natural resources. From this policy, strategies and action plans will be drawn up which should be an important stage for input by the national plant genetic resources programme.

Since there has thus far not been much activity in producing crop varieties in Namibia, no system of incentives for plant breeders has been developed and since the only plant breeding activity at the moment rests with government institutions, it is not likely that such incentives will be introduced.

Until recently there were no loan or subsidy schemes for communal farmers. Their choice of crop was therefore largely determined by climatic conditions, food preferences and traditions. The impact of this policy/lack of policy has therefore been positive rather than negative on conservation of traditional varieties. Besides there not being any improved varieties of the main crop (pearl millet) available to Namibian subsistence farmers in the past, financial constraints have forced these farmers to stick to their traditional crops. Some improved varieties of several other minor crops have been introduced on a small scale. Since the Small Scale Advance Loan Scheme for communal farmers of the Agricultural Bank of Namibia (subsidised by the Ministry of Agriculture, Water & Rural Development) was only recently introduced, the effect of the availability of financial support for subsistence farmers has not yet been assessed. It is assumed that this will, however, influence not the types of crops farmers grow, so much as the amount (acreage and increased yield per ha) that they grow (A. Botes, pers. comm.). Financial aid is also available to small farmers through the Namibia Development Corporation (NDC) for pearl millet and cotton production.

Commercial farmers may receive loans from the Agricultural Bank of Namibia for inputs. The Ministry of Agriculture subsidises the interest on these loans, which are administered by the Agronomy Board and are available for inputs for growing of wheat, sunflower and maize. Loan availability does not seem to have a significant effect on the crops grown by commercial farmers. Their first consideration when choosing a crop is the economic viability of their operation i.e. market value of their product, production costs and suitability of the crop for their area. Crop farmers tend to use these loans to increase the acreage that they plant rather than to finance their entire farming activity (A. Botes, pers. comm.). The increase of cultivated acreage potentially is detrimental to the conservation of plant genetic resources.
NPGRCom members are often involved in planning of agricultural development projects, but this is not a formalized process. This needs to be considered in future. Evaluating projects as to their impact on local plant genetic resources conservation and utilization has to become a priority.

5.5 TRADE, COMMERCIAL AND OTHER INTERNATIONAL AGREEMENTS

After independence, trade between Namibia and most other countries (other than South Africa) became possible and has increased over the past 5 years. Before independence South Africa was virtually our only trading partner due to boycotts and trade restrictions aimed at that country.

With trade in plant genetic resources, especially in improved varieties of common crops, between SADC countries now being common, the national programme may potentially be affected as regards genetic erosion of traditional varieties. It therefore now has the task of trying to conserve these traditional varieties as fast as possible, which is a heavy burden on a small programme like this.

It seems that the government did not consider the impact of its trade policies on local plant genetic resources. Material is entering the country without it being fully evaluated as to its possible impact on local varieties of the crop, its suitability for the country, seed purity or quality. The national programme will have to make a serious effort to have a voice in drafting of such policies.

The GATT agreement could possibly have an impact on wheat production in Namibia. The producer's price for wheat may, as a result of the agreement, drop too low for Namibian farmers to make wheat production a viable business. The full impact of this can however not be assessed at this stage (A. Botes, pers. comm.).

CHAPTER 6
International Collaboration

6.1 UNITED NATIONS INITIATIVES

UNCED

Namibia signed the Biodiversity Convention in Rio de Janeiro, June 1992. Since then, a National Biodiversity Task Force has been established, which is a network of expertise from various disciplines in the country . Its first task will be to prepare the Biodiversity Country Study for Namibia (requirement of Chapter 15 of Agenda 21). In future this task force will act as a technical co-ordinating body for any biodiversity research in the country. The country study is to include plans for future action once the gaps in knowledge have been identified. During the process of preparing the country study, databases will be established where they do not already exist and existing knowledge summarised to facilitate any future monitoring and research.

Some aspects of Chapter 14G of Agenda 21 have been addressed by Namibia. The Sorghum and Pearl Millet Improvement Programme for example was implemented. Indigenous landraces were evaluated and are now being used in this programme, which is aimed at producing improved planting material for subsistence farmers. Through training at ICRISAT, local capacity in the field of genetic resources utilization was built. FAO assisted in establishing a seed supply and testing system with the ultimate goal of farmer seed co-operatives. The government of Namibia has revised its staff structure to accommodate the increase in activities in agronomy and related disciplines. The national plant genetic resources programme was established and *ex situ* conservation of some material has been achieved. Through training opportunities identified by SPGRC, local capacity for conservation of genetic resources has improved, but is not yet adequate. The National Botanical Research Institute has shifted the emphasis of its research towards economic botany with planned projects on medicinal plants, poisonous plants, potential new indigenous crops and ornamentals. A project evaluating the potential of indigenous *Cucurbitaceae* (a regionally important family) is ongoing.

FAO Global System

Namibia is not a member of the FAO Commission on Plant Genetic Resources. The role of an international fund is seen as providing financial assistance to programmes or projects that are directly involved with the conservation of plant genetic resources, especially *in situ* conservation methods, new methods of utilization and development of new crops. Projects assisted by the fund must have high local priority. At this stage, Namibia can be neither a beneficiary nor a donor, because the programme presently is not developed fully to be able to utilize such funds. In future Namibia may become a beneficiary.

FAO assisted Namibia in establishing a seed supply and testing system. FAO is also involved in strengthening the phytosanitary and quarantine system in Namibia.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

The CGIAR

The national programme has collaborated with both the regional (Sub-Saharan Africa) and head office of IPGRI since 1990. Two collecting missions for wild species (1990 & 1991), which contributed about 340 accessions to the national collection, were launched by regional IPGRI staff (Moss, 1990, 1991). A third collecting mission with IPGRI-SSA collaboration in 1994, concentrated on Cucurbitaceae and contributed about 70 accessions. A course for germplasm collectors in collaboration with ILCA was held by IPGRI in 1991 in northern Namibia (Guarino, 1991). Further training in which IPGRI was involved were courses in "Plant Genetic Resources Conservation and Genebank Management" at the University of Namibia, in 1993 and 1994, and a course on "Plant Exploration and Conservation Strategies" in collaboration with the Darwin Initiative, in 1994. The library at IPGRI headquarters has been most helpful in obtaining literature and references.

ILCA staff from the head office in Addis Ababa was involved in training of collectors in Namibia in 1991 as well as in individual on-the -job training of an assistant in tissue culture methods. In future, collaboration with ILCA in Niger on animal traction technology could be helpful in developing the Namibian agronomy sector.

Collaboration with ICRAF staff from both the head office and regional offices involved the collection of Sesbania germplasm with the necessary training beforehand (1993). Regional ICRAF staff is also involved in a consultative role for the establishment of an agroforestry research programme in Namibia.

There is strong collaboration with ICRISAT through collaborative annual workplans. ICRISAT is involved with the Namibian national programme mainly in the Sorghum and Pearl Millet Improvement Programme. A germplasm collecting mission was undertaken in 1991 by ICRISAT staff from the head office. This collection of mainly pearl millet is presumed to be representative of the diversity available in Namibia and consists of about 1,100 accessions. ICRISAT has helped with germplasm characterisation of *sorghum* and pearl millet collections (1992). They provide research material for *sorghum*, pearl millet, groundnuts, pigeon peas and forages. Scientists and technicians have received training at ICRISAT centres and the ICRISAT scientists provide technical support to the local Namibian breeder.

Collaboration with IITA on cowpea and root crops and ICARDA on other or new crops for Namibia, needs to be strengthened and/or established as soon as Namibia has some local capacity for research in these fields.

Until now, assistance requested from the CGIARs dealt with could be complied with satisfactorily. Communication with the CGIARs is mainly on a personal level between scientists. This has been adequate so far, but the national programme has not yet had much experience.

The role of the CGIARs is seen as providing assistance and advice on activities carried out by the national programmes. The centres should have basic information available that can be passed on to national programmes to enable them to perform their tasks efficiently e.g. ideal storage conditions , monitoring intervals, priorities for conservation for their mandate species. Where necessary, CGIAR's should do basic research to provide the information that is still lacking. The functions of IPGRI are seen very much in the light of the above. Its main role should be in co-ordinating plant genetic resources activities globally. IPGRI should provide baseline data and information or be able to point national programmes to persons or institutes that could provide such information. IPGRI should make recommendations on optimum methods of conservation, characterization, evaluation, utilization and legal matters (agreements, IPRs). Another function of IPGRI should be training or the identification of training opportunities.

Regional Research Centres

Research at regional centres should concentrate on specific problems common to the region. Such centres should identify regional priorities and assist national programmes in solving specific problems they encounter. Presently, collaboration with such centres does not depend on formal agreements, because individual efforts and contacts make the difference. Having a formal agreement does help when budgeting or motivating for projects, but it is not essential.

6.3 REGIONAL INTERGOVERNMENTAL INITIATIVES

The national programme of Namibia is part of the SADC Plant Genetic Resources Centre Project. The advantages of being part of this initiative are that training opportunities are provided and some activities are co-ordinated and standardized in the region e.g. documentation programme, Regional Crop Working Groups. Opportunities exist for the exchange of knowledge and experiences with other national programmes. The Project can also act as a spokesperson for national programmes and solicit funding on behalf of them. The cost of participating in this programme is an annual financial contribution as well as staff time for board meetings, workshops and working group meetings.

The SADC Tree Seed Centre Network functions similarly to the above for forest genetic resources.

At this stage no further regional programmes are needed. Existing programmes should rather be strengthened and improved. Regional centres should only co-ordinate, advise and provide assistance if requested by national programmes. Such centres could have a role in convincing governments to implement and commit to national programmes.

6.4 BILATERAL INTERGOVERNMENTAL INITIATIVES

At present there are no such agreements between Namibia and any other government. SPGRC facilitates procurement of equipment under bilateral agreements between SIDA and SADC member states.

CHAPTER 7
National Needs and OPPORTUNITIES

- A computerized inventory of all plant genetic resources in Namibia must be compiled, but the capacity to do this is lacking.
- A database containing basic information on factors that influence plant genetic resources e.g. climatic data, soils, farming systems, socio-economic conditions, indigenous knowledge, development plans, is needed. This would require a multidisciplinary approach for which a co-ordinating body needs to be established. At present the capacity for this does not exist, but the National Biodiversity Task Force could in future possibly play a role.
- Undergraduate training of local students and technical staff needs to be improved and expanded to include fields such as genetics, agronomy, plant breeding. This is the first vital step towards building local capacity. This should preferably be done by strengthening and expanding existing educational facilities and courses.
- Local capacity for characterization, evaluation, regeneration and multiplication activities needs to be built. If characterization can be done at this early stage of the programme, the demand on the national programme will not be so great in future when regeneration of stored accessions will become a necessary priority.
- The national programme needs to embark on an extensive awareness campaign to sensitise decision makers and the general public, especially crop producers. The use of local plant genetic resources within Namibia needs to be promoted and expanded.
- The national programme needs to strengthen and develop linkages between the various disciplines contributing to plant genetic resources activities. In particular extension workers, training institutions, rural women and users of genetic resources and the conservation programme need to co-ordinate their activities and co-operate wherever possible. This could be achieved by revising the composition of the NPGRCom.
- The properties and potential or value of local genetic resources needs to be determined and documented. This research should be aimed mainly at the needs of the communal farmers, thereby contributing towards increased food security and better living standards.

- Promising wild species in Namibia need to be investigated as to their potential for development into new crops.
- The conservation of genetic resources *in situ* (both on-farm and in reserves) needs to be considered and action plans prepared.
- The seed production and supply system and accompanying legislation for all crops in Namibia need to be fully implemented and/or revised.
- Research on phytosanitary matters such as plant pests and diseases, quarantine and biosafety, urgently needs to be done in order to revise legislation pertaining to the import and export of plant material. This legislation should include importation of new cultivars (incl. genetically engineered material) for planting to control quality of imported material and safety of existing local genetic resources. The phytosanitary section of the Ministry of Agriculture, Water and Rural Development needs to be strengthened and expanded to be able to cope with this task.
- National legislation on collection and exploitation of local genetic resources urgently needs to be formulated and enacted. This legislation should empower the national programme to enter into mutual agreements, ensuring mutual benefit for users and suppliers of plant genetic resources. Legislation on IPRs will have to be considered. Namibia will need external input for this.
- The extent and severity of genetic erosion of local Namibian genetic resources needs to be determined and documented. In the meantime efforts should be made to minimize this erosion.
- To facilitate the work of the national plant genetic resources programme, guides on identification and collecting and conservation methods, understandable to laymen, need to be published.
- There are several regional and international initiatives or programmes from which Namibia could benefit. These initiatives have to be strengthened and developed to their full capacity to be efficient and effective in the tasks assigned to them. The national programme should co-operate with and contribute to such initiatives whenever possible.
- The national programme should assist local and international projects with technical services e.g. identifications, collecting of germplasm, storage, identification of training and funding opportunities.

CHAPTER 8
Proposal for a Global Plan of Action

THE GLOBAL PLAN OF ACTION SHOULD:

- promote and facilitate the revision and updating of global priorities for collection and conservation;
- make provision for an easily accessible fund for collection and conservation of priority plant genetic resources;
- provide technical aid for documentation, conservation and research efforts;
- promote and facilitate extensive public awareness campaigns at all levels through all possible media;
- promote commitment by national governments to plant genetic resources conservation and utilization activities through adequate funding and logistic support of national programmes.
- strengthen and promote existing regional and international initiatives that have direct influence on plant genetic resources conservation and utilization.

ANNEX 1
Namibia Forest Genetic Resources

compiled by:

M.A. N. MULLER

March 1995

CHAPTER 1 INTRODUCTION

Information on Namibia's forest genetic resources is rather erratic. The country has low rainfall, from 50-700 mm per annum, which falls mainly in the hot summer months. This is followed by a dry period of about eight months when the temperatures often drop below freezing point. Due to these factors the woody resources are relatively scarce in the southern and western part of the country and are mainly restricted to the seasonal watercourses. The majority of forest resources are restricted to the north and north-eastern part of the country which have an annual rainfall of 500-700 mm.

CHAPTER 2 INDIGENOUS FOREST GENETIC RESOURCES

Several forest species, both of social and economic importance are dealt with by the Directorate of Forestry. Species of main economic importance are:

Pterocarpus angolensis (Dolfwood, Kiaat)
Baikiaea plurijuga (Zambesi Teak)
Guibourtia coleosperma (Shivi, False Mopane)
Colophospermum mopane (Mopane)

2.1 *Pterocarpus angolensis*

The distribution of this commercially important species is limited to the Kalahari sand soils of north and north-eastern Namibia. It seldom occurs in pure stands but is rather sparsely distributed.

The wood is sought after for use in wood-carving and furniture making. At present no precise records are available of standing stock in Namibia. Two projects aiming at determining the status of this as well as other woody species viz. the Vegetation Mapping and Forestry Inventory projects are underway. At present only one concession holder has permission to harvest trees in the Bushmanland area - and only in limited quantities. Until more information on the standing woody biomass is available from above mentioned projects no more concessions will be granted for the harvesting of this species in any area.

In the Kavango Region this species is used on a large scale for wood carvings. In a survey done by CANAMCO in the Kavango, this tree was identified as one of the most important multi-purpose tree in all of the 4 villages questioned (P. Keen, pers. comm.). Being a communal area, very little can be done to control this unsustainable practice. It can be said that the future of this species in the Kavango Region is threatened. On the other hand, in Bushmanland research projects are presently investigating the sustainable management of this species.

2.2 *Baikiaea plurijuga and Guibourtia coleosperma*

Both species are exploited on a small scale and were identified by 3 of the 4 villages questioned in the CANAMCO survey as amongst the most important multi-purpose tree in the Kavango. Unfortunately no records are available on the present status of these species. Information on the status will only become available after the completion of the Forestry Inventory project (hopefully by the end of 1996). The distribution of these species is limited to the Kalahari sand soils of northern Namibia.

2.3 *Colophospermum mopane*

Mopane is a multi-purpose tree used for fodder, house building and fuelwood. It is the host plant of the famous “mopane worm” or caterpillar which is a sought after delicacy and recently it was in the limelight for its roots which are used for ornamental purposes. Unfortunately due to uncontrolled exploitation, the harvesting of these roots had to be stopped. A survey on the present status

of this species is now underway. Mopane, a dominant species in the Owambo region, is under heavy pressure. A research project on the rehabilitation of mopane woodland has already started.

All the above-mentioned species are all protected by the Forestry Act.

2.4 *Hyphaene petersiana* (Makalani Palm)

The future of the Makalani palm at provenance level is at risk. The use of the leaves of the Makalani palm for basket-weaving and hut-building purposes has resulted in the large-scale destruction of this species in the north-eastern part of the Kavango region. The recent, large-scale use of seeds for ornaments sold to tourists and curio shops, may cause a drop in the natural regeneration of populations (P. Craven, pers. comm.). Research trials for the re-establishment of this species in north-eastern Kavango is in the planning stage.

2.5 *Protea gaguedi* (White Sugarcane)

This species, which occurred naturally along the Okavango River, is for all practical purposes extinct in Namibia due to frequent veld fires and the over-exploitation of the roots for medicinal purposes. Namibia is in the process of acquiring genetic material from the Angolan side of the Kavango River for re-introduction to its original habitats.

2.6 Various Indigenous Fruit Trees

Important indigenous fruit tree species are:

- *Sclerocarya birrea* subsp. *caffra* - Marula
- *Berchemia discolor* - Dogplum
- *Strychnos* spp. - Monkey oranges
- *Schinziophyton rautanenii* - Manketti

Although heavily exploited for their fruit in rural areas, all these species are protected by local people. Research on the natural regeneration of these species is in the planning process.

Other tree species identified during the CANAMCO survey as being important multi-purpose tree species were:

Terminalia sericea, *Burkea africana*, *Croton gratissimus*, *Dichrostachys cinerea* (3 out of 4 villages) and *Lonchocarpus nelsii*, *Peltophorum africanum*, *Dialium engleranum*, *Boscia albitrunca*, *Terminalia prunioides*, *Strychnos cocculoides*, *Diplorhynchus condylocarpon*, *Acacia mellifera*, *Combretum collinum*, *Acacia erioloba*, *Securidaca longepedunculata*, *Ziziphus mucronata*, *Combretum imberbe* (1 out of 4 villages).

CHAPTER 3 NATIONAL CONSERVATION ACTIVITIES

All *in situ* conservation of tree and shrub species is in proclaimed National Parks and proclaimed Forest Reserves. *in situ* conservation in these areas is managed by technical experts. Some of these *in situ* areas are maintained as total wilderness areas, others are partly open for tourist purposes with special conditions that indigenous vegetation may not be disturbed.

The country is in the process of establishing a National Tree Seed Centre (NTSC). This Centre is in Okahandja and is housed temporarily in the present accommodation until the newly planned facilities are finished. The cost of the National Research Institute, which will also house the NTSC, will be approximately N$ 1,2 mio. on completion and will be borne by the Government of Namibia.

The National Tree Seed Centre is part of the SADC Tree Seed Centre Network which is sponsored by the Canadian International Development Agency (CIDA). The NTSC receives technical and training assistance as well as support in terms of material and supplies from this project. A technical tree seed specialist (Western Region) who provides technical support to the tree seed centres of Namibia and Angola, is based in Windhoek.

The NTSC is responsible for collecting, processing, storing and distributing of tree seeds of high physiological and genetic quality. This seed will be used in afforestation/ reforestation and research programs in Namibia. The emphasis in this case is on short term storage.

The NTSC will concentrate mainly on indigenous tree and woody species of Namibia. A collecting programme will be designed to cover those species for which there is a demand as well as species which are in need of protection.

As part of the SADC TSC Network the NTSC will also participate in range-wide collections in southern Africa.

The NTSC will compile information on the reproductive and seed biology of all species collected, enabling the centre to collect seeds of high quality at reduced costs in the future.

The Directorate of Forestry has already committed itself to several afforestation programmes in the severely deforested areas of northern Namibia. For these programmes large quantities of seed are urgently needed to produce enough seedlings for planting in deforested areas. Although most of the seed will be used by the Directorate of Forestry in afforestation programmes there is also a big demand for seed from other government organizations, non-government organizations as well as international forest research institutes.

Until now the Directorate of Forestry received most of its tree seed, both indigenous and exotic, from the Republic of South Africa. By establishing its own NTSC it will eventually be able to fulfill its own tree seed needs as well as provide external needs.

As soon as the NTSC can employ sufficient staff to run the Centre, they will embark on a planned collection programme. This programme will consider the requests from the Directorate of Forestry and other interested organizations and individuals. It is anticipated that the NTSC will eventually develop a cost-covering system to partly cover the collection costs. In doing this the Centre can generate income which will make it sustainable.

Storage Facilities

Material collected by the National Tree Seed Centre is not earmarked for long-term storage. In fact the aim of the Centre will be to provide the immediate needs of the country and abroad.

There will be short term storage facilities for an intermediate storage period (5-10 years) as well as long term storage for research purposes. Short term storage of tree seed will be maintained at low temperatures in sealed plastic containers. Treatment and storage of all tree seed will comply with internationally recommended standards. Base collection material will be stored at the National Plant Genetic Resources Centre which is fully equipped to handle this type of collection and will also accept responsibility for viability testing. Regeneration will be done in collaboration with the Directorate of Forestry.

Arboreta and field genebanks will be established as soon as enough staff can be secured by the Research Division of the Directorate of Forestry. These facilities will be part of the national tree breeding programs and utilization needs. The government's concern with these programmes is reflected in its commitment to an afforestation program of N$6.2 mio. which is to run until 1999.

Documentation

The NTSC will have to start from scratch as no collection or collection data existed before independence. All data from collected material will be computerized and it is envisaged that a seed catalogue will eventually be published annually. All samples will be fully documented - containing passport data, characterization data and indigenous knowledge. Information will be made available by computer print-outs.

It is anticipated that after establishing the NTSC, five satellite stations will be established viz. at Hamoye (north-east), Opuwo (north-west), Walvis Bay (Namib Desert), Hardap (south) and Gobabis (east). Material will be collected and processed at these satellite stations and be transferred to the NTSC for storage and distribution.

Evaluation and Characterizatiom

As yet characterization and evaluation of tree germplasm samples is non-existent. However, it is anticipated that as soon as there is progress on plant collecting activities, these processes will be carried out.

Regeneration

As yet no forestry regeneration programme exists in Namibia. The NTSC intends to regenerate the accessions in its collection as soon as possible. The regeneration will be done by tree breeding officials of the Directorate of Forestry.

CHAPTER 4 NATIONAL GOALS, POLICIES, PROGRAMMES AND LEGISLATION

Forest Policy

The National Forest Policy as well as the Constitution of the Republic of Namibia adopted a policy aimed at the

"maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of natural resources on a sustainable basis for the benefit of all Namibians, both present and future."

Point 6.1.4 of the Forest Policy states:

"For the conservation of total biological diversity, the network of national parks, sanctuaries, biosphere reserves and other protected areas should be strengthened and extended adequately."

Under point 6.2 it is proposed that the aim of Namibia should be to have approximately 10% of the country declared as forest reserves.

Point 6.13 of the policy recommends "Research into effective conservation and management of existing forest resources (mainly natural forest eco-systems)."

Training

The NTSC was established recently and its staff consists of a single research technician with a B.Sc. degree. It is already planned that after a period of two years the officer will be sent away for further training. It is envisaged that more staff will be appointed soon to run this Centre efficiently.

Training of staff will be done as part of the SADC TSC Network training programme. Training includes long-term training as well as short term training. Attachments to other tree seed centres in the SADC region, various courses in seed collecting, handling, testing and procurement are all part of the short term training.

Training in genetic resources in the country is restricted to undergraduate level. Locally there is a complete lack of forest geneticists with the result that people will have to be trained elsewhere. The same applies for seed science, taxonomy, germplasm health, tree breeding etc. Unfortunately the local demand is too low to make in-country courses in tree genetic resources viable.

There is still a lack of knowledge in the broader user community about tree genetic resources due to the non-existence of expertise in this particular field.

National Legislation

Namibia as yet has no quarantine facilities with the result that all material earmarked for quarantine treatment has to be sent to the Republic of South Africa. However, tree genetic material can be imported subject to certain conditions e.g. free of specific pests and diseases. Tree genetic resources which are imported under these conditions may be planted out and distributed without any problems.

No legislation exists governing the sale and distribution of tree seeds. Legislation on Intellectual Property Rights (IPR's) is also non-existent in Namibia. There is also no policy governing exchange of tree genetic resources. Assistance is therefore urgently needed on legal matters concerning tree genetic resources.

CHAPTER 5 INTERNATIONAL COLLABORATION

Since Namibia adopted Agenda 21 in 1992, the Directorate of Forestry committed itself to the conservation and sustainable use of Namibia's tree genetic resources in the planning of all forestry activities. Local communities are involved in the planning activities of forestry projects. Where it is possible, projects are partially delegated to non-government organizations and communities like DAPP, the Northern Namibia Forestry Committee and the Development Brigade Corporation who are all actively participating in the National Afforestation project in northern Namibia.

The NTSC as part of the SADC TSC Network closely collaborates with other TSC's in the region and ICRAF. Range-wide collections will be undertaken in collaboration with ICRAF in the coming years. Material obtained from these range-wide collections will be shared and all countries receiving material are expected to follow the Biodiversity Convention.

CHAPTER 6 NATIONAL NEEDS AND OPPORTUNITIES

Future planning and development of the forest genetic resources of Namibia should aim at establishing a sustainable NTSC which can take a leading role in the sustainable use of forest genetic resources.

In order to achieve this target it is of utmost importance to strengthen the NTSC in providing sufficient manpower, training and financial support. Without these the NTSC will have little hope of succeeding.

APPENDIX A

List Of Priority Species For Germplasm Collection Identified By The NPGRCom-NAMIBIA

1. Palatable grasses

Andropogon chinensis
A. gayanus
Anthephora pubescens
A. schinzii
Brachiaria deflexa
B. nigropedata
Cenchrus ciliaris
Centropodia glauca
Chloris virgata
Cynodon dactylon
Dactyloctenium aegyptium
Danthoniopsis ramosa
Dichanthium annulatum
Digitaria eriantha
D. seriata
Echinochloa colona
E. stagnina
Enneapogon desvauxii
E. scoparius
Eragrostis echinochloidea
E. nindensis
E. rotifer
E. superba
Fingerhuthia africana
Monelytrum luederitzianum
Panicum maximum
P. novemnerve
Paspalum scrobiculatum
Pennisetum foermeranum
P. glaucocladum
P. mezianum
Schmidtia pappophoroides

1. Palatable grasses

Setaria appendiculata
S. verticillata
Stipagrostis ciliata
S. hirtigluma
S. hochstetterana
S. obtusa
S. uniplumis
Themeda triandra
Tricholaena capensis
Triraphis schinzii
Urochloa brachyura
U. bolbodes

2. Forage legumes

Acacia spp.
Colophospermum mopane
Cullen biflora
Faidherbia albida
Indigofera spp.
Parkinsonia africana
Ptycholobium biflorum
Rhynchosia spp.
Sesbania spp.
Tylosema esculentum
Vigna spp.
Zornia spp.

3. Other forage species

Atriplex spp.
Boscia spp.
Monechma spp.
Petalidium spp.
Phaeoptilum spp.

4.Wild Crop relatives

Amaranthus spp.
Citrullus spp.
Corchorus spp.
Cucumis spp.

4.Wild Crop relatives

Dioscorea spp.
Gossypium spp.
Momordica spp.
Oryza longistaminata
Pennisetum spp.
Sesamum spp.
Solanum spp.
Sorghum spp.

5. Wild species with economic potential

Acanthosicyos horridus
Berchemia discolor
Harpagophytum procumbens
Schinziophyton rautanenii
Sclerocarya birrea subsp. *caffra*
Tylosema esculentum

6. Wild species of horticultural interest

Aloe spp.
Anacampseros spp.
Conophytum spp.
Crinum spp.
Cyphostemma spp.
Lithops spp.
Pachypodium spp.

7. Landraces of crop plants

Arachis hypogaea
Citrullus lanatus
Sorghum bicolor
Pennisetum glaucum
Vigna unguiculata
Vigna subterranea

8. Minor crops

Arachis hypogaea
Citrullus lanatus
Gossypium herbaceum
Oryza sativa
Vigna unguiculata

9. Wild species threatened or locally extinct

Protea gaguedi

APPENDIX B National Policy Guidelines

published in Dinteria 23:152-154(1992)

A. Policy

1. The NPGRCom is to formulate the national guidelines for the NPGRC and all other matters pertaining to PGR, based on recommendations from the Workshop delegates and other sources of expertise.
2. It must be stated that *ex situ* conservation of PGR cannot replace *in situ* conservation, but that these two forms of conservation complement each other and a national front, across the various ministries, should be formed to collaborate with the NPGRC on conservation issues.
3. It must be made clear to all concerned that external institutions cannot and will not take charge of the national programme but may assist when requested by the NPGRCom or may contribute under the guidance of the NPGRCom.
4. All collecting missions must be co-ordinated by the NPGRCom. Authorised, competent local persons should be involved in all PGR activities. Whenever possible, local staff should be trained during such activities.
5. Subsamples of germplasm and all information pertaining to it must be deposited in the NPGRC.
6. Consideration should be given to restrict movement of specific indigenous germplasm of economic potential e.g. landraces or crop plant relatives and medicinal plants.
7. Continued access to the benefits gained from indigenous germplasm should be guaranteed for Namibia as the source of the material.

B. Dissemination of Information

1. A national database must be compiled by the NPGRC Curator from all available information from within the country.

2. All information pertaining to Namibian germplasm must be available and provided as a routine procedure.
3. An inventory of PGR activities in Namibia that have taken place to date must be drawn up by the NPGRCom, assisted by the Crop Working Groups and external institutions where necessary.
4. The draft policy will be circulated amongst workshop delegates, national institutions and other interested parties for comment before being submitted to the Government.
5. The NPGRC will disseminate PGR information through all available media on a regular basis to increase awareness of its activities.

C. Funding

1. The NPGRC will fall under the Ministry of Agriculture, Water and Rural Development which will provide a budget to fund and create the recommended posts, of which the post of Curator is of primary importance.
2. The Government of Namibia will be responsible for the provision of staff, operating costs and facilities for the NPGRC. Limited funds for staff training are available from other sources.
3. The NPGRCom will evaluate conservation facilities and decide the allocation of available funds.
4. Although essential funding for the NPGRC will be the responsibility of the Government of Namibia, additional complementary funding may also be sought from outside agencies to support specific projects. The NPGRCom would assist in the preparation of requests for and the co-ordination of external funding.

D. Conservation

1. All germplasm should be duplicated and stored in relevant institutions and forms for national security.
2. All germplasm conservation, both *in situ* and *ex situ* should be managed according to international scientific standards; and where necessary, funding sought nationally and internationally to ensure that this takes place.

3. All relevant institutions should be involved in the conservation of national plant genetic resources.

4. Land must be made available by the Government of Namibia for field genebanks, multiplication and study in environments similar to those in which the germplasm originated.

E. Training

1. There is an acute shortage of trained manpower which must be addressed by the Government. A minimum of three staff at degree level are essential for the NPGRC. These should be supported by three technical staff members.

2. Improved communication is necessary between committee members and national institutions to identify training needs and nominate appropriate personnel for available opportunities.

3. The following areas were identified as lacking trained personnel:

   - Plant Taxonomy
   - Genebank procedures and management.
   - *In Vitro* culture
   - Data management
   - Seed Technology

Training is needed on both the technical and academic levels. Possible venues for training include:

- **TECHNICAL**: ILCA, SRGB, IITA, ICRISAT, SACCAR, FAO, NGB
- **ACADEMIC**: University of Birmingham, University of Reading, Wageningen Agricultural University, University of Zambia, Royal Veterinary and Agricultural University in Copenhagen.

4. The Workshop recommends that courses in PGR should be incorporated into the Life Sciences degree at the University of Namibia once the University is in a position to do so. Appropriate institutions could also organize appropriate training.

5. Information regarding PGR should be incorporated into school curricula to increase national awareness regarding this issue.

F. Rescue Operations

1. Provision must be made for various rescue operations that rely on national and/or international assistance for collection of material from large sites which are to be used for dams, roads, monoculture etc. if such destruction is unavoidable or in any area where local extinction of germplasm is probable. As far as wild species are concerned, participation by the National Herbarium will be essential.

G. Collaboration

1. The NPGRC will collaborate with all relevant national institutions and participate fully in the regional programme. Technical assistance will be sought from international or other institutions and organizations when required.

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Abbreviations

AGRECONA	Agricultural Economists of Namibia
BRAHM	SBotanical Research and *Herbarium* Management System
CANAMCO	Canada-Namibia Co-operation
CGIAR	Consultative Group on International Agricultural Research
DANIDA	Danish International Development Authority
FAO	Food and Agriculture Organisation of the UN
GATT	General Agreement on Tariffs and Trade
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICPPGR	International Conference and Programme for Plant Genetic Resources
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICRAF	International Council for Research in Agroforestry
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Centre for Africa
IPGRI	International Plant Genetic Resources Institute
IPGRI-SSA	International Plant Genetic Resources Institute - Sub-Saharan Africa Office
IPR	Intellectual Property Rights
MAWRD	Ministry of Agriculture, Water & Rural Development
MOU	Memorandum of Understanding
NBRI	National Botanical Research Institute
NDC	Namibia Development Corporation
NGO	Non-Governmental Organisation
NPGRC	National Plant Genetic Resources Centre

NPGRCom	National Plant Genetic Resources Committee
ODA	Overseas Development Administration (UK)
PGR	Plant Genetic Resources
SADC	Southern African Development Community
SIDA	Swedish International Development Authority
SMIP	Sorghum and Millet Improvement Programme
SPGRC	CADC Plant Genetic Resources Centre
TSCN	Tree Seed Centre Network
UNAM	University of Namibia

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