

COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

NAMIBIA



**Second
Country Report
on
Plant Genetic Resources for
Food and Agriculture**

NAMIBIA

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Note by FAO

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ACRONYMS

ABS	Access and Benefit Sharing
ATF	Agricultural Trade Forum
CBD	Convention on Biological Diversity
CBNRM	Community-Based Natural Resource Management
CGIAR	Consultative Group on International Agricultural Research
CRIAA SA-DC	Centre for Research-Information-Action in Africa – Southern Africa Development and Consulting
DART	Directorate of Agricultural Research and Training
DEES	Directorate of Extension and Engineering Services
DRFN	Desert Research Foundation of Namibia
EEAN	Environmental Evaluation Associates of Namibia
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organisation of the United Nations
FFEM	French Funds for Global Environment (Fonds Français pour l'Environnement Mondial)
GBIF	Global Biodiversity Information Facility
GEF	Global Environment Facility
GMO	Genetically Modified Organism
HOGRAN	Hoodia Growers' Association of Namibia
IBPC	Interim Bio-prospecting Committee
ICEMA	Integrated Community-Based Ecosystem Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IPGRI	International Plant Genetic Resources Institute (now Bioversity International)
IPTT	Indigenous Plant Task Team
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	World Conservation Union (formerly International Union for the Conservation of Nature and Natural Resources)
KAFASEPA	Katima Farmers Seed Producers' Association
KFSRE	Kavango Farming Systems Research and Extension
LFC	Likorere Farmers' Cooperative
MAWF	Ministry of Agriculture, Water and Forestry (since 2005)
MAWRD	Ministry of Agriculture, Water and Rural Development (until 2005)
MCA	Millennium Challenge Account
MET	Ministry of Environment and Tourism
MSB	Millennium Seed Bank
MSBP	Millennium Seed Bank Project
MSP	Market Share Promotion
MTA	Material Transfer Agreement
NAB	Namibian Agronomic Board
NACSO	Namibian Association of CBNRM Support Organisations
NamIP	Namibian Indigenous Plants (database)
NAU	National Agricultural Union
NBRI	National Botanical Research Institute
NDP	National Development Plan
NGO	Non-Governmental Organisation
NNFSGC	Northern Namibia Farmers' Seed Growers Co-operative
NPGR	National Plant Genetic Resources Centre

NPGRCom	National Plant Genetic Resources Committee
PGRFA	Plant Genetic Resources for Food and Agriculture
RBG	Royal Botanic Gardens (Kew)
SABONET	Southern African Botanical Diversity Network
SACU	Southern African Customs Union
SADC	Southern African Development Community
SDIS	SPGRC Documentation and Information System
SEPASAL	Survey of Economic Plants in Arid and Semi-Arid Lands
SPAN	Supporting the Protected Areas Network (Project)
SPGRC	SADC Plant Genetic Resources Centre
UNAM	University of Namibia
UNDP	United Nations Development Programme
WinSDIS	Windows-Based SPGRC Documentation and Information System



SUMMARY

1. The state of diversity

- 1.1 Namibia's crop sector is divided into communal and commercial production systems. The relative importance of crops varies between these systems as well as within, depending on factors such as climate, household income, tradition, language and location.
- 1.2 Pearl millet, sorghum, maize, cowpea, bambara groundnut and cucurbits (melons and pumpkins) are the most important crops in communal areas.
- 1.3 Maize, wheat, grapes, lucerne and an array of fruit and vegetables are produced mainly by the commercial farming sector.
- 1.4 Indigenous plants are important in Namibia because they form the support base of the livestock and wildlife sectors and provide additional income, food, raw materials and services for people.
- 1.5 Little is known about the diversity between or within crops or wild plants. Some isolated studies and inferences from other research lead to the belief that diversity within crops or species is high. Little systematic attempt has been made to investigate and document this.
- 1.6 Efforts by government to improve crop sector performance through research, improved varieties, support systems and markets, have resulted in more diverse crops and larger areas planted. The precise effect on genetic diversity or erosion has, however, not been investigated. Genetic erosion is thought to occur due to promoting factors being present.
- 1.7 The most significant constraint in determining the state of genetic diversity in Namibia is the inadequate number of qualified staff. Collaboration between stakeholders and mainstreaming of PGRFA are secondary constraints.
- 1.8 There is need to assess genetic diversity and identify incidences of genetic erosion; publicise the value of existing PGRFA; promote conservation through inclusion in national policies and strategies; promote better collaboration between stakeholders nationally; improve human capacity through training and creating more job positions and improve resources available.

2. The state of *in situ* management

- 2.1 There is no systematic surveying of *in situ* PGRFA and bench-mark inventories are mostly lacking.
- 2.2 On-farm management of PGRFA is not formally addressed yet but efforts have started. Conservation of landraces by farmers occurs due to other factors like preference of characteristics of traditional cultivars.
- 2.3 Promotion of indigenous plant products through some national initiatives has resulted in increased value for some species and improved conservation on farmland.
- 2.4 Promotion of grain markets and improved varieties for communal farmers has led to more small farmers moving to commercial production and possibly a decrease in on-farm diversity.
- 2.5 There have been improvements in conservation of forest areas with the establishment of state and community forests. Inside existing nature reserves and in conservancies attempts are being made to shift the focus to a more integrated management approach instead of the previous emphasis on animal wildlife and tourism.
- 2.6 No systems exist to restore PGRFA in farming systems after disasters.
- 2.7 Constraints for *in situ* conservation lie mainly in insufficiently experienced and qualified manpower, in part due to inadequate national training and lack of a focused national approach involving all stakeholders.
- 2.8 There is a need for surveys and inventories of existing *in situ* resources and subsequent monitoring; updating and harmonising of legislation, policies and strategies; increased capacity for *in situ* conservation through training; improved collaboration between stakeholders and improved awareness and education.

3. The state of *ex situ* management

- 3.1 *Ex situ* conservation is largely confined to the national germplasm collection at the NPGRC. This long-term storage facility now houses 3 600 accessions of which 1 822 are of crop species and 1 778 of indigenous plants.
- 3.2 NPGRC staff is responsible for collecting, characterisation, multiplication and management of the collection. It is assisted by MSBP staff for collection of wild species and by SPGRC for multiplication of crop species. Internationally accepted standards are applied in all activities.
- 3.3 Documentation at the NPGRC is computerised but the system used is still under development.
- 3.4 Safety duplication occurs at SPGRC for crops and wild species and MSB for wild species only.
- 3.5 Evaluation of germplasm is done on a very limited basis and is user-driven.
- 3.6 Crop collecting has been minimal in the recent past while wild species collecting is focused on endemic, threatened and useful species.
- 3.7 Constraints to the *ex situ* programme include insufficient expertise and resources and inadequate awareness.
- 3.8 Needs for *ex situ* management are an increased staff structure at the NPGRC, human resources development, a focused approach towards identification of gaps in the national collection, filling these through targeted collecting, an improved documentation system, completion of characterisation of existing accessions and publicising of available information and improved collaboration with national and regional/international stakeholders to create more awareness.

4. The state of use

- 4.1 Distribution of germplasm from the NPGRC is variable but has shown an upward trend. Access is determined on a case by case basis and subject to signing of a Material Transfer Agreement.
- 4.2 Use of NPGRC accessions in crop breeding is limited due to constraints in national breeding capacity and available characterisation and evaluation data or a core collection.
- 4.3 Development and sustainable use of indigenous PGRFA has increased due to improved knowledge, support systems and market opportunities and through public/private investment for indigenous plant products. Markets for crops were improved through various programmes and it is assumed that this has led to greater crop species diversity and production volume.
- 4.4 Seed supply systems for communal farmers depend on farmers' seed co-operatives, supported by government. Commercial farmers obtain imported seed from agricultural supply companies.
- 4.5 Namibia does not have a seed law. A draft seed bill exists but should this be enacted, capacity to implement it is inadequate.
- 4.6 Crop improvement includes mainly testing of exotic varieties and some breeding of the main communal crops. Government and the University of Namibia are the only implementers of crop improvement initiatives.
- 4.7 Availability of improved varieties for communal crops since 1994, with an assumed adoption rate of about 50%, is thought to have had a positive impact on food security.
- 4.8 Future changes in use of PGRFA are anticipated with a move towards irrigation agriculture and more communal producers venturing into commercial production systems.
- 4.9 The use of PGRFA is limited mainly by low capacity in plant breeding or crop improvement and inadequate information on local germplasm. The inadequate legal framework, organisation of producers and focus of current research may be contributing factors.
- 4.10 There is a need to identify and publicise characteristics of germplasm in Namibia and strengthen national capacity to use it; and improve the legal framework for crop improvement.

5. The state of national programmes, training and legislation

- 5.1 The national programme is led by the NPGRC with the NPGRC being the implementing entity.
- 5.2 There is no legal framework specifically for the national programme but the NPGRC is institutionalised in the MAWF. Government and stakeholder support has remained stable.
- 5.3 Training of NPGRC staff is inadequate in certain aspects and tertiary training institutions in-country do not offer



any specialised training in PGRFA.

- 5.4 Legislation with bearing on PGRFA has been developed recently, of which some has been passed into law while others are still at the stage of bills for consultation. The draft Access to Genetic Resources and Associated Traditional Knowledge Bill is the most relevant. Cabinet has approved an interim arrangement for access and benefit sharing issues.
- 5.5 National information systems to support PGRFA use, development and management are fragmented but this is being addressed through the development of a system that consolidates disparate data sources.
- 5.6 Public awareness on PGRFA is limited and raising this confined to *ad hoc* efforts by national programme staff, mainly at NPGRC meetings.
- 5.7 Activities of the national programme, training and legislation are constrained by capacity, mainly expertise, but also due to inadequate information, awareness and resources.
- 5.8 The national programme needs to be revised and refocused, the NPGRC staff complement increased, training and education improved on all levels, draft legislation enacted, expertise sought to assist in awareness creation and information systems improved.

6. The state of regional and international collaboration

- 6.1 Namibia is a member of the SADC Plant Genetic Resources Centre (SPGRC) network. Participation is beneficial but the network needs to implement the draft strategy and recommendations of the 2006 in-depth programme review to realise the full benefits of regional collaboration.
- 6.2 Benefits on international level have been mainly in the form of information and training received as well as duplicate storage facilities.
- 6.3 Namibia is a signatory to the CBD, ITPGRFA and Cartagena Protocol. Regional and international trade agreements exist that all are presumed to affect PGRFA but the full impact has not been felt or is not yet fully understood.
- 6.4 Constraints to full and effective participation in regional and international initiatives are mainly insufficient human capacity and financial resources.
- 6.5 There is a need to analyse and identify benefits and impacts of regional and international collaboration to maximise assistance to the national programme; improved support of the SPGRC regional network; continued training by international or regional collaborators; consolidation of relevant activities on regional level and continued supply of information and training materials.

7. Access to PGRFA and sharing of benefits arising out of their use, and Farmers' rights

- 7.1 Access to genetic resources of suspected or indicated bioprospecting use, is regulated by the Interim Bio-Prospecting Committee established by Cabinet Directive as an interim measure until ABS legislation is enacted.
- 7.2 Once approved, access is often subject to signing of a MTA, of which two versions – for academic research and for commercial applications – are used.
- 7.3 Annex 1 crops of the ITPGRFA Multilateral System at the NPGRC have been formally placed in the system and access is facilitated.
- 7.4 The transfer of benefits accruing from use of plant genetic resources to the providers thereof remains a challenge. Structures and models that would enable this have been investigated.
- 7.5 A draft Farmers' Rights bill is available for discussion. National understanding of issues is unclear and intensive stakeholder consultation will be necessary for further progress.

8. The contribution of PGRFA management to food security and sustainable development

- 8.1 Local PGRFA and indigenous species contribute to agricultural sustainability due to their adaptation to the local environment and provision of options for diversification in land use or crop production.
- 8.2 A large part of Namibia's crop production is traditionally based agriculture practiced by the majority of the

population. Subsistence agriculture is still based largely on landrace material and PGRFA therefore contributes considerably to national food security.

- 8.3 Improved business and marketing opportunities for traditional crops and indigenous plant products result in cash income used to buy food and other commodities and services, thus contributing to food security, economic development and poverty alleviation.
- 8.4 To fully realise the importance and values of Namibian PGRFA, more work on these resources is needed (surveys, inventories, characterisation, evaluation, research) as well as the interaction with the human factor (cultural, social). To implement a revised, focused national programme will require institutional strengthening and an increase in human and financial resources, expertise and capacity. Improved collaboration between stakeholders must be promoted and the legal and policy framework for PGRFA and their implementation developed and harmonised.



THE STATE OF DIVERSITY



1.1 The main values of plant genetic resources

Namibia's crop agriculture can be divided into commercial (normally larger scale) and communal (mostly small scale, often subsistence) production (Mendelsohn, 2006). The importance of individual crops differs between these sectors (MAWRD, 2005; NAB, 2007).

In communal farming areas, pearl millet (*Pennisetum glaucum*) is the most important crop with the highest area planted with this staple grain. The importance varies between crop producing regions (climate), with the eastern Caprivi Region producing more maize than pearl millet, while the regions further west (Oshana, Oshikoto, Oshana, Omusati) plant almost exclusively pearl millet. Pearl millet is extremely important for food security and consumption differs according to household location (urban/rural), tradition, language group, size, age structure and income (Leporrier *et al.*, 2002).

In commercial production systems maize is the most important crop with the highest acreage planted. Maize is also planted by communal farmers, but to a lesser degree and depending on the region of the country and the associated climatic conditions (Table 1.1). Maize is an important staple grain and its consumption differs according to household income, tradition and location (Leporrier *et al.*, 2002).

TABLE 1.1
Crop Production in Namibia (tonnes)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Millet/sorghum - communal	41 100	64 500	129 500	46 616	47 500	83 600	70 4300	35 200	58 200	80 500
Millet/sorghum - commercial	-	-	-	-	787	787	1 100	400	255	170
Maize - communal	1 600	5 600	12 100	1 082	2 100	14 100	4 500	2 100	1 700	4 100
Maize, white - commercial	42 600	13 561	24 558	40 760	15 026	26 410	41 100	26 310	28 891	29 444
Maize, yellow - commercial	5 331	920	52	3 972	910	941	2 751	4 579	5 215	1 752
Wheat - commercial	6 400	3 168	3 982	5 274	2 903	3 428	6 671	6 846	10 289	8 262
Grapes - commercial	2 298	2 748	3 344	3 914	5 227	3 796	5 864	7 244	7 515	8 473
Lucerne - commercial	6 300	9 000	12 708	13 830	13 800	15 674	3 600	7 425	6 700	8 002
Sunflower - commercial	845	396	161	40	40	45	129	170	306	105
Groundnuts - commercial	100	200	300	200	159	250	398	118	45	242
Cotton - commercial	1 200	1 990	2 000	3 200	5 037	5 900	4 600	2 500	2 380	1 955

Sorghum is the third most important grain in Namibia and its importance is very close to that of maize, but it is planted almost exclusively by communal farmers. The area planted with maize and sorghum by communal farmers is very similar. Consumption is restricted mostly to urban areas and its use across regions differs from flour (for porridge) to fermented beverage production (Kreike, 1995; Flower & Van Rooyen, 1999).

Wheat is grown exclusively by commercial farmers, only under irrigation (Table 1.1). National production is very low compared with national consumption, the deficit of which has to be imported. Wheat products (bread, pasta) are an important staple mainly in urban areas (Leporrier *et al.*, 2002).

Several legumes, chiefly cowpea (*Vigna unguiculata*), bambara groundnut (*Vigna subterranea*), groundnut (*Arachis hypogaea*) are grown mainly by the communal sector for own consumption where they are an important source of protein. No production figures are available. Very little groundnut is grown by commercial producers (Table 1.1). There is not much difference in the importance of these crops across regions in the country. Differences are mainly attributable to climate and tradition.

Melon (*Citrullus lanatus*), pumpkin (*Cucurbita* spp.) and sweet potato (*Ipomoea batatas*) are crops most commonly grown by communal farmers. These are produced as vegetables but *Citrullus* is also grown as an oil crop or for animal fodder. Commercial farmers produce a large variety of fruit and vegetables, but not on a large scale. Crops grown are tomatoes, onions, cabbage, potatoes, watermelons, dates, citrus, lucerne, cotton, sunflower, olives and some others (MAWRD, 2005; NAB, 2007).

Grape production deserves separate mention. This is on a commercial basis under irrigation and for export markets. It constitutes about 25% of Namibian fruit and vegetable production (NAB, 2007).

Recently there have been initiatives to diversify into the production of biofuels, primarily *Jatropha curcas*. A National Oil Crops for Energy Committee has been established to oversee this process (NAB, 2007). The effect this will have on the crop sector and PGRFA, is not yet fully evident.

Indigenous plant species play a very important role in Namibia. Firstly, livestock farming is a much larger sector of the country's economy than crop production. This farming sector depends almost exclusively on indigenous forage species. There is a large variety of species of forages and their importance differs greatly across regions depending on factors like climate, livestock type and palatability.

Secondly, for the human population, especially in rural areas, the harvesting of a great variety of wild species is important for access to medicine, building material or food. Wild harvested products present a safety net in times of food scarcity, e.g. during droughts when crops often produce insufficiently (Du Plessis, pers. comm.). Many social and cultural uses of wild species add to their importance (Christian, 1999). Wild harvested products are increasingly sold on local and international markets and make an important contribution to households' cash income.

1.2 Diversity within and between crops

Very little is known about the genetic diversity of crops in Namibia. Few surveys, scientific or quantified studies have been made of the diversity either within or between cultivated crops in the country. There are no bench-mark studies done so far to objectively determine whether diversity is increasing, decreasing or stable (Kolberg, 1998c).

The diversity between cultivated crops (major and minor/underutilized) is not high, since very few crop species are grown or are suitable for growing in Namibia. It is not known if this number is increasing, decreasing or remaining stable. Circumstances that changed in the crop production sector of Namibia would, however, suggest that the diversity of crops cultivated in Namibia should be increasing. For instance, horticultural fresh products were declared controlled products in 2002. This means that only holders of permits issued by the Namibian Agronomic Board are allowed to import fresh fruit and vegetables into Namibia. Coupled with the Namibian market share promotion system, that increases market access for local producers by requiring all importers of fresh produce to source at least 15% of their products locally, import substitution was promoted and the share of locally produced fresh produce increased to 29% in 2007 (NAB, 2007). This suggests that a greater diversity of species is grown by Namibian farmers. These are, however, only improved varieties and the diversity within crops is likely to be very limited, because the Namibian environment is usually only suitable to one or two varieties.

Studies of diversity within crops have been conducted for accessions of sorghum, pearl millet and *Citrullus* melons using morphological characters (Kolberg, 1999a; Kolberg & Loots, 1996 - 2004; Maggs, 1998; Maggs-Kölling *et al.*, 2000; Maggs-Kölling & Christiansen, 2003). One study based on molecular markers (Horn *et al.*, 2007) was done for Namibian material of sorghum and one for *Citrullus* (Maggs, 1998). These studies concluded that there was genetic diversity within the crop, at least within the accessions investigated. The number of new varieties available to Namibian farmers is increasing mainly for the crops grown on a commercially, but also slowly for the subsistence crops (Ipinge, 2007). It is assumed that this has led to a decrease in the number of landraces grown by farmers and an increase in the number of modern varieties. Recurring droughts also cause erosion of genetic resources, at least in the perception of farmers interviewed in the Kavango Region, who reported that the number of legume landraces they were able to keep on their farms decreased after eight years of poor harvests in 1995 (KFSRE, 1996). The sum total of these effects on genetic diversity at national level has not been investigated.

Based on the number of plant species that are known to be used from the wild, the diversity is high. Wild species that are used on a national scale or across regions by humans are far fewer (about 5-6). Due to the development of new products from and markets for wild species, the diversity of what is harvested on a larger scale has increased over the past 8 years (IPTT, 2007). The diversity within wild species has never been investigated on any large scale, but is assumed to be high considering that they occur over diverse habitats (Kolberg 1998b; Maggs *et al.*, 1998). Jacobson and Lester

(2003) made a first assessment of the genetic diversity of *Welwitschia mirabilis* and found that diversity is high within populations and across their sampled range. A few studies have been made on marketable or agronomic characteristics of wild species (e.g. *Sclerocarya birrea*, *Schinziophyton rautanenii*, *Cleome gynandra*, *Amaranthus* spp.) to determine if there are differences within the species (Botelle, 1999; Botelle *et al.*, 2002; MAWRD, 2004b).

1.3 The main factors affecting the state of diversity

The relative importance of the two main grain crops produced by communal farmers in Namibia, pearl millet and sorghum, has increased since 1995 due to a concerted effort by the Ministry of Agriculture, Water and Forestry (MAWF). Projects were launched to improve the seed supply sector, processing sector (mills) and local markets (Ipinge, 2007; NAB, 2008b). Pearl millet is now a crop controlled by the Namibian Agronomic Board (NAB, 2008b), which means that producers that produce more than 5 t annually as well as processors, must be registered and permits for imports and exports of the crop are required, while the borders are closed for pearl millet during a certain time of the year (NAB, 2007). This drive has resulted in pearl millet now also being more readily available in urban areas, for instance.

The National Horticulture Development Initiative administered by the Namibian Agronomic Board on behalf of the MAWF, with the aim of increasing local fruit and vegetable production and marketing, has been successful in increasing local horticultural production by 131% for 2004 to 2005 and by 18% from 2005 to 2006 (NAB, 2006, 2007). This would involve improved varieties only, but probably means higher diversity in terms of species and varieties and an increase in acreage planted.

Through an initiative by the MAWF, the Indigenous Plant Task Team (IPTT) was established in 2000 (Du Plessis, 2002). This multi-sectoral and multi-institutional forum, has made great progress in promoting indigenous plant products on technical, marketing and community benefit levels. The National Botanical Research Institute (NBRI) of the MAWF has also created a section for Plant Product Development to cater for the increased interest, mainly from outside the country, for new plant products. These initiatives should have no direct influence on genetic diversity of PGRFA in Namibia, but could contribute towards increased awareness and use thereof as well as changes in farming systems or land use.

The exact effect that the above initiatives have on genetic diversity and/or erosion, is not known. No surveys are or have been carried out to monitor this. It is assumed that there must be genetic erosion occurring in the country, because factors like variety replacement, policy and legislative changes, economic pressure, over-utilisation of land, urbanisation, population growth, habitat loss through major developments (e.g. mining), natural disasters (droughts, floods) are present or do occur (Erkkilä, 2001; KFSRE Team, 1996; Werner, 2000). The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) process specifically mentions the “rapid depletion of Sub-Saharan Africa’s natural resources and genetic erosion of indigenous germplasm” which would support this assumption (Markwei, *et al.*, 2008).

1.4 Future needs and priorities

Needs

- Diversity assessments, at all levels, need to be made part of policies, workplans and priorities of all the relevant stakeholders.
- Human and financial resources need to be increased to be able to undertake surveys and assessments.
- Improved collaboration between stakeholder institutions who also do surveys for their sectors, must be attempted to optimise limited resources and in that way achieve several goals. The UNDP commissioned study to collect baseline data for climate change adaptation in Omusati Region is an initiative in which the Namibian PGRFA programme should have input and could obtain useful results (IECN, 2008).
- Specialised training in assessment methods for both professional and support staff will be needed. This will be particularly important for staff at stakeholder institutions that are not directly involved with PGRFA conservation and use but could contribute.
- Better feed-back from users of germplasm should be promoted by following up and requesting any information generated so that this can contribute to the knowledge base of local germplasm.
- Assistance is needed to analyse existing policies and laws regarding their influence on the diversity of plant genetic resources in-country. The effect of any future policies, laws, developments or projects on genetic resources, needs to be included as a consideration, e.g. in EIAs.



Priorities

- Morphological assessments of existing germplasm accessions in the national collection should be completed, analysed and made accessible.
- More work is needed in determining genetic diversity of indigenous species. Those that make a large contribution to the economy and possibly have the potential for biggest growth (staple grains, new products) should be prioritised.

1.5 State of the art

Capacity is being built in the country in the field of plant taxonomy and systematics following a biosystematics needs assessment in 2002 (Irish, 2003). Taxonomic expertise is particularly important for indigenous species. Over the past years this capacity has remarkably increased (Kwembeya, pers. comm.) in part resulting from the capacity building component of the SABONET project (Smith *et al.*, 2004). A National Herbarium is institutionalised in the NBRI-MAWF and a species list of indigenous Namibian plants exists (Craven, 1999; Germishuizen & Meyer, 2003) that is being continuously updated. An electronic database for indigenous plant species (NamIP) is being developed by the NBRI. Herbarium data are computerised, with quality control ongoing. Training of Namibians in plant taxonomy is underway and interest is being generated among young Namibians to qualify in this discipline (Irish, 2003; Kwembeya, pers. comm.; Maggs-Kölling, pers. comm.).

Staff at the National Plant Genetic Resources Centre (NPGRC), in collaboration with colleagues from the Subdivision Agronomy, perform phenotypic characterisation of genebank accessions. The capacity to do characterisation is very limited (at most 120 accessions per year). Further training in phenotypic data analysis methods, and user-friendly publication thereof, would be desirable.

Capacity in molecular analysis methods is being built at the University of Namibia. Students have in the recent years requested germplasm from the national collection for small projects on genetic diversity. This kind of work needs to be more structured and systematic if it is to be of any use in analysing the state of diversity in the country. Results need to be published or at least fed back to the NPGRC.

THE STATE OF *IN SITU* MANAGEMENT



2.1 Inventories and surveys

Since the First Country Report, no surveys on crops or crop relatives have been done in Namibia for the purpose of *in situ* conservation. Consultancies done for the forestry sector have sometimes included small aspects of forest genetic resources management and conservation on-farm, e.g. Andreasen, 1998; Mubita, 1999; Botelle *et al.*, 2002. Surveys on wild species and biodiversity have been conducted, notably by the Tree Atlas Project of Namibia that, through public participation, compiled an updated distribution of woody species including information on habitat, abundance and phenology (Curtis & Mannheimer, 2005). Again this was not specifically done for *in situ* conservation of genetic resources. One ecogeographical survey of *Sesamum* species in Namibia was published in 2001 (Loots, 2001).

Surveying the flora of Namibia through herbarium collecting continues as a routine activity (Kwembeya, *et al.* 2006). A list of plant species indigenous to Namibia was compiled (Craven, 1999) and updated (Germishuizen & Meyer, 2003; Archer & Craven, 2004; Craven & Voster, 2006; GBIF, 2008), but since this is a continuous process, the NamIP electronic database is being developed at the NBRI to update such information more regularly (Maggs-Kölling, pers. comm.). Herbarium information has also been captured on the Spmndb database at that institution. Preliminary conservation status assessments (IUCN system) have been completed for about 32% of indigenous Namibian species and published (Loots, 2005). A survey was conducted of indigenous species in proximity to the commercial crop producing area around Grootfontein-Tsumeb-Otavi to support the Biosafety decision making process, should applications for growing of genetically modified crops be received in future.

Surveying plant genetic resources in Namibia is constrained by:

- a shortage of human resources with suitable expertise;
- a lack of policy that prioritises and plans such surveys within the responsible institutions;
- inadequate co-operation between stakeholder institutions.

Priorities should be:

- the creation of baseline information for all crop species and wild species of national importance. Their distribution, abundance, current conservation coverage (within – outside reserves; conserved on-farm) should be assessed and serve as a basis by which future surveys can detect any changes;
- increasing the number of staff positions at the NPGRC and other institutions with a stake in *in situ* conservation (MET);
- improving co-operation between stakeholders. This would require high-level decisions, policy and institutionalising of survey activities;
- training existing staff in survey methodologies and planning;
- promoting the inclusion of plant genetic resources and survey methods in tertiary training curricula.

2.2 On-farm management and improvement of PGRFA

On-farm management and conservation of PGRFA is still not addressed on any formal level, although the NPGRC is drafting a proposal to start an on-farm project (Loots, pers. comm.). There are no incentives for on-farm conservation except for circumstances that compel farmers to grow landraces. These include preference of landraces due to taste, adaptability or other characteristics, periodic shortage of seed of improved varieties and economic reasons like cost of seed and growing improved varieties or market demand for certain landraces, e.g. *Citrullus* for oil production. There are reported traditions of indigenous fruit tree management and conservation on farmland whereby these trees are not removed when expanding farmland (Kreike, 1995) and farmers generally understand the role of landraces in spreading their risk of crop failure.

On-farm participatory breeding methods were utilised by government breeders in developing the improved varieties available to small scale farmers (Ipinge, 2007). It is not known if or how many small scale seed production and exchange initiatives exist in the farming community, but exchange and barter for planting materials is reported to exist (MAWF, 2005a). Seed production and supply rests with co-operatives that receive support from government (land, facilities). The Northern Namibia Farmers Seed Growers' Cooperative (NNFSGC) is the main formal or organised seed production and supply organisation in Namibia and focuses on the North Central Regions. Katima Mulilo Farmers Seed Producers' Association (KAFASEPA) in Caprivi and Likorere Farmers' Cooperative (LFC) in Kavango Regions entered the seed sector somewhat later. Efforts towards the development of the seed industry in Namibia have mainly been focused on development of improved varieties of pearl millet, sorghum, bambara nut and cowpeas by the Subdivision Agronomy of the MAWF (MAWF, 2005a). In a joint effort by government research and extension agencies and the seed co-operatives, more and different varieties of the crops produced by small farmers, are available than there were in 1995 (Ipinge, 2007). Table 2.1 shows details of varieties released. It must be noted that Namibia does not yet have any seed legislation, including variety registration/release and "release" of varieties bred by the public research system (MAWF) operates on an interim system in the absence of such legislation and proper variety testing and release procedures. There is a variety release committee composed of personnel from DART and a representative of DEES who consider evaluation data that are presented by the breeder, after which a variety is considered 'released' (MAWF, 2005a). Exchange of seed between farmers was promoted by the agricultural extension services in the late 1990s through the organisation of seed fairs (Kolberg & KFSRE Team, 1998). There was no policy or common strategy on these, however, and recently none have been held. No detailed data exist on how useful these fairs were to farmers or the promotion of on-farm conservation.

TABLE 2.1

Varieties released by the Subdivision Agronomy, DART, MAWF

Crop	Number of varieties released	
	1995 - 1999	2000 - 2004
Pearl millet	2	5
Sorghum	1	2
Cowpea	2	2
Bambara groundnut	1	3
Sweet potato	1	4

Table adapted from Ipinge(2007)

There has also been a drive by the government of Namibia to improve markets for the staple grains produced mainly by small scale farmers that has resulted in more use of improved varieties and more farmers moving towards commercial rather than subsistence production (Mallet & Du Plessis, 2001; CRIAA, 2001; MAWRD, 2003a; NAB, 2006, 2007). It is assumed that this has an effect on the diversity and on-farm conservation of these crops, but no concrete data are available.

On-farm management of indigenous forages on commercial livestock farms has always been part of those farming systems. On communal land, management of common forage resources is much more difficult, but over the years a number of projects have included aspects to improve this. In general, current rangeland management is reported to be unsustainable leading to deterioration of rangelands, most noticeable by severe bush encroachment of vast areas of formerly productive rangeland (Rothauge, 2007; De Klerk, 2004). In 2008 the Livestock Producers' Organisation of Namibia (affiliated to the Namibia Agricultural Union) has taken first steps towards developing a national rangeland management strategy because it was established that management practices in the past were not sustainable and that rangeland degradation is taking place. The strategy is planned to take into consideration all factors that influence rangelands (water, soil, human) and provide an integrated approach towards future sustainable management and reclamation of degraded rangelands (NAU, 2008). Once implemented, this strategy should have a positive impact on on-farm conservation of indigenous forages.

2.3 Restoring agricultural systems after disasters

No formal mechanisms are in place to restore diversity of PGRFA in farming systems after disasters. Besides frequent (endemic) drought conditions in Namibia's crop producing areas, no other natural disasters have occurred in the country recently except for occasional floods such as of 2007/2008, when large areas of crop fields were inundated. The effects

of these floods on food security and agricultural systems are assumed to be serious but no specific figures are available yet. The priority of government has been the provision of food and shelter for flood victims. Recurring droughts do cause erosion of genetic resources, at least in the perception of farmers interviewed in the Kavango Region, who reported having lost certain legume landraces after eight dry years (KFSRE Team, 1996).

The restoration of agricultural systems is constrained by:

- insufficient knowledge on the distribution, genetic diversity and importance of local PGRFA;
- inadequate consideration of PGRFA in disaster management plans.

A need exists to:

- establish mechanisms by which the restoration of PGRFA in farming systems is included in national disaster relief programmes so that this responsibility can be shared between all stakeholders;
- train staff in survey and restoration methods;
- find a mechanism to make available sufficient seed of local landraces following disasters. Regional assistance may be needed in this, since disasters often only strike limited areas in the region and the unaffected parts could assist in, for instance, seed multiplication or provision of seed. The effect of importing or receiving unprocessed, viable grains and legumes as disaster relief aid on local genetic resources needs to be considered in national policies.

2.4 *In situ* conservation of wild crop relatives, wild plants for food production and associated biodiversity

One of the more notable actions taken for the sustainable use of indigenous plants has been the establishment of the IPTT in 2000 (Du Plessis, 2002). Through efforts of the IPTT considerable changes have occurred in the indigenous plant product sector since 2000. All aspects of new product development are covered by this programme, including technical aspects of production, supply chain development and marketing (mainly for export markets), community benefits and intellectual property rights. Table 2.2 lists the priority species of the IPTT programme and progress (IPTT, 2007). The general perception is, that by adding value to products from wild species, their conservation is promoted, but Wynberg (2006) refutes this. This effect, or lack thereof, needs to be investigated. According to Kreike (1995) and DRFN (2003), traditional tenure systems for fruit trees exist and contribute towards the conservation of these species on farmland, but possibly also decreasing diversity through preference for certain species.

The Devil's Claw (*Harpagophytum procumbens*) and *Hoodia gordonii* industries are also established, but these are not treated exclusively under the IPTT, both also having separate fora and funding sources. For Devil's Claw sustainable harvesting practices have been investigated and emphasised (Strohbach & Cole, 2003; Cole, 2003; MAWRD, 2003d; CRIAA, 2002).

TABLE 2.2
IPTT priority species and progress made

Species	Product	Progress
<i>Sclerocarya birrea</i>	Oil, fruit pulp, juice	Oil successfully commercialised in European cosmetic market; pulp and juice trials completed, markets investigated; processing factory established, run by women's co-operative
<i>Schinziophyton rautanenii</i>	Oil	Technical trials completed; markets investigated, large resource
<i>Citrullus lanatus</i>	Seed oil	Agronomic and technical trials completed; breeding ongoing; market established (export, community traded); collaboration with local commercial processor established
<i>Ximenia</i> spp.	Oil	Processing trials completed; network of and system for harvesters established; markets investigated /established
<i>Acanthosicyos horridus</i>	Seed oil	Technical and marketing aspects investigated; small scale novelty markets established (mainly local)
<i>Adansonia digitata</i>	Fruit pulp	Technical trials completed, markets investigated, EU novel food status approved
<i>Colophospermum mopane</i>	Essential oil	Fruiting studies underway, distillation technologies being explored
Indigenous leafy vegetables	Spinach	Technical and marketing trials completed; recommendations for improved processing and local marketing made
<i>Commiphora</i> spp.	Resin, essential oil	Resource surveys done; distillation trials underway; niche markets being explored

Through the IPTT, an important aim of getting collaboration between different role players in-country, thus sharing the cost and effort of product development and resource conservation, is being achieved. The IPTT has become a repository of information, first point of contact and co-ordinates any activities in the indigenous plant product development sector.



Changes that would affect these genetic resources would be evident to the IPTT and action could be taken.

The conservation of indigenous plants inside national reserves is still not a priority for the relevant ministry (Ministry of Environment & Tourism), which concentrates more on conservation of animal species. Inventories and specific management plans for these resources do not exist. The six-year Supporting the Protected Areas Network (SPAN) Project, funded by the GEF and UNDP, was initiated in 2006 by the MET to address the need for a better protected areas network. The project focuses on strengthening capacity, including an enabling legal/policy environment, management and institutional capacity (SPAN, 2008). The National PGR Programme does not have direct input into this project, but there should be potential for better conservation of wild plant species through this intervention.

The constant expansion of the conservancy network coupled with the Integrated Community-Based Ecosystem Management (ICEMA) project, should improve *in situ* conservation of plant resources. The establishment of conservancies on both communal and commercial land has increased over the recent years. In 2003 there were 29 registered communal conservancies, while in 2007 this had risen to 50 (Long, 2004; NACSO, 2008). This is an effective means of *in situ* conservation, since large, connected areas are involved and it includes the human dimension, often lacking in formal protected areas. This movement has been quite effective for the conservation of animal species, but in general plants are still not fully included in management plans. With the inception of the GEF/World Bank and FFEM funded ICEMA project by the MET, there is movement towards a more integrated ecosystem approach. The project aims to promote community-based integrated ecosystem management that accrues socio-economic benefits, and prospect for benefits, to conservancies. High-value indigenous plant products are one focus area of ICEMA in an attempt to achieve these goals (MET, 2008b).

Establishment of state and community forests in recent years should have contributed to *in situ* conservation of wild resources in these areas. Inventories, with focus on timber resources, and management plans exist for these forests (MAWF, 2005b). The effectiveness of these plans on the conservation of PGRFA in these areas is, however, not documented.

In the field of ecosystem rehabilitation and restoration, Namibia has only recently started taking first steps especially in areas degraded through mining (Kolberg & Burke, 2006) and unsustainable rangeland management practices (NAU, 2008). There is a need for research to establish methodologies and generate the necessary information for restoration. There is the will in the affected private sector (mining) companies to promote such research. The passing of the Environmental Management Act 7 of 2007 will facilitate the enforcement of rehabilitation of disturbed sites (Republic of Namibia, 2007). At present initiatives are at the level of rehabilitation (restoring the physical environment to more or less its former state) rather than restoration (restoring ecosystems to their former state) which occurs at an experimental level or is left to occur naturally (Kolberg & Burke, 2006; EEAN, 2008).

The Nature Conservation Ordinance of 1975 needs to be updated as a matter of priority to improve *in situ* conservation nationally. It should be ensured that adequate management of indigenous species important for food production and food security and their genetic diversity, is included in this legislation and future policies. The option to, for instance, declare genetic reserves, would best be placed in this legislation. Strengthening the procedures of the Interim Bio-Propecting Committee (instituted until access and benefit sharing legislation is enacted) and benefit sharing aspects, could assist *in situ* conservation.

The limitations to *in situ* conservation of indigenous plants for food production are:

- the lack of complete and detailed inventories and quantified surveys of *in situ* resources;
- the fact that responsibilities are spread over government institutions and ministries, which complicates collaboration and setting of priorities;
- the lack of updated policy and legislation.

All of these constraints can be attributed to the shortage of appropriately experienced and qualified manpower and financial resources.

2.5 Needs and priorities

In order to enhance the *in situ* conservation of PGRFA, the need exists to:

- obtain more (detailed) knowledge of existing resources through surveys and inventories;
- formalise the sharing of responsibility for *in situ* conservation of indigenous plants between the relevant institutions;
- include at least basic aspects of *in situ* conservation in national tertiary training curricula;
- create awareness of the value of *in situ* PGRFA;

- improve the acute manpower shortage to implement *in situ* conservation activities; and
- provide the legal and policy framework to support this.

2.6 State of the art

In Namibia the focus of ecosystem conservation is largely still on species level and does not consider genetic diversity, crop relatives or food plants in particular. It is aimed mostly at animal species and in very few cases includes the needs of local communities. Conservation of PGRFA is still not a priority in management plans of protected areas and poor collaboration between stakeholders in ecosystem conservation remains a problem. The SPAN (for formal protected areas) and ICEMA (for conservancies) projects will hopefully address some of these issues (MET, 2008b; SPAN, 2008).

One ecogeographical survey of *Sesamum* species in Namibia was published in 2001 (Loots, 2001). Since 1995 surveys have been done on some indigenous species under investigation for product development (*Ximenia*, *Adansonia*, *Sclerocarya*, *Schinziophyton*, *Harpagophytum*, *Hoodia*, *Colophospermum mopane*, *Commiphora wildii*) but these were focused on aspects of economy and production volume and a few phenology surveys, but not fully covering all aspects of a proper ecogeographical survey (Botelle, 1999; Botelle *et al.*, 2002; Gallardo, 2006). Forest inventories have been done by the Directorate of Forestry (see Mendelsohn & El Obeid (2005) for a list of these), but the information therein is of limited use for determining the state of forest genetic resources and their conservation (Selänniemi & Chakanga, 2000). No surveys for crops or crop relatives have been conducted.

The IUCN Red Listing criteria were applied to 1 275 of the close to 4 000 indigenous plant species and a Red Data Book for Namibia produced (Loots, 2001b, 2005). This was based, however, on limited data available in literature and herbaria and the few field surveys or assessments done. The assessment was not aimed at crop relatives or food plants in particular, but some of these are included. This process is further limited by the shortage of suitably trained and experienced staff and the lack or scarcity of knowledge about for instance breeding biology, distribution, population biology, habitat preference of indigenous Namibian plant species.

In the field of ecosystem rehabilitation and restoration, Namibia has only recently started taking first steps by implementing experiments at a few sites.

The Directorate of Forestry, formerly resorting under the Ministry of Environment and Tourism, has been moved to the Ministry of Agriculture, Water and Forestry. Improved collaboration between this directorate and the responsible institution for PGRFA conservation (NPGRC) within the same ministry, should therefore be possible. With its relatively large staff complement spread throughout the country, established community and state forests and updated legislation (Forest Act 12 of 2001), considerable contributions to *in situ* conservation of PGRFA could be made.

There is no formal programme for on-farm conservation in Namibia yet, but a proposal to start a trial is being drafted.

Most of the constraints identified in this chapter were also identified by the National Biodiversity Strategy and Action Plan (Barnard *et al.*, 2001) and a strategy proposed for addressing these, but since the National Biodiversity Programme was put on hold, awaiting re-modelling (MET, 2008a), the implementation of the NBSAP has not been completed.



THE STATE OF *EX SITU* MANAGEMENT

3.1 Sustaining and expanding *ex situ* collections

The National Plant Genetic Resources Centre (NPGRC) of the National Botanical Research Institute (NBRI) in the MAWF houses the only long-term seed storage facility in Namibia. The Tree Seed Centre of the Directorate of Forestry of the MAWF keeps a collection of seed of tree species but this is aimed at utilisation and of a more short-term nature.

The facilities of the NPGRC have increased slightly since 1995 with addition of more storage space and other equipment. Plans and funding have been approved by government for the expansion and upgrading of the present infrastructure and construction has commenced (Maggs-Kölling, pers. comm.).

The collection at the NPGRC has increased since 1995 from 1 738 accessions to 3 600 accessions in 2008. See Table 3.1 for details on the number of accessions per crop or species. Some crop accessions have also been multiplied since 1995 (Table 3.2) and is more than one batch of seed for these accessions stored.

TABLE 3.1
Change in number of accessions stored at NPGRC since 1995:

Crop / Species	No of accessions in 1995	No of accessions in 2008	% increase since 1995
Pearl millet (<i>Pennisetum glaucum</i>)	921	1 441	56
Sorghum (<i>Sorghum bicolor</i>)	124	134	8
Cowpea (<i>Vigna unguiculata</i>)	8	58	625
Bambara groundnut (<i>Vigna subterranea</i>)	38	55	45
Groundnut (<i>Arachis hypogaea</i>)	18	29	61
Maize (<i>Zea mays</i>)	0	11	100
Pumpkin (<i>Cucurbita</i> spp.)	0	13	100
Melon (<i>Citrullus lanatus</i>)	54	98	81
Wild species	575	1 761	206
Total	1 738	3 600	107

TABLE 3.2
Number of accessions multiplied/ regenerated by NPGRC since 1995

Crop / Species	Total number of accessions at NPGRC	Number of accessions multiplied	% accessions multiplied
Pearl millet (<i>Pennisetum glaucum</i>)	1 441	1 027	71
Sorghum (<i>Sorghum bicolor</i>)	134	134	100
Cowpea (<i>Vigna unguiculata</i>)	58	9	16
Bambara groundnut (<i>Vigna subterranea</i>)	55	43	78
Groundnut (<i>Arachis hypogaea</i>)	29	22	76
Maize (<i>Zea mays</i>)	11	0	0
Pumpkin (<i>Cucurbita</i> spp.)	13	5	38
Melon (<i>Citrullus lanatus</i>)	98	26	27
Wild species	1 761	3	0.2
Total	3 600	1 269	35



The multiplication and regeneration of accessions at the NPGRC is constrained by insufficient experienced, specialist staff. NPGRC staff must rely on staff from the Agronomy subsection of the MAWF at facilities far away (850 km) from the centre. Even though some of these staff have received short-course training in PGR management, the distance presents problems with prioritising germplasm multiplication, supervision and training of helpers. As a result, only few accessions can be multiplied per planting (e.g. 60 for pearl millet) and at the most two plantings can be done per year. An off-season planting can only be done at stations that have irrigation facilities, of which, at present, there is only one suitable for this task. The backlog of accessions that need multiplication/regeneration is not cleared fast enough by NPGRC alone and builds up. For instance, the first multiplications of pearl millet were done 10 years ago in 1998/99 and until 2004 only about one third of the entire NPGRC millet collection had been multiplied. It is obvious that the first round of multiplications/ regenerations would not be completed before the first accessions will need regeneration again. It was therefore decided in 2005 that the SPGRC regional centre in Lusaka would assist with multiplying some 772 accessions of which 305 have been successfully multiplied and returned to the NPGRC (these are included in Table 3.2).

The approach at the NPGRC in multiplying accessions has not been well focused. No viability testing is done prior to multiplication and selection of accessions to be multiplied is based solely on seed numbers or age. With the employment of a technician that has been trained in germination techniques, this will now be rectified (Loots, pers. comm.).

Safety duplication of NPGRC accessions does not pose any constraints to the national programme. Crop accessions of which sufficient seed is available (i.e. that have been multiplied) are duplicated at the regional centre (SPGRC) in Lusaka. The largest proportion of the pearl millet and sorghum collections are also duplicated at ICRISAT (1 128 pearl millet and 189 sorghum accessions from Namibia are at ICRISAT), who were responsible for their collection in 1991 (ICRISAT, 2008). Collections of wild species collected after 2001 are duplicated at the Millennium Seed Bank of the Royal Botanic Gardens, Kew, U.K. A constraint for wild species' safety duplication is the usually small size of the collection that can be obtained, making further division often impossible. Since no unique accessions have been identified in the NPGRC collection, it is aimed to duplicate all collections between the institutes mentioned. The institutes take responsibility for maintaining the duplicate collection.

Documenting the *ex situ* collection at the NPGRC relies on the computerised system designed by the SPGRC network (SDIS, now WinSDIS) as well as hard copies of collection, management and characterisation information. Development of this system is progressing slowly, mostly due to lack of feedback from users at the national centres, resulting in an inadequate system for management of germplasm at the NPGRC. Updating of information on the system (from all network partners) and of the system itself occurs annually, which is too infrequent, but SPGRC is now investigating a web-based system that would greatly improve upon the current situation. A large backlog of data to be entered has built up at the Namibian NPGRC due to absence of staff and shortcomings of the system to handle certain data. For instance the module for characterisation data was changed and old data that had been entered will have to be re-entered, the germplasm distribution module has not been implemented. Once entered onto WinSDIS, this data is not in a very accessible format for further analysis in statistical packages for instance.

The NPGRC aims to minimise genetic erosion during multiplication by following internationally accepted methods (FAO & IPGRI, 1994), including a suitable environment, good isolation, understanding of the reproductive system of the crop, adequate population size, training and supervision of non-specialist assistants. Priorities for maintaining viability and preventing genetic erosion in the NPGRC collection are primarily for crop species.

There have not been any attempts at expanding conservation of PGRFA to other methods besides the seed banking done at the NPGRC due to the constraints already mentioned. Tissue culture and genebank facilities were erected at the Ogongo Agricultural College / UNAM Northern Campus, but due to capacity and resource constraints, have not been taken into operation for the purpose of genetic conservation. The National Botanic Garden attached to the NBRI serves mainly an educational purpose and is limited in *ex situ* conservation due to lack of facilities and resources. It has recently (2006 to 2008) played a role in propagating the threatened species *Juttadinteria albata* for a restoration trial (Kolberg & Burke, 2006). Obstacles to using other available *ex situ* conservation methods are shortage and expertise of manpower and cost of maintaining such collections, especially the more high-technology methods. The need for other methods of *ex situ* conservation in Namibia is not great, since most of its crops and wild species are, or are assumed to be, orthodox and the combination of seed banking and *in situ* conservation should be adequate. It would make sense to rather share the conservation of the few exceptions that would require specialised methods, on a regional basis.

Namibia remains a partner in the SPGRC network and benefits by receiving support for the national PGRFA programme. In 2001 the MAWF entered into an agreement with the Royal Botanic Gardens, Kew, U.K. to collaborate on the Millennium Seed Bank Project (MSBP). Benefits are concentrated on wild species and activities focus on prioritising and collecting endemic, endangered or useful species.

3.2 Planned and targeted collecting

Since 1995 collecting by the NPGRC has concentrated mainly on wild species, which increased steeply with the employment of a full-time collector for the MSBP in 2005. Table 3.3 lists the major collecting missions and resulting number of accessions per mission.

TABLE 3.3
Collecting missions undertaken for NPGRC Collection (1995 – 2008)

Year	No of collecting missions	Target crop / species	No. of accessions collected	Collecting Institute
1995	4	2 Wild species, 1 caprivi crops, 1 cucurbits	143	NPGRC, NBRI, RBG,Kew
1996	2	Wild species	26	NPGRC, NBRI
1997	4	2 Wild rice, 1 kavango crops (seed fair) 1 wild species	77	NPGRC, NBRI
1998	6	1 Wild rice, 3 leafy vegetables, 1 wild species, 1 kavango crops (seed fair)	56	NPGRC, NBRI
1999	3	1 Cowpea, 2 wild species	34	Agronomy, NPGRC, NBRI
2000	5	4 Wild species, 1 ohangwena seed fair	140	NPGRC, NBRI
2001	4	Wild species	75	NPGRC, NBRI
2002	4	3 Wild species, 1 devil's claw	106	NPGRC, CRIAA
2003	4	Wild species	49	NPGRC, NBRI
2004	5	Wild species	86	NPGRC, MSBP
2005	5	Wild species	174	MSBP, NPGRC
2006	8	Wild species	197	MSBP
2007	8	Wild species	147	MSBP
2008	11	Wild species	99	MSBP, NPGRC
Various		Various – donated to NPGRC	453	various

Gaps in the NPGRC crop collection have been identified on the basis of species and geographical cover (Kolberg *et al.*, 1997). Plans were proposed to target these gaps but were never further developed or executed due to human resource constraints. The need exists to also identify gaps on a morphological characteristic basis and possibly others (biochemistry, agronomic characters, molecular) and then develop and execute collecting plans. For wild species collecting under the MSBP, a comprehensive targeting exercise was completed and is being executed (Crook, 2006; Kolberg, 2003a, 2006). Wild species endemic to, threatened in or of economic value to Namibia were targeted. Information from herbaria and literature was gathered into a Collecting Guide to assist with collecting (Craven and Kolberg, 2006). At the end of 2007, 23% of target species (215 out of 950) were collected and banked.

Priorities for crop collecting in Namibia should be legumes, *Cucurbitaceae*, maize and to a lesser extent pearl millet and sorghum since gaps have been identified there. The wild species collecting priorities as set for the MSBP can remain with maybe slightly more focus on useful species and much more emphasis on crop wild relatives. Research to assist planning of targeted collecting missions should focus on identifying characteristics that are in demand by users and to what extent these are represented in the NPGRC collection.

3.3 Assessment of major *ex situ* needs

Expanding *ex situ* conservation is hampered by:

- a shortage of human and financial resources;
- inadequate experience or training of NPGRC and assisting staff;
- the long distance between the NPGRC and the crop producing areas and facilities;
- the low priority for PGRFA activities or lack of clear directives from supervisors in collaborating institutions;
- an inadequate documentation system at the NPGRC.

Priorities for *ex situ* conservation of PGRFA therefore are:

- expanding the NPGRC staff structure. The Draft MAWF Strategic Plan (2008) that will require re-structuring of the MAWF for effective implementation, and has been submitted for consideration and approval. It is proposed that the structure of the NPGRC is expanded from four staff positions to seven (Maggs-Kölling, pers. comm.).
- upgrading the knowledge and expertise of existing NPGRC and collaborating staff through training, including training at low levels of expertise and for non-specialists;
- improving collaboration with other stakeholders that could assist in *ex situ* activities;
- completing the multiplication/regeneration of the backlog of accessions at the NPGRC and identify priorities for future multiplications based on viability testing;
- identifying gaps in the *ex situ* collection and planning targeted collecting to fill these;
- continuing to assist the SPGRC network in getting a fully functional documentation system in place;
- rationalising the NPGRC collection and activities by making use of regional and international collaboration to share the burden of conserving (including research on) resources that are common to the region or which may require more advanced methodologies for which local capacity is lacking and not feasible to acquire;
- support to the SPGRC network to implement the improvements needed to facilitate PGRFA conservation in the southern African region;
- improving awareness of the value of the NPGRC collection by publicising accession characteristics and potential uses thereof.

Developing and using low cost conservation technologies is not a high priority at the moment since the provision of the funds to maintain the relatively small collection at the NPGRC by the MAWF is likely to continue. It may also present some difficulty to switch from the present technology (foil bags, domestic freezers) to some other system. Cheaper technologies may become necessary when *ex situ* conservation is expanded to rural/farmer level outside the NPGRC.

Completing safety duplication is also of a lesser priority. Most accessions at the NPGRC are duplicated at SPGRC, ICRISAT, Svalbard long-term safety base collection or MSB already. Further duplication can occur only after multiplying accessions that are not yet duplicated at one of these institutions and could also be considered once unique collections have been identified.

3.4 State of the art

Ex situ conservation methods are limited to seed banking at one institute, the NPGRC, with safety duplication at SPGRC, Lusaka, ICRISAT, long-term safety base collection at Svalbard and MSB, UK. Storage conditions are of international standard (FAO & IPGRI, 1994) for long-term storage.

Alternative *ex situ* conservation methods are not well developed in Namibia due to resource constraints. The National Botanic Garden does not have the capacity to do conservation of sufficiently large populations of plants and the Subdivision Agronomy, Directorate of Forestry and UNAM are constrained by capacity to establish field genebanks, arboreta or *in vitro* collections.



THE STATE OF USE

4.1 Distribution of plant genetic resources

The process for approving seed distribution from the NPGRC collection differs according to the origin of the request and the crop in question. If the request comes from within Namibia, the head of the NPGRC can directly handle this and depending upon the availability of the requested material, issue it to the requester. The requester signs a basic material transfer agreement (MTA), agreeing to use the material only for the requested purpose, not transferring it to any third party and providing feed-back (results, publications) to the NPGRC. If the request comes from outside the country, it is first reviewed by NBRI management and a decision made on whether the NPGRC could in principle comply with the request i.e. availability of the material. Depending on the purpose of the request (academic research or commercial) or the crop in question (in the Multi-lateral System of the ITPGRFA or not) this request may be referred to the Interim Bio-Prospecting Committee (IBPC). A MTA has recently been adopted by the NBRI for the supply of any plant genetic resources. This agreement is forwarded to users for signature before material is distributed. The agreement has two different forms, depending on whether the material is requested purely for scientific research or for commercial application. Request forms for germplasm can be downloaded from the NBRI website (www.nbri.org.na). Crops within the Multi-lateral System of the ITPGRFA require a Standard MTA.

The computerised documentation system at the NPGRC does not make provision for management of germplasm distributed from the collection. On the older version of the system (SDIS) the recipient, with address and purpose for requesting the material could be documented. With the move to the Windows-based system (WinSDIS), this module has, however, not been implemented yet. Germplasm distribution is documented manually (hardcopy) at the moment.

The use of NPGRC accessions in breeding programmes is minimal. Some accessions of pearl millet as well as a few accessions of *Citrullus* were used since 1995 by Namibian researchers. See Table 4.1 Virk (2001) found that the use of local germplasm by the national crop improvement programme was inadequate since most breeding and evaluation trials made use of exotic materials from the region or further afield.

TABLE 4.1

Number of accessions requested and distributed from the NPGRC (1995 – 2004)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Accessions distributed	80	10	37	56	10	14	44	21	131	52	133	303	6
Requests received	-	-	10	15	4	4	15	11	18	6	10	10	4

4.2 Utilisation and enhancing use of plant genetic resources

There are not many specific examples of use of PGRFA for crop improvement since 1995. Neither the extent of the contribution of local PGRFA to each of the new varieties released nor the increase in production attributable to each variety, are known. The almost complete lack of feed-back from users results in these knowledge gaps. Ipinge (2007) reports the sources of germplasm obtained from the NPGRC for pearl millet improvement by the MAWF to be 20%, by the Crop Science Department as 40%. The contribution of farmer's material to pearl millet breeding by MAWF is estimated at 70%, while for sorghum breeding this is 20% (Ipinge, 2007). The use of exotic material far exceeds that of local germplasm in crop improvement by the Subdivision Agronomy (Virk, 2001). This is mainly due to lack of capacity in plant breeding.



In the years since 1995, the Subdivision Agronomy of the MAWF has allocated the majority of its resources into line development (60%), with line evaluation second (30%) and germplasm enhancement third (10%). Since 2005, 5% of resources are invested in biotechnology (micropropagation/tissue culture) with line evaluation being decreased to 25%. The Department of Crop Science at UNAM allocates all its resources to line evaluation (Ipinge, 2007).

Potential production by small-scale farmers has improved over the years since the introduction of improved varieties (partially bred from local germplasm) of pearl millet and sorghum through the national and regional Sorghum and Millet Improvement Programmes, but, as would be expected from rainfed agronomy, shows a lot of variation depending on the seasonal rainfall (Figure 4.1). The area planted with pearl millet and sorghum (not separated because these crops are usually planted together) in the communal area shows equal variation but there seems to be a small downward trend (Figure 4.2) (MAWRD, 2005). The adoption rate of improved pearl millet varieties Okashana 1, Okashana 2 and Kangara and of the sorghum variety Macia is reported to be close to 50% resulting in yield increase of 35 to 40% (MAWRD, 2001).

Six accessions of *Citrullus lanatus* from the NPGRC have been used in the development of a variety for seed oil production since 2006. The process is still ongoing and the eventual contribution of this to the melon seed oil industry remains to be seen (Braun, 2006).

FIGURE 4.1
Pearl millet and sorghum production in the northern communal areas of Namibia

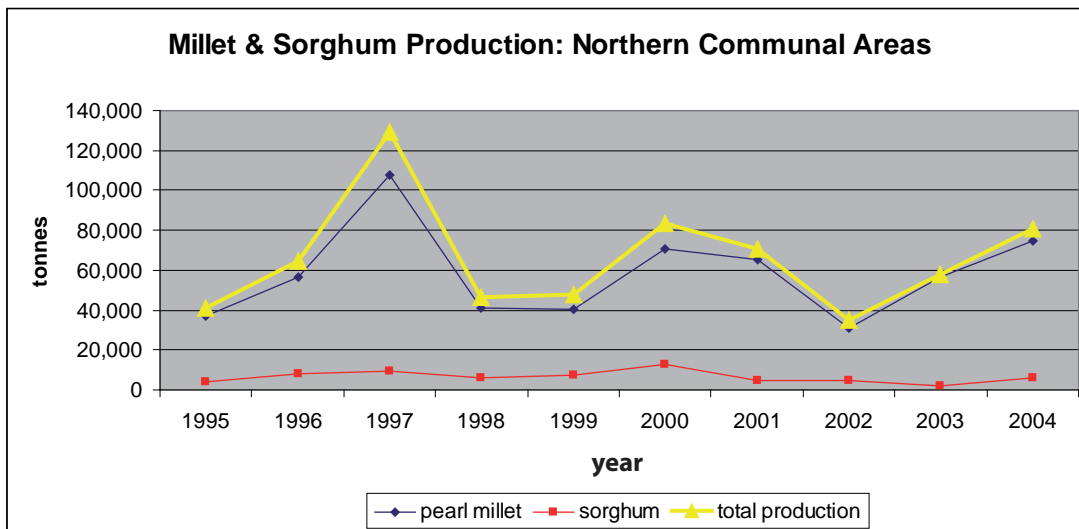
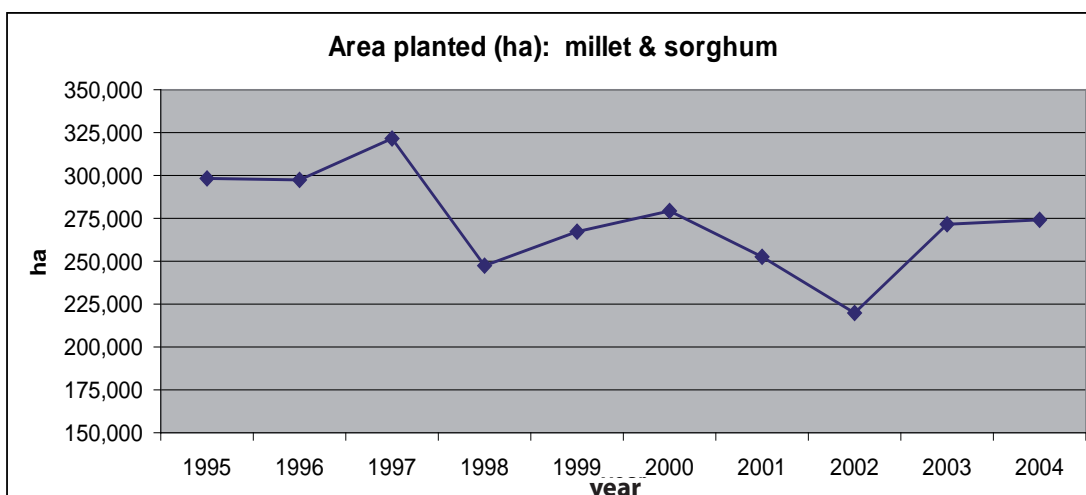


FIGURE 4.2
Area planted with sorghum and millet in Northern Communal Area of Namibia



Some activities have been undertaken to try and improve the use of plant genetic resources. Characterisation and evaluation of existing accessions at the NPGRC has started (Table 4.2), but the capacity for this is low and limited to morphological/ phenotypic characterisation and some biochemical and agronomic evaluation. No attempt has been made to establish core collections due to a lack of capacity (manpower and knowledge).

TABLE 4.2

Accessions at NPGRC characterised

Crop	Total no. accessions at NPGRC	No. accessions characterised	% accessions characterised	Type of characterisation / evaluation
Pearl millet	1 441	553	38	morphological/phenotypic
Sorghum	134	126	94	morphological/phenotypic
Sorghum	134	24	18	molecular
Maize	11	0	-	
Cowpea	58	9	16	morphological/phenotypic
Bambara groundnut	55	43	78	morphological/phenotypic
Groundnut	29	22	76	morphological/phenotypic
<i>Citrullus lanatus</i>	98	26	27	morphological/phenotypic
<i>Citrullus lanatus</i>	98	12	12	agronomic & seed oil evaluation
<i>Cucurbita</i>	13	5	38	morphological/phenotypic
Other	1 761	3	0.2	morphological/phenotypic

Attempts were also made at improving the collaboration between staff and institutions concerned with conservation on the one hand and utilisation of plant genetic resources on the other, through meetings and re-structuring of organisations and workplans (Annual Research and Farming Systems Reporting Conference, farming systems approach in research, Agronomy meetings, restructuring of NPGRCCom). Closer collaboration with crop producers was sought through holding of seed fairs to promote the exchange of seed between farmers and between NPGRC and farmers (Kolberg & KFSRE Team, 1998). Some effort was put into increasing the capacity in plant breeding in the Subdivision Agronomy through formal training (university level) and more specific training in short courses. With the strengthening of the Department of Crop Science at the University of Namibia, national capacity was also increased. (Ipinge, 2007). Some progress was made in enhancing the use of genetic resources of indigenous plant species through the activities of the IPTT. Several new markets were established and technologies and business aspects investigated and attempts made to transfer these to the producer community (Schreckenber, 2003; MAWRD, 2004a, 2006; Gallardo, 2006; IPTT, 2007).

4.3 Seed supply systems and the role of markets

The seed supply systems for subsistence or traditional crops differs from that of commercially grown crops. The seed supply system for traditional crops in Namibia was started as a public venture by the Subdivision Agronomy, MAWF and was then phased out to the private sector. In 1992 a pilot seed production project with 34 selected farmers was initiated, which developed into the Northern Namibia Farmers' Seed Growers Co-operative (NNFSGC) by 1997 (MAWRD, 2001). Through a management contract between the two parties (Government and the NNFSGC), the co-operative has right of use of facilities and equipment that belong to government (MAWF, 2005a). Two other seed co-operatives, Katima Mulilo Farmers' Seed Producers Association (KAFASEPA) in the Caprivi Region and Likorere Farmers' Co-operative (LFC) in the Kavango Region recently entered the seed sector and are supported by the Extension Services of the MAWF (MAWF, 2005a). While small scale farmers buy seed mainly from these co-operatives, large scale commercial farmers obtain their planting material from sources outside the country, mainly South Africa (MAWF, 2005a). According to a consultancy done for the MAWF on the country's seed policy, (MAWF, 2005a) the existing seed system in Namibia is completely inadequate and urgent steps should be taken to implement policy and legislation, as well as establish the necessary infrastructure. It is not known, if and how many small scale seed production and exchange initiatives exist in the farming community, but exchange and barter for planting materials is reported to exist (MAWF, 2005a).

Through efforts by the MAWF and the NAB, the markets for pearl millet and sorghum have been investigated and expanded (NAB, 2006, 2007), leading to availability of these former mainly traditional, informally traded products on the



formal markets in urban areas. It can only be assumed that this market expansion has or will lead to increased production using improved varieties. No specific data, however, exist.

New markets have been established recently for some indigenous plant products through the IPTT (IPTT, 2007). This is challenging because of the high cost of developing new products and finding such markets that are predominantly in the developed world (export markets). The low volume of supply by the relatively small Namibian producer base and capacity on all levels from producer to the market, are further constraining this. Attempts have been made to link the producers with the markets e.g. *Citrullus*, *Sclerocarya* by the IPTT (Schreckenber, 2003; IPTT, 2007). In fact some markets exclusively want to deal with small scale producers (community traded products) but in general producers need to organise themselves into some form of grouping to better control quality and negotiate with the market and make it more attractive for the market that does not want to deal with several hundred producers, but only a few representatives (Wynberg, 2007; IPTT, 2007). This is the approach of the Hoodia Growers' Association of Namibia (HOGAN) and similar producer organisations are being formed for Kalahari Melon Seed oil (*Citrullus*) and *Ximenia* oil (Carr, pers. comm.). Any constraints in marketing the final product, will result in a decreased incentive to use the genetic resources that provide these products.

4.4 Crop improvement programmes and food security

There are basic crop improvement programmes for the main crops (pearl millet, sorghum, cowpea, bambara groundnut) as well as for some minor crops (rice, cotton, sweet potato, cassava). This includes testing of varieties from elsewhere for suitability to Namibian conditions (Ipinge, 2007).

The contribution of the crop improvement programme to food security has not been specifically investigated. An adoption figure for the improved pearl millet and sorghum varieties is estimated at 50% (MAWRD, 2001). Until 1994 there were no improved varieties of the small scale farmer crops available, now 7 varieties of pearl millet, 3 varieties of sorghum and 8 legume varieties are available in the country (Ipinge, 2007). The major focus of the national crop improvement programme has been improved yield and resistance to abiotic stresses (drought, poor soils). Aspects of participatory breeding were employed in developing varieties favoured by farmers. There are attempts to identify bird resistant pearl millet lines, but these have not been released yet (Horn, 2006). Breeding for resistance to other pests and diseases, in particular storage pests, is not a high priority for the national crop improvement programme (Ipinge, 2007). Since these aims primarily contribute to increased yield and the resulting varieties have improved the options available to farmers in Namibia's unpredictable agro-ecological environment, there must be some positive effect on food security. The degree to which this effect is decreased by grain losses at storage, is not known, but the improved varieties are known to have poorer storage qualities than some landraces (weight and quality loss). Since grain storage at farm level is a significant component of Namibia's national food security system it is expected that the positive effect of increased yields of improved varieties on household food security is significantly decreased through storage losses (Mallet, pers. comm.).

Changes are expected in the use of plant genetic resources over the next 10 years as far as wild species, for which markets have been developed, is concerned. With efforts by MAWF to increase the capacity for crop improvement, increased use of PGRFA may result. Changes in crop production are expected because of the increase in irrigation agriculture promoted by the government's Green Scheme and Horticulture Initiative (MAWF, 2008, NAB, 2006, 2007). This may result in a need for different crop varieties or species which could be developed from germplasm available in-country and enhancing their use. On the other hand, other factors, like increased urbanisation, may result in fewer crop producers and a decrease in demand for planting materials.

4.5 Constraints, needs and priorities

A significant problem regarding with distribution of genetic resources from the NPGRC is the non-compliance of users with the condition that any information gained from use of the material must be returned to the NPGRC. Many users simply ignore this and there is no easy way for the NPGRC to take action.

Improved use of PGRFA is constrained by the following:

- the lack of accessible characterisation and evaluation data or a core collection at the NPGRC;
- the small crop breeding programme in Namibia resting solely in the hands of the public sector. Due to the nature (mainly subsistence) and small size of the crop sector, private investment in crop improvement is not economical and therefore absent in the country. The absence of a proper variety release system and law on plant breeders' rights may be another reason that discourages private investment in plant breeding (MAWF, 2005a);

- the weak integration and collaboration between stakeholders responsible for the conservation and those involved in utilisation of genetic resources;
- the small potential for the diversification of crop production in the marginal environment of Namibia with many production and marketing constraints.

Most of these constraints can be related to insufficient capacity, mainly human resources. It can be argued that plant breeding and development of core collections are not really national priorities and that such material could be developed in the region in collaboration with countries or institutions with greater capacity for common gain by participating partners.

Future priorities to enhance plant genetic resources use will be:

- To obtain and make available all information for npgrc accessions in a user-friendly and accessible way;
- Evaluation of plant genetic resources on a user-driven basis;
- Involvement of experts in institutions other than the npgrc in performing research or evaluation of germplasm;
- Capacity building within the national crop improvement programme.

The main constraints in getting new varieties on the market are:

- Low capacity in plant breeding and
- Inadequate or lack of policy and legislation.

The constraints in marketing crop and indigenous plant products are:

- Low research and development capacity on all levels (economic, technical, social). The fact that some of the current research is not linked to user or market demands, is not an efficient use of limited resources;
- Inefficient communication and organisation of all stakeholders in the marketing of plant genetic resources products. The relative success of the iptt in developing new markets for indigenous plant products can mostly be related to its multi-stakeholder nature and the fact that the sector has itself organised and presents a single point of contact (iptt, 2007);
- The changing demand for products.

Priorities in improving the seed supply sector and marketing of products, should be:

- Increasing local capacity in plant breeding, plant product research and development and marketing through specialised training;
- Focusing research activities on user demands that may be achieved through better communication between stakeholders;
- Promoting the formation of producer organisations and supporting them where appropriate;
- Further development of the draft bills for seed legislation, farmers' rights and plant breeders' right towards enactment into law and regional harmonisation of legislation.

4.6 State of the art

The number of accessions distributed from the NPGRC has varied over years and is subject to signing of an MTA. The exact contribution of NPGRC material to varieties resulting from crop breeding is not known. Attempts have been made to enhance the use of local PGRFA.

Seed supply systems exist with a combined contribution between government and seed co-operatives as well as the private sector, but legislation to regulate the seed sector needs to be finalised.

Market development for agricultural and indigenous plant products has taken place and is presumed to have a positive effect on the use of PGRFA.

Crop breeding and improvement programmes are small with a resulting limited use of PGRFA from the NPGRC collection. Farmers' material has been used in these programmes as well. Exact contributions of each to released varieties is unknown. The programme's contribution to food security is not quantified.

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION



5.1 National programmes

A national programme for plant genetic resources was established in 1990 (Maggs & Strohbach, 1992). A National Plant Genetic Resources Committee (NPGRCom), with members from stakeholder institutions, is the focal point for the programme. The NPGRCom operates under the Ministry of Agriculture, Water and Forestry and is endorsed by the Permanent Secretary of the MAWF. The committee was re-constituted and revived in 2004 after being inactive for some time. Members are nominated by and representing the following institutions or stakeholders:

- **Ministry of Agriculture, Water and Forestry**
 - Directorate Agricultural Research and Training
 - Subdivision National Botanical Research Institute
 - National Plant Genetic Resources Centre
 - Subdivision Agronomy
 - Directorate Extension and Engineering Services
 - Directorate Forestry
- **Ministry of Environment and Tourism**
 - Directorate Scientific Support Services
 - Directorate Environmental Affairs
- **Ministry of Education**
 - Dept. Tertiary Education, Science & Technology
- **University of Namibia**
 - Faculty of Agriculture
- **NGOs**
 - CRIAA SA-DC

The NPGRCom serves to oversee and advise on national activities, develop and advise on policy, promote collaboration between stakeholders and represent Namibia in regional and international fora (SPGRC network, FAO). It aims to meet at least twice annually and contact is maintained through email by the NPGRCom that forms the secretariat. The NPGRCom executes the programme through local *ex situ* and *in situ* activities and collaboration in the SPGRC network. National stakeholders are involved in the programme through the NPGRCom as well as through direct contact between NPGRCom staff with relevant persons or institutions.

The NPGRCom resorts under the National Botanical Research Institute (NBRI), which falls under the Directorate of Agricultural Research and Training (DART) of the MAWF. The NPGRCom has been allocated 4 staff positions, 2 of which are for professionals (4-year university degree), 1 for a technician (3-year university degree or diploma) and 1 assistant (high school certificate). All positions are presently filled. One technician was recently promoted into a professional position after full time study. Although this had a negative effect on implementation of routine activities during the study leave period of four years, it was a good investment.

No legal framework has been established for plant genetic resources programmes specifically, but these are covered by general national laws. Government policies and structures cover the working of the NPGRC. The Draft MAWF Strategic Plan (2008) that will require re-structuring of the MAWF for effective implementation, and has been submitted for consideration and approval. It is proposed that the structure of the NPGRC is expanded from four staff positions to seven (Maggs-Kölling, pers. comm.). The staff positions allocated to the NPGRC, for instance, are decided upon at subdivisional (NBRI) level and are part of a pool of agricultural research posts allocated to the NBRI. However, this also has benefits as staff from other sections are made available to assist with NPGRC activities and issues.

Collaboration with other national programmes outside the NBRI is limited. There was some collaboration with the National Biodiversity Programme (programme on hold since 2003), environmental conservation (comments on EIAs, research and access permits, revision of legislation), agronomy research (multiplication and characterisation sites, supply of germplasm, planning meetings), development of new crops (IPTT). PGRFA activities or programmes are not mainstreamed in other programmes and collaboration is on an *ad hoc* basis mostly boiling down to mutual acknowledgement of activities and existence. Unless there is personal engagement from a member of either programme, PGRFA is not considered in other programmes. This can mainly be attributed to shortage of personnel, the necessary awareness of PGRFA at high level and in policies as well as the engagement and suitability of members of the NPGRCCom. The national programme would greatly benefit from a fully integrated approach to agriculture, as proposed by the IAASTD process in which the country participated (Markwei *et al.*, 2008).

Over the past 10 years support for the national programme has increased in terms of the funding and staff available at the NPGRC, but in real terms (considering inflation, expansion needed in programme) funding levels have probably remained static or decreased. Overall support by other national stakeholders, through the NPGRCCom or directly to the programme, has declined. This is due mainly to staff turn-over and vacant positions in some member institutions or due to some programmes having terminated (e.g. Biodiversity programme, Kavango Farming Systems Research and Extension programme) (Kolberg & Loots, 1995-2005). Participation by certain key stakeholders has, however, remained constant. These constraints are not unique to Namibia and similar challenges have been experienced by all NPGRCComs in the SPGRC network, where the Namibian NPGRC is considered to be one of the most active (Maggs-Kölling, pers. comm.).

The challenges for the national programme are:

- adequately covering all aspects of PGRFA;
- insufficient human resources at the NPGRC;
- inadequate involvement of or guidance by NPGRCCom;
- inadequate stakeholder representation on NPGRCCom.

Priorities for strengthening the national programme will be to:

- re-evaluate and refocus the national programme with more input from the NPGRCCom and the stakeholders it represents;
- expand the NPGRC staff complement through the MAWF restructuring process.

5.2 National networks

There is no national network within Namibia for plant genetic resources.

5.3 Education and training

Staff at the NPGRC has received qualifying training through support from MAWF and the SPGRC network. Training needs are regularly assessed for the MAWF (in particular by NPGRC/NBRI) and submitted to the Directorate of Training of the Ministry, feeding into a human resources development plan. Applications for training by staff members are evaluated by the Ministerial Training Committee against the priorities identified. If resources are available and appropriate staff has been identified, permission to attend training courses is granted. NPGRC staff possibly still needs some specialised training in new technologies or methodologies of PGRFA, if and when they become appropriate to the national programme. A good example of such training would be the course in multiplication and characterisation of Cucurbits organised by the SPGRC network in Namibia in 1999 because network members had experienced some difficulty in doing this (Kolberg, 1999b; Loots 1999).

Education of the public, focusing on the farming and conservation community, needs to be maintained and improved. In formal education, from primary school to tertiary level, at least some general modules on the importance of PGRFA should be included. The NPGRCCom members representing tertiary training institutions should, for instance, become

involved in curriculum development or identification of research activities that students could carry out as part of their qualifications. The need for improved education, training and extension structures that integrate the entire spectrum of agriculture and related sectors was also recognized by the IAASTD process for the entire Sub-Saharan African region (Markwei *et al.*, 2008).

Prior to 1995 and up to 1997, experts from the then IPGRI, SPGRC and NPGRC taught short modules at the University of Namibia (Kolberg, 1997a, 1997b, 1997c, 1997d). However, this initiative that was intended as assistance to university staff to continue with this teaching, was never taken up by the university. Reasons for this are firstly staff turn-over at the university as well as the NPGRC, SPGRC and IPGRI and the heavy burden that rests on the few staff members to cover the ever increasing diversity of topics in their curricula. Recognising the importance of plant genetic resources and inadequate communication between the national programme and tertiary training institutions, may be secondary factors.

In general, opportunities for education and training outside the country (regional and international) are known to the national programme. The SPGRC network, FAO and CGIAR centres, especially Bioversity International, alert the national programme to such opportunities, which in turn get widely circulated by the NPGRCom within the country. The short notice at which some of these courses are announced, results in poor uptake. Participation in the offered training courses is usually constrained by a lack of full funding for participants or lack of Namibians with the pre-requisite qualifications (especially on post-graduate level). There are at present no positions that the national programme could offer a trainee upon the completion of training and this also acts as a disincentive to interested candidates. Participation in short courses that are offered on a regular basis (e.g. genetic resources management at the Nordic Gene Bank) is sometimes constrained by a lack of suitable candidates in-country, mainly due to NPGRCom members not advertising the opportunity widely enough.

Obstacles to effective education and training are:

- a shortage of appropriately experienced and qualified specialists in Namibia to provide training;
- a shortage of suitable Namibian candidates for training regionally or internationally;
- the identification of the most appropriate candidates for training by the NPGRCom;
- financial support for international training;
- the inadequate coverage of PGRFA issues in curricula of education institutions.

The priorities for addressing these constraints should be:

- identification of training materials developed elsewhere, but appropriate to Namibia, that could be used by local training and education institutions;
- improved availability and wider distribution of information on available training opportunities;
- improved engagement by NPGRCom members from training institutions to include PGRFA aspects in their curricula;
- identification of funding sources for training courses.

5.4 National legislation

In the years since 1995, Namibia has established national legislation in the following related fields:

- Environmental Management Act 7 of 2007 (governing EIAs, sustainable management)
- Forestry Act 12 of 2001 (management of forest resources, community & state forests)
- Biosafety Act 7 of 2006 (biotechnology research, GMOs)

Draft policy or bills exist for phytosanitary matters (Mosoti, 2007), seed production and supply (MAWF, 2005a), Access to Genetic Resources and Associated Traditional Knowledge (MET, 2006), Parks and Wildlife Management (MET, 2005), Plant Breeders' Rights (MAWF, 2006a) and Farmers' Rights (MAWF, 2006b). The processes of drafting these documents mostly started in the late 1990s and is progressing slowly for various reasons.

Obstacles to developing national legislation are:

- limited expertise on all levels – technical, legal, policy development, enforcement;
- the large backlog in Namibian legislation that needs revision and national priorities are therefore considered first;
- low priority of plant genetic resources in national programmes, thus receiving limited consideration when policies and legislation is drafted.



Priorities in an attempt to overcome these constraints are:

- allocation of more resources to drive this process – in the national PGR programme and for other stakeholders;
- awareness on or training in environmental legislation for legal drafters, which could contribute to better understanding of the issues at hand and their importance, leading to better legislation.

5.5 Information systems

National information systems to support sustainable use, development and conservation of PGRFA are fragmented. The computerised documentation system at the only *ex situ* collection in Namibia (NPGRC) is inadequate for management at this institution (see Chapter 3: Sustaining and Expanding *ex situ* Collections) and even less suited for providing information in understandable form to non-specialists and decision makers to support their tasks. There is no standardisation across stakeholder institutions for easy data exchange. This was planned in the early 2000s by the National Biodiversity Programme of the MET, but never fully executed. The programme is no longer active. Some limited information is available on the website of the MET (MET, 2008a) but this is not being updated. A species list with some additional information for some species is available through the GBIF portal (<http://www.biodiversity.org.na/index.php>). The Bioinformatics Section at the NBRI is co-ordinating the further development of NamIP, an information system on Namibian indigenous plant as well as crop species. Once completed, information like NPGRC accessions available, seed lists, characterisation data will be easily accessed through this web-based system (Maggs-Kölling, pers. comm.). Separate information systems exist in the Agricultural Laboratory for the MAWF with their information ranging from physical land characteristics and infrastructure (soil, agro-ecological zones, gazetteers, GIS of agricultural infrastructure) to biotic aspects like crop modelling, biomass assessments, livestock numbers. The Directorate of Planning in the MAWF maintains databases on economic aspects (agricultural statistics) and also houses the Namibian Early Warning and Food Information Unit. Further sources of information related to agriculture are the National Planning Commission's Central Bureau of Statistics, the Namibian Agronomic Board, The Namibian Agricultural Union and many individual researchers or programmes.

Challenges in providing adequate information systems for PGRFA are:

- inadequate software at the NPGRC and SPGRC network;
- a backlog of information that is not yet in electronic format at the NPGRC, but also other stakeholders;
- a backlog of analysis of raw data and conversion thereof into user-friendly information;
- lack of a unified system for information in the agricultural sector;
- inadequate data ownership, sharing, access and use policies or agreements.

Priorities for the national programme to address these constraints are:

- finding resources to complete data analysis and entry into electronic systems; employment of temporary staff or students could be of assistance in some cases;
- providing assistance to SPGRC in improving the network's documentation system;
- participation in any fora that address information system issues on a national or agricultural sector level;
- strengthening the Bio-Informatics section at the NBRI, as being proposed in the MAWF restructuring process.

5.6 Public awareness

The general public's awareness of plant genetic resources is limited in Namibia. There is more of an inherent awareness of the importance of PGRFA among the crop producing community. No formal awareness programmes have been developed by the national programme. Awareness has been raised informally in isolated cases as the opportunity and need arose. This includes covering of various plant genetic resources related topics via radio, television, newspaper, fliers, publications, scholar and student visits to the NPGRC, open days, trade fairs and newsletters by NPGRC, NPGRCCom or associated staff (Günster *et al.*, 1994; Kolberg, 1998; Brand, 2000; Kolberg, 2000; Swiegers, 2002; Kolberg, 2004; Burke & Kolberg, 2007; Kolberg & Burke, 2007a, 2007b; NBRI, 2008).

Raising awareness on PGRFA in Namibia is limited by:

- time available to programme staff to concentrate in any significant way on this activity;
- inadequate expertise in methodologies, including language barriers, to effectively reach different target audiences;

- low demand for PGRFA information or disinterest particularly on student level, often discouraging follow-up awareness actions.

Priorities for awareness raising should be:

- attempting to use specialists in developing awareness material and campaigns, e.g. the Liaison Office or agriculture and forestry extension services of the MAWF and possibly also other stakeholder's relevant offices;
- concentrating on the farming and conservation community where improved awareness could possibly result in the largest gain for PGRFA conservation and use.

5.7 State of the art

The national programme for PGRFA is led by the NPGRCom and executed by the NPGRC with some limited involvement of other stakeholders. The NPGRCom is relatively active but some shortcomings also exist. The NPGRC is institutionalised in the MAWF. Support by government is stable and expansion of its staff complement has been motivated in an attempt to alleviate the acute human resources shortage. Attempts are made to refocus the national programme.

Training in PGRFA is ongoing by making use of local, regional or international opportunities that are relatively well advertised and known to the national programme. Suggestions are made for addressing the constraints in PGRFA education at national training institutions.

Three acts with relevance to PGRFA were promulgated since 1995 and drafts for six more are available. Constraints in legislation are mostly outside the control of the national programme.

Information systems for PGRFA are fragmented and some data still in a format unsuitable for electronic dissemination. The NPGRC has started addressing the backlog of data not analysed or entered onto WinSDIS. Wider stakeholder involvement is, however, needed to develop a national information system.

Public awareness has been promoted on an *ad hoc* basis by national staff but specialist assistance should be sought to improve the effectiveness of such efforts.

The National Biodiversity Strategy and Action Plan (Barnard *et al.*, 2001) identified and tried to address many of the issues raised in this chapter. The National Biodiversity Programme was instrumental in progress made for instance in legislation, awareness and information systems areas in Namibia.



THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 International networks

The most important international /regional network that Namibia participates in, is the SADC Plant Genetic Resources Centre (SPGRC) network of which the country became a member in 1990. The Namibian government contributes significantly towards this network by an annual financial contribution to the budget of the regional centre in Lusaka through the SADC Secretariat. It also provides the framework, infrastructure (physical and financial) and human resources for the running of the national centre, the NPGRC. Further inputs from the national programme are expertise, information and germplasm. Benefits received through participation in the network include safety duplication of germplasm, sharing of responsibilities for network activities (e.g. germplasm multiplication), exchange of technical expertise, training for national programme staff, exchange of information on many topics, increased awareness of PGRFA in the region, resources to develop a joint position at international fora (e.g. negotiations for the IT) and access to financial resources and equipment. The support from the SPGRC programme has varied from year to year according to the needs as identified by the national programme.

Funding of the SPGRC Programme by the Nordic donors is coming to an end in 2009 with SADC members taking over full responsibility of maintaining the network. A review of the programme has been completed that aptly summarises the strengths and weaknesses of the network and makes recommendations on addressing the latter and for the phase following the donor-assisted period (Bangwe *et al.*, 2006). The benefits and needs from a Namibian perspective are adequately covered in this review. The network has discussed and drafted a sustainability strategy for the next phase which addresses improvements to the network and proposes options for funding mechanisms (SPGRC, 2007). Namibia has had sufficient input into the development of this strategy through the Annual NPGRC Technical Meetings and the Board Meetings and endorses its recommendations for the way forward (Maggs-Kölling, pers. comm.).

6.2 International programmes

Programmes of IPGRI (now Bioversity International) have been beneficial to the national programme. This has been mainly in the form of information available thorough this programme, like descriptor lists, technical publications, abstracts and general, up-to-date information on plant genetic resources. IPGRI staff have also been involved in awareness creation, lecturing, training and germplasm collecting in Namibia, prior 1995. Through Bioversity International, the national programme is still advised on training opportunities available. There were never any formal agreements with IPGRI and the Namibian Government has not yet signed the establishment agreement for Bioversity International (Maggs-Kölling, pers. comm.).

The Millennium Seed Bank Project (MSBP) of the Royal Botanic Gardens, Kew, has been active in Namibia since 2001 when a collaboration agreement was signed between the Royal Botanic Gardens, Kew and the MAWF for an initial period of five years with an extension for a further five years to 2010. It has benefited the national programme mainly by increasing collection of seed of indigenous species and associated data and herbarium vouchers. Less prominent benefits have been in transfer of technology, safety duplication, access to financial resources, increased research capacity (facilities and expertise), exchange of technical expertise, training of national staff, exchange of information, increased awareness of PGRFA in country and avoiding duplication of efforts e.g. seed collecting on the RSA – Namibian border (Crook, 2006). The support of the MSBP to Namibia has increased particularly since 2005 when activities were expanded in the country.



In 2006 an agreement between the MAWF and the Royal Botanic Gardens, Kew was made to establish a node for the SEPASAL project in Namibia. The impact has been that available and documented information on use of wild plant genetic resources has been collected and entered in a centralised, accessible (on Internet) database (RBG, 1999). This could assist in identifying priorities and gaps for the genetic resources programme.

Namibia furthermore participates in other international or regional (SADC) programmes and initiatives which, though aimed at agriculture or biodiversity in general, have some bearing on PGRFA. Recommendations, if adopted, of the IAASTD process with its multi-thematic, multi-spatial, multi-temporal intergovernmental approach to agriculture, could possibly address the lack of co-operation, collaboration and mainstreaming of issues that have been identified for PGRFA in Namibia in this report. The commitments of SADC governments in the Dar Es Salaam Declaration (SADC Secretariat, 2004) have direct impact on most of the issues identified for PGRFA in Namibia (support to small farmers, quality seed provision, promotion of agro-industries, crop breeding, irrigation development, sustainable use and management of natural resources, disaster preparedness, training and human resource development, research into “new” products, increased resource allocation to agriculture). The national programme should take full advantage of these commitments in negotiating increased importance for PGRFA in-country. The SADC Regional Biodiversity Strategy (SADC, undated) echoes the issues relevant to PGRFA identified by the NBSAP for Namibia, like inadequate capacity in inventorying and monitoring of diversity, low awareness, weak institutional and legal frameworks and inadequate research and funding. This strategy could be an appropriate framework through which SADC member states could address these constraints on a regional basis and thus share responsibility and cost.

In the SADC Region Namibia is considered to be at the forefront regarding, for instance, community-based natural resource management and the implementation of access and benefit sharing policies. Through participation in various regional fora national representatives transfer this knowledge and experience to stakeholders in the region (Du Plessis, pers. comm.).

Needs for future international/regional collaboration relating to the understanding of the state of diversity are:

- a strong regional network (SPGRC) that can continue to assist the Namibian national programme;
- continued support for and provision of training opportunities for national staff;
- continued provision of information material or access thereto, including information on funding sources for research and training;
- development of training materials for all levels of expertise that could be adopted and implemented by national teaching staff;
- consolidation of activities on a regional level where appropriate, e.g. establishing an institution that can assist with high technology, expensive methodologies (*in vitro* conservation, molecular diversity studies) that would not be feasible to establish in Namibia given the capacity constraints and relative importance of PGRFA in-country that need these specialised conservation methods. The biotechnology laboratory at SPGRC, where construction is about to commence, is a first step towards such activities.

Priorities for the national programme relating to international/regional collaboration are:

- continuing support of the SPGRC network by all means, in particular in implementing the proposed strategy for the next phase;
- taking advantage of offered training opportunities to upgrade national capacity;
- making best use of information material offered to promote the conservation and use of PGRFA nationally.

6.3 International agreements

Three international conventions, treaties or agreements which are perceived to have some or potential effects on the conservation and utilisation of plant genetic resources in the country, were entered into by Namibia.

The Convention on Biological Diversity (CBD) was signed in 1992 and ratified in 1997 (CBD, 2008a). This has had an impact on PGRFA by raising awareness on sovereign rights over and value of genetic resources and related knowledge. It led to the drafting of legislation on access and benefit sharing (MET, 2006), which has not yet been finalised. Finalisation of ABS legislation in Namibia has been put on hold until the finalisation of the International Regime on ABS (about 2010) (Maggs-Kölling, pers. comm.).

In 2000 Namibia became a signatory to the Cartagena Protocol on Biosafety, which was ratified in 2005 (CBD, 2008b). It has resulted in the passing of the Biosafety Act 7 of 2006 that governs the management of biotechnology and GMOs in the country. No effect has been experienced on the conservation and utilisation of PGRFA in Namibia yet.

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was signed by Namibia in 2001 and ratified in 2004. The impact of this treaty can only be assessed once full implementation has occurred, as certain issues remain vague (Maggs-Kölling, pers. comm.).

The Agricultural Trade Forum (ATF), a company not for gain registered in 2003, has developed into a body recognised as representing Namibia's agricultural sector in regional and international trade relations. The ATF's objective is, "to promote and represent the agricultural production, processing and export sectors of Namibia in regional and international trade negotiations and relations in a transparent way" (NAB, 2006, 2007). Government's objectives of the Third National Development Plan (NDP III) and Vision 2030 envisage the development of rural areas through better agricultural production, unhampered by this sector's exposure to market fluctuations for agronomic products and subsidised food imports (NAB, 2007). The national plant genetic resources programme should collaborate with this forum to sensitise its negotiators to the needs of local PGRFA so that these can be considered in any trade negotiations.

By being a member of SADC, the Southern African Customs Union (SACU) or on its own accord, Namibia is party to the following trade agreements:

- SADC Free Trade Agreement
- Common Market for Eastern and Southern Africa (COMESA)
- EU – African, Caribbean and Pacific Countries Agreement (Cotonou)
- EU Economic Partnership Agreements (EPA)
- African Growth Opportunity Act (AGOA)
- Common Monetary Area
- World Trade Organisation (WTO)/ TRIPS
- SACU/Mercosur agreement with Argentina, Paraguay, Uruguay and Brazil
- SACU/ European Free Trade Association (EFTA) agreements
- Free trade agreement with Zimbabwe
(after UNAM, 2008)

The effects of these agreements on PGRFA have not been investigated and none have to date been experienced. A separate, detailed study of this would be needed by an expert in this field.

ACCESS TO PLANT GENETIC RESOURCES AND SHARING OF BENEFITS ARISING OUT OF THEIR USE, AND FARMERS' RIGHTS



7.1 Access to plant genetic resources

In the years since 1995, Namibia has subscribed to the ITPGRFA (signed 2001, ratified 2004) and CBD (signed 1992, ratified 1997). The effect of this on access to plant genetic resources has been mainly an awareness that this needs to be regulated and has led to a drafting of legislation on access and benefit sharing (MET, 2006). The draft bill on Access to Genetic Resources and Associated Traditional Knowledge was initiated in the 1990s by the then National Biodiversity Programme and considers mainly indigenous species. A cabinet directive was issued to institute interim measures (Cabinet Chambers, 2007; Carr, pers. comm.). An Interim Bio-prospecting Committee (IBPC) was established in August 2007 and considers applications for access to genetic resources for bioprospecting purposes only. This is seen mainly as a learning process to feed into development of regulations for the Act, once it has been passed. The MET receives applications and refers relevant cases to the IBPC for consideration. Terms of reference for the IBPC exist and precise guidelines for evaluating applications are being developed (Carr, pers. comm.). Upon favourable consideration of applications, the IBPC issues a permit for access and, if the material is to be exported, an MTA or contract is usually signed with the NBRI on behalf of the IBPC (for plant genetic resources only).

Even in the absence of legislation to specifically support this, and prior to establishment of the IBPC, the NBRI developed an MTA for access to genetic resources. Two forms of the MTA were developed, one for academic research purposes and one for commercial purposes. This agreement is presently being scrutinised by the Office of the Attorney General to address legal issues. It is this MTA that is used when the IBPC recommends access to plant genetic resources. It should be noted that this MTA is not the Standard MTA as recommended by the ITPGRFA, but the contents is similar.

A few crops on the Multilateral System of the ITPGRFA are important in Namibia (pearl millet, sorghum, cowpea, maize) and subscribing to this Treaty will thus have an effect on access to germplasm of these species. Annex 1 crops that are in the NPGRC have been formally placed in the Multilateral System. Since this has not been an issue in Namibia yet (no requests for germplasm received or made), the exact implications thereof are not yet completely understood. There is also no experience in trying to obtain plant genetic resources outside the Multilateral System of the ITPGRFA, from sources outside the country and any obstacles experienced cannot be reported.

There have been a few contracts between commercial partners for access to genetic resources for the development of products and markets. Due to the sensitive nature of such contracts, no further details are available. Protection of Namibia's genetic resources and ownership of intellectual property are, however, important considerations in these negotiations and contracts.

Gaining access to Namibian genetic resources has become more regulated over the past ten years because no restrictions existed in Namibia before, whereas now at least a permit or MTA is required. In the case of the medicinal species, *Hoodia gordonii*, a total embargo on exporting of any wild harvested material of this nationally protected species was instituted by the MET. Protection of the resource, was the main aim of this embargo and it enabled the gathering of information and organisation of the industry prior to engaging in this market.

7.2 Fair and equitable sharing of the benefits of the use of plant genetic resources

Very little information is available on the benefits of use of plant genetic resources to the country. The benefits are usually not direct and difficult to quantify. Benefits can generally be grouped under the headings of knowledge and research results, access to expertise and facilities, access to financial resources, training opportunities and access to markets. The

direct beneficiary is in most cases the government. To a far lesser degree, farmers or producers and the general Namibian public benefit, e.g. through availability of new varieties and markets and conservation of biodiversity. Producers and potential producers of Namibian products for which markets were identified are benefiting through business opportunities leading to income and employment generation. Mechanisms of sharing benefits and getting them to the grassroots providers of plant genetic resources, is a difficult issue that has been investigated for the IPTT (for wild plant products) by Schreckenber (2003) and Wynberg (2006) but the implementation thereof is proving a challenge. In an attempt to have closer collaboration between the IPTT whose members are mainly Windhoek-based, and stakeholders in the regions, the establishment of eco-regional satellite centres was started in 2004 (IPTT, 2007; MAWRD, 2004a, 2006). One of the aims of these centres is bringing the benefits of IPTT programmes to the producers and poorer sectors of the rural population.

7.3 Implementation of Farmers' rights

A draft bill on Farmers' Rights has been developed by the MAWF for discussion in Namibia (MAWF, 2006b). Not much progress has been made in this field, because the concept is not well known or understood among the farmers as well as the scientific community of Namibia. There is no comprehensive documentation that outlines the role and achievements by Namibian farmers in the past on which such a system could be based.

The obstacles to achieving and enhancing the implementation of farmers' rights are the same as internationally experienced. There is a general lack of awareness and not sufficient information on methodologies and structures that work locally to adequately address this. Secondary obstacles are the lack of local expertise in the field and that this is not seen as a priority in Namibia.

7.4 Needs and priorities

The main obstacle in making significant progress with access and benefit sharing issues as well as the implementation of Farmers' Rights is a lack of awareness on all levels of the Namibian population. The full implications of not regulating access to PGRFA need to be made clear to everybody through well-aimed and continuous awareness campaigns.

THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

8.1 Contribution to agricultural sustainability

Despite Namibia's agricultural sector being only the 8th largest contributor to national GDP (of 18 sectors) and the second largest of the primary industries (mining, agriculture, fishing) (Table 8.1), it is nevertheless very important to the country's economy (MAWRD, 2005). Although the agro-ecological environment is not conducive to agriculture in general, a large proportion of the country's population depends on agriculture for a living. According to the Namibia Household Income & Expenditure Survey 2003/2004 (Central Bureau of Statistics, 2006), 29.6% of Namibian households derive income from agriculture, which is the second largest source of income after salaries and wages (46.4%).

TABLE 8.1
Percentage contribution to total gross domestic product

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Primary Industries	19.1	20.9	20.0	19.6	19.4	20.9	22.6	23.9	19.3	19.4
Agriculture and Forestry	6.9	6.5	5.8	4.8	5.3	5.5	4.1	5.1	5.4	5.0
Commercial	4.1	3.9	3.2	2.4	2.6	3.3	2.6	4.0	4.0	3.4
Subsistence	2.8	2.6	2.6	2.4	2.8	2.1	1.5	1.1	1.4	1.6
Fishing and fish processing on board	3.9	4.2	3.9	5.0	4.7	4.4	5.2	4.9	5.2	4.0
Mining and Quarrying	8.3	10.3	10.3	9.8	9.4	11	13.2	13.9	8.8	10.4
Secondary Industries	16.4	14.0	14.6	16.1	15.0	14.6	14.5	14.8	17.4	18.5
Tertiary Industries	53.1	54.4	54.6	53.5	53.7	54.8	52.9	51.7	55.4	53.1
All Industries at Basic Prices	88.5	89.3	89.2	89.2	88.1	90.2	90.0	90.4	92.2	90.9
Taxes less subsidies on products	11.5	10.7	10.8	10.8	11.9	9.8	10	9.6	7.8	9.1
GDP at Market Prices (million Namibia Dollars)	12 706	15 012	16 750	18 787	20 685	23 692	27 687	32 908	33 841	36 902

Adapted from MAWRD (2005)

Environmental conditions in Namibia are marginal for crop production. The country therefore needs material that is adapted to these conditions, characteristics that can probably be found in landraces that have been grown under these marginal conditions for centuries by small scale farmers. For sustainable development and food security, the continued availability of these landraces and modern cultivars developed from them are critical. Modern cultivars developed by other countries in the region are usually not completely suitable for Namibia because of the very different environment. For this reason also, there probably are unique characteristics to be found in the Namibian landraces. Crops developed from indigenous wild species, or wild harvested products contribute considerably to farming systems and rural incomes (Hachfeld, 2003; Du Plessis, 2001). Diversification of agriculture into these indigenous options (*Hoodia*, *Harpagophytum*, *Citrullus*) will contribute towards sustainability in the farming sector by spreading risk, adapting to the extreme environment and increasing the area where crop production is possible. For harvesting of Devil's Claw (*Harpagophytum*) sustainable harvesting practices have now been investigated and are being implemented (Strohbach & Cole, 2007). Some studies have been done for *Hoodia* as well (Carr, pers. comm.; MAWRD, 2003c) while for *Citrullus* it is less critical because it is an annual, cultivated crop.



Wild plant genetic resources are also essential for the livestock sector, which is the major agricultural sector in Namibia. Due to climatic conditions, intensive livestock farming (planted pastures, stabling, feeding) is not possible on any large scale. Rangeland management practices have not been sustainable in the past (Rothauge, 2007), but this is being addressed by developing a National Rangeland Management Strategy (NAU, 2008). Changes in climate, land ownership/tenure or farming systems are imminent and will cause genetic erosion. Thus the conservation of these resources is important in order to sustain or develop the level and diversity of current livestock agriculture. Livestock plays an important role in food security, but an even greater part in the country's economy (Table 8.2).

TABLE 8.2

Agricultural output at current prices – percentage contribution to total agricultural output

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Commercial sector	69.5	72.2	68.2	80.3	73.1	58.9	82.3	80.2	80.5	72.8
Livestock	65.7	68.2	61.5	74.5	65.6	53.6	73.3	73.7	71.4	62.8
Crops	3.8	4.0	6.7	5.8	7.5	5.3	9.0	6.5	9.1	10.0
Communal sector	28.2	25.6	29.1	17.1	24.4	38.9	14.9	17.6	16.7	24.0
Livestock	11.7	7.2	6.7	1.7	9.3	21.6	(4.2)	3.9	(2.0)	0.3
Crops	4.3	6.9	9.3	2.9	2.8	5.6	5.6	1.9	5.2	8.2
Other	12.2	11.4	13.1	12.5	12.3	11.6	13.5	11.9	13.5	15.4
Own Construction	2.4	2.2	2.6	2.6	2.5	2.3	2.8	2.2	2.8	3.1

Adapted from MAWRD (2005)

8.2 Contribution to food security

Not many improved crop varieties are available to small scale farmers in Namibia. The majority of crop producers in the country are subsistence or small scale farmers. Landraces are still an important part of their crop systems and are assumed to contribute significantly to food security. Kreike (1995) argues that farmers see improved varieties as additions to and not a replacement for their landraces. The 2008 floods of a large part of the crop producing region have shown the effect that such a disaster can have on national food security and economy. The few improved varieties, based in part on local plant genetic resources, were bred for *inter alia* higher yield, which contributes to improved food security. In an environment where there is increased population growth (2.6% in 2001), pressure on the limited arable land available to the country increases to produce sufficient food. Higher yielding and better adapted varieties can contribute towards achieving this goal. On the other hand, landraces are needed to ensure harvest security in the unpredictable climate of Namibia and to develop these improved varieties.

In the same way, wild harvested food is very important for a large proportion of the population, either for direct consumption or sale as a means of sustaining a livelihood. In years of food scarcity due to poor agricultural harvests, wild harvested food provides a safety net. The majority of food is imported to the country since not sufficient amounts can be produced given the environment. The sale of wild harvested or agricultural products (mostly non-food products) is an important means of generating cash income to buy food (Robinson, 1996; Flower & Van Rooyen, 1999). It can be assumed that a considerable proportion of the agricultural production listed as "Other" under the Communal Sector in Table 8.2, is derived from wild plants.

8.3 Contribution to economic development

With the Namibian government's drive towards expansion and development of the market for pearl millet, industries have developed around processing (mills), seed supply and marketing. The contribution this has made to the local economy has not been fully investigated and documented.

Products for which new markets were established for Namibia are usually based on traditional use. Producers therefore inevitably are small-scale farmers or communities. Many of the new markets also prefer community traded products, which means greater opportunities for communities and small-scale producers, leading to economic development of this sector. Some of the new products open up areas that are not traditionally crop producing and enables inhabitants

over a larger area of the country to participate in these markets, sharing the benefits with a larger part of the population and resulting in development in otherwise neglected areas of the country. Development of industries related to these new products (processing, packaging, collecting) is another contribution. The estimated value of exports for the most important indigenous plant products are shown in Table 8.3 below.

TABLE 8.3

Projected values of products from indigenous plants

Species	Projected Export Value (US\$)	Source
Devil's Claw (<i>Harpagophytum procumbens</i>)	2.7 million	Hachfeld (2003)
Kalahari Melon Seed Oil (<i>Citrullus lanatus</i>)	1 million	Du Plessis (2001)
Marula (<i>Sclerocarya birrea</i>)	1.7 million	Wynberg (2006)
Hoodia (<i>Hoodia gordonii</i>)	1 billion (but no income yet)	Wynberg (2006)

Mendelsohn & El Obeid (2005) estimate the direct contribution of non-timber forest products to Namibia's national product to be N\$ 282 706 000, while the direct and indirect contribution to the national economy is given as N\$ 619 459 000. The direct value to national product and direct and indirect value for the Namibian economy for fuelwood are N\$609 416 700 and N\$965 990 300, respectively. Björkman (1999) and the forestry inventories (listed in Mendelsohn & El Obeid, 2005) also give some indication of timber value of Namibian forested areas.

8.4 Contribution to poverty alleviation

Improved varieties with a potential higher yield can result in surplus production which can be sold by farmers, provided market development for their products is also taking place. The cash income contributes to poverty alleviation. New products and markets are based on traditional, small-scale production and the poorest of the nation can therefore benefit. The fair trade, community traded, organic markets are generally higher value, benefiting the producers, who may be very poor. The development of an entire industry around new products gives rise to increased employment and business opportunities, contributing to poverty alleviation. The sale of craft items, often derived from indigenous plants, is an important factor in poverty alleviation in rural areas (Du Plessis, pers. comm.). With the growing tourism sector in Namibia, the market for crafts is improving.

The land reform policy, which has high priority for the Namibian Government, is aimed at poverty alleviation among the previously disadvantaged Namibian citizens through redistribution of land (Republic of Namibia, 1995, 2002; Sandrey & Vink, 2008). This may have a positive effect on poverty alleviation, but promote movement from subsistence towards commercial production, which could result in decreased genetic diversity due to increased use of improved cultivars.

8.5 Priorities to better understand the roles and values of PGRFA

- There is very little quantified information on the roles and values of PGRFA. Surveys to serve as a bench mark and regular updates are needed to fully understand this. Especially if economic value would be known, it could contribute to a better appreciation of the resource and mainstreaming of PGRFA.
- There is a need to identify any PGRFA in Namibia with characteristics that are in demand by users or which are unique, especially in cultivated crops. This would increase the value attached to these resources.
- More research needs to be done on social and cultural importance of PGRFA as well as the ecological roles that some species play in the ecosystem and its important functions.
- There needs to be better co-operation and collaboration between stakeholders in-country on all levels and sectors of PGRFA.
- The influence of national, regional and international policies, legislation, agreements, programmes and projects on PGRFA needs to be investigated by specialists and considered in all future initiatives.
- Human resource development and institutional strengthening with regards to PGRFA, need urgent attention.



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