National Agricultural Support Services Programme (NASSP)

Indigenous Plant Development Strategy Review

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Ministry of Agriculture, Water and Rural Development
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The Programme is complementing the Government of Namibia's efforts to enhance the livelihood of smallholder households. The Programme has 5 components: institutional support, rural enterprises development and finance, livestock development, crop diversification and mahangu (millet) development.

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Disclaimer

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Acronyms and Abbreviations

ABS	Access and benefit-sharing
ADC	Agricultural Development Centre
CBD	Convention on Biological Diversity
CIRAD	Centre for International Research in Agronomy for Development (France)
CITES	Convention on International Trade in Endangered Species
COSDEC	Community Skills Development Centre
CRIAA SA-DC	Centre for Research Information Action, Southern Africa Development & Consulting
CSIR	Council for Scientific and Industrial Research (South Africa)
DCWG	Devil's Claw Working Goup
DFID	Department for International Development (UK)
DoF	Directorate of Forestry
EU	European Union
FAO	Food and Agriculture Organisation (United Nations)
FSRE	Farming System Research & Extension
GRN	Government of the Republic of Namibia
IDRC	International Development Research Council (Canada)
IFTT	Indigenous Fruit Task Team
IPTT	Indigenous Plants Task Team
LuxDev	Luxemburg Development
MADI	Mashare Agricultural Development Institute
MAWRD	Ministry of Agriculture, Water & Rural Development
MET	Ministry of Environment and Tourism
MHETEC	Ministry of Higher Education, Training & Employment Creation
MTI	Ministry of Trade and Industry
NASSP	National Agricultural Support Services Programme
NAB	Namibian Agronomic Board
NBRI	National Botanical Research Institute
NCAs	Northern Communal Areas
NCRs	North Central Regions (Oshana, Omusati, Ohangwena & Oshikoto)
NGO	Non-governmental organisation
NNF	Namibia Nature Foundation
NNFU	Namibian National Farmers' Union
PIF	Promoting Indigenous Fruit in Namibia project
R&D	Research and Development
RDC	Rural Development Centre
S&AP	Strategy and Action Plan
SABONET	Southern African Botanical Network
SANProTA	Southern African Natural Products Trade Association
SIDA	Swedish International Development Agency
SME	Small and Medium Enterprises
TA	Technical Assistant
UNAM	University of Namibia
UPDP	Useful Plants Development Project
US	United States of America
WAD	Women's Action for Development

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Introduction

Namibia is the one of the driest countries in sub-Saharan Africa and northern Namibia is agro-ecologically one of the most marginal places in the world where crop farming is nevertheless still a mainstay of the local subsistence economy. This makes Namibian smallholders particularly risk-averse and hinders extension efforts aimed at promoting crop diversification.

On the other hand, Namibia is a large country with a small population and many areas have a substantial resource endowment of indigenous plants with the potential to contribute both cash and in-kind benefits to rural livelihoods. Moreover, a lack of viable alternatives implies that indigenous plant products can (in theory, at least) be produced in Namibia at a relatively lower opportunity cost than in most parts of southern Africa – ironically, this might eventually translate into a decisive competitive advantage for Namibian producers.

For these reasons the Ministry of Agriculture, Water and Rural Development, in partnership with other stakeholders, has in recent years taken an active interest in promoting the sustainable commercialisation of indigenous plant products to:

- achieve greater household food security
- promote agricultural diversification
- create income, employment and livelihood opportunities
- stimulate agro-industrial development.

It is further believed that such sustainable-use benefits could provide important long-term economic incentives for the conservation of indigenous plants.

The purpose of this document is to review previous and current Namibian efforts to promote indigenous plant commercialisation and make recommendations as to how the National Agricultural Support Services Programme (NASSP) can help to remove some of the obstacles to achieving this development objective, in ways that complement rather than duplicate existing initiatives.

Summary of recommendations

The recommendations below are presented roughly in order of priority. Indicative budget figures and timeframes are provided. In some cases (notably cultivation of devil's claw, *Hoodia*, succulents and indigenous vegetables) it would be highly desirable to source continued funding (from national sources or donors) before the support of NASSP ends in 2005/6.

A. It is strongly recommended that NASSP:

- ***a. funds the forthcoming national workshop in May***
- ***b. styles this meeting as a national workshop on indigenous plants promotion***
- ***c. promotes and supports a decision at this workshop to transform the IFTT into the Indigenous Plants Task Team (IPTT)***
- ***d. helps the task team to secure high-level endorsement of an appropriately expanded mandate and terms of reference***

Budget: N$200 000
Duration: Workshop 8-9 May 2003, proceedings by July 2003

B. It is recommended that – in addition to national-level initiatives as detailed below – NASSP encourages and supports the establishment of (eco-)regional satellite centres which can serve as local foci for indigenous plant promotion. Such satellite centres can be based at GRN experimental farms or ADCs, forestry stations or (where more appropriate) can be hosted by community-level organisations such as conservancies. The aim of this work should be to institutionalise indigenous plant promotion by making it part of the on-going work of such satellite centres (rather than to create additional or new structures). In this regard NASSP can – through its various components – play an important networking function.
Budget: Consultations to be included in other NASSP components
Duration: On-going

C. It is further recommended that NASSP prioritises and actively supports a systematic investigation into technologically and environmentally appropriate cultivation of devil's claw (both species).
Budget: N$200 000/a x 3 years
Duration: 5 years starting mid-2003

D. It is also recommended that NASSP supports a systematic consultation among stakeholders (including foreign buyers) aimed at improving marketing and/or local value-adding of devil's claw (either through declaring it a controlled product in terms the Agronomic Industry Act, or through a voluntary industry association, or by simply closing Namibia's borders to exports of unprocessed material).
Budget: N$100 000
Duration: 2 months (3rd quarter 2003)

E. It is recommended that NASSP provides funding to NBRI for the continuation and expansion of its* Hoodia *and indigenous succulent programme, including employing a horticulturalist to act as Project Coordinator.
Budget: N$250 000/a x 3 years

F. It is recommended that NASSP supports the establishment of an indigenous vegetables programme at NBRI, focussing initially on leafy vegetables and adding other types later.
Budget: N$100 000/a x 3 years
Duration: Late 2003 on

G. NASSP should also consider supporting the emergency dissemination – through agriculture and forestry extension workers as well as the mass media – of sustainable devil's claw harvesting guidelines (especially in areas where this has not been done before, such as the parts of the NCAs where H. zeyheri is harvested).
Budget: N$75 000
Duration: A.s.a.p. until February 2004

H. It is recommended that the Devil's Claw Working Group (DCWG) continues to operate as a separate and distinct institution, but that it considers measures that would facilitate better interaction with other initiatives around indigenous plants (primarily so that these initiatives can be systematically informed about and learn from the much more developed devil's claw industry).
Budget: None (except for NASSP TA involvement in both DCWG and IFTT)
Duration: On-going

I. It is recommended that NASSP convenes a meeting between LuxDev, MADI management, relevant MAWRD and DoF staff members and the PIF project coordinator to clarify the opportunities and constraints around a manketti pilot project based at Mashare Agricultural Development Institute.
Budget: Depends on contribution from Lux Development
Duration: Mid-2003 on

J. The training approach proposed for the indigenous plants component is for NASSP to sponsor an internship programme for four recent Unam or Polytechnic graduates, who will be attached to CRIAA SA-DC on 6-month renewable contracts, during which time they will be systematically exposed to and tutored in a wide range of activities related to the commercialisation of indigenous resources.
Budget: N$40 000/intern/a x 4 plus N$120 000 management costs – N$280 000/a
Duration: Mid-2003 to mid-2004, renewable if successful

K. It is recommended that NASSP supports community outreach efforts by the national programme to promote indigenous plants use, specifically by funding systematic contacts with conservancies, FSRE focal groups, women's groups, traditional healers, traditional authorities and other actual and potential grassroots stakeholders, and (provided extending the task team is endorsed by the national workshop) by financially supporting the participation of representatives of these stakeholders in IFTT (or IPTT) meetings.
Budget: N$150 000/a
Duration: 3 years

Main Report

Background

1. This study reviews Namibia's strategy for supporting and promoting the development of indigenous natural products, specifically those produced from indigenous plants (see Annex A for terms of reference). It forms part of the integrated inception study of the National Agricultural Support Services Project (NASSP) and is intended to contribute to the project's overall work plan and to the revision of its detailed logical framework.

2. The overall objective of NASSP is to enhance the livelihoods of smallholder households in the communal areas of Namibia. This includes increasing the income that farmers derive from the sustainable commercialisation of indigenous plant resources. Specifically, the indigenous plants component of NASSP is expected:

- To get more people involved with and aware of commercial activities with indigenous plants and fruits
- To improve commercial output of products like marula and devil's claw
- To improve post-harvest and processing techniques
- To increase demand for products based on indigenous plants and fruits
- To improve coordination with neighbouring countries on development of indigenous plant resources
- To have local people capable of managing the production chain for indigenous plant resources

Indigenous plants and local livelihoods

3. Indigenous plants are central to rural livelihoods in all communal areas of Namibia, but their exact role varies from region to region, in accordance with local livelihood strategies. Efforts to promote commercial use of such plants have a much higher chance of success if they take full cognisance of this variability, which is an expression of local abiotic, ecological, cultural and socio-economic conditions.

4. North-central Namibia, for example, is often characterised as having an "agro-silvo-pastoral" farming system, in which on-farm indigenous plants – most notably, but by no means exclusively, indigenous fruit trees – are actively managed by smallholders as low-input-high-yield components of very diversified production systems. There is a close correlation between relatively superior agricultural soils and the distribution of highly prized indigenous species such as *Sclerocarya birrea* (marula), *Berchemia discolour* (eembe, bird plum) and *Diospyros mespiliformis* (eenyandi, jackal berry), as well as a considerable amount of evidence to suggest that recruitment of these desirable species is directly favoured and assisted by human settlement, with homesteads acting as protected sites for the establishment of seedlings. As a result, the NCRs have a relatively high potential for agro-forestry interventions based on indigenous species and indigenous knowledge (e.g. traditional crop husbandry skills).

5. The devil's claw harvesters of the Omaheke and Otjozondjupa regions, by contrast, are typically very poor retrenched generational farm workers living on pre-

Independence resettlement farms, who opportunistically harvest communal wild resources for a seasonal cash income and/or supplementary food supply. While these people often have a deep cultural knowledge of useful wild plants, they usually have no (or at best a very recent and superficial) tradition of crop farming. Combined with lower rainfall and poorer soils, this lack of traditional agronomic skills suggests that a more suitable approach in these areas would be extensive wild crafting aided by enrichment plantings of highly desirable species.

6. Between these two poles there is a range of other resource-use practices and patterns, e.g. traditional hunter-gatherers who use wild plants mainly as a food source and only occasionally for cash (e.g. the Ju/hoansi of Nyae-Nyae), nomadic pastoralists in remote areas who rely on indigenous plants to satisfy personal needs for medicines, cosmetics and veterinary remedies (e.g. the OvaHimba), or subsistence cultivators who harvest open-access resources for own use and as an important source of cash (e.g. in Kavango and Caprivi).

7. From the above it should be obvious that in Namibia there can be no one-size-fits-all strategy for promoting the commercial use of indigenous plants and their products. The main challenge for a national intervention strategy is therefore to strike a balance between eco-regional and socio-economic specificities (which largely determine primary production), and the more general or generic national support structures and policies required for all natural products. This paper proceeds from the assumption that a successful strategy must adequately address both the specific and the general in order to have the desired development impacts.

8. ***It is recommended that – in addition to national-level initiatives as detailed below – NASSP encourages and supports the establishment of (eco-)regional satellite centres which can serve as local foci for indigenous plant promotion. Such satellite centres can be based at GRN experimental farms, ADCs, forestry stations or (where more appropriate) can be hosted by community-level organisations such as conservancies. The aim of this work should be to institutionalise indigenous plant promotion by making it part of the on-going work of such satellite centres (and their existing networks) rather than to create additional or new structures. NASSP can play an important facilitating role by actively pursuing synergies between indigenous plants promotion and its other components (e.g. grain storage, crop diversification, improved livestock marketing etc.) at both national and local levels.*** Indigenous plant use is an integral part of rural livelihoods and should therefore also be integrated into the "mainstream" of FSRE, community forestry and other extension initiatives. Regional centres must – by their very nature – adapt national strategies in a participatory manner to suit local needs, circumstances and capacity. In reality each centre is therefore likely to eventually have a unique and evolving set of indigenous plant promotion activities. In general, however, such centres could usefully contribute some or all of the following:

- local expertise about target resources and other aspects (e.g. livelihood strategies, farming systems, grassroots organisations)
- nursery facilities, propagation materials and local cultivation trials/guidance
- training in resource management, post-harvest processing, SME-level value-adding etc.
- venues, payment systems, temporary storage sites and transport assistance for (semi-)commercial intakes (pending the "privatisation" of collation systems)
- venues for pilot processing and technology demonstration

- advice on processing technologies and/or referral service for technology enquiries
- (two-way) information and communication functions (e.g. about markets and prices) through regular networking with local stakeholders
- (interim) cost-recovery sales of bottles, labels, preservatives etc.
- coordination of local-level research activities (e.g. resource surveys, participatory appraisals)
- capacity-building nodes
- regional representation on national structures (and reporting back to local level)

Getting a system of regional centres to function will require good coordination at both national and regional levels – see paragraph 19 below for further discussion of the need to support such coordination and networking.

Devil's claw

9. Namibia is by far the world's largest supplier of devil's claw (*Harpagophytum* spp.), and devil's claw is currently Namibia's most important commercialised natural product by far. If – as initial export figures indicate – Namibia did indeed produce more than 1000 tons of this medicinal tuber in 2002, the trade is now worth at least N$20 million a year to primary harvesters, and about double that much to the national economy, despite no significant in-country value-adding. In Germany devil's claw ranks third among all herbal remedies in terms of sales value, having achieved sales in excess of Euro 30 million in the year up to June 2002. This is the result of around 50 years of commercial exports, clinical research, and market development.

10. Virtually all devil's claw is still wild crafted. Current levels of exploitation have therefore raised serious national and international concerns about resource sustainability, manifested in on-going discussions as to whether the plant should be listed on CITES (the Convention on International Trade in Endangered Species). Even if *Harpagophytum* is still not endangered as a species (due to substantial parts of its range not being harvested at present) wild populations in many areas are now clearly under pressure from increased harvesting. Of special concern is the rapidly increasing harvesting (primarily in the northern communal areas) of *H. zeyheri*, which was recently (early 2003) listed in the European Pharmacopoeia alongside *H. procumbens*, but is inadequately covered by present resource management measures (because these have focussed on *H. procumbens*).

11. There are good reasons (aging population in the developed world, swing to natural medicines) to expect that the international market for devil's claw will continue to grow strongly in the foreseeable future. To the extent that Namibia fails to secure and capitalise on its position as market leader, other producers (or other products) will sooner or later step into the breach. Developing cultivation techniques that are suitable for traditional production areas has therefore become more urgent than ever. Concerns (however legitimate) about the long-term impacts of such cultivation on the livelihoods of extremely poor harvesters must be addressed by explicitly targeting such harvesters as beneficiaries of cultivation efforts, and by maximising the competitive (price, image, quality) advantages of the wild-crafted product. At current prices it is unlikely that devil's claw cultivation will be a very attractive option for most commercial farmers, but the equation could change if over-harvesting, and regulatory responses to over-harvesting, result in much higher prices, or a strong market preference for cultivated material.

12. All of the above clearly sets devil's claw apart from all other Namibian natural products, and justifies the continued existence of a working group dedicated to this one resource/industry alone. ***It is recommended that the Devil's Claw Working Group (DCWG) continues to operate as a separate and distinct institution, but that it considers measures that would facilitate better interaction with other initiatives around indigenous plants (primarily so that these initiatives can be systematically informed about and learn from the much more developed devil's claw industry).*** If an industry association or marketing board for devil's claw (as proposed in paragraph 14 below) becomes a reality, the DCWG will obviously need to re-evaluate its continued relevance and/or redraft its terms of reference.

13. ***It is further recommended that NASSP prioritises and actively supports a systematic investigation into technologically and environmentally appropriate cultivation of devil's claw (both species)***. The four proposals summarised in Annex D require further development and consultation before being funded/implemented. The exact level of support required will only be clear when the EU-funded Omaheke livelihoods programme has completed reviewing its work plan (which review might also have implications for other indigenous plant resources that are common in the eastern parts of Namibia). A sensible way to start a Namibian cultivation programme would be to get Professor Von Willert of Münster University to share his experience of dry land devil's claw growing in South Africa with potential Namibian implementers. A cultivation programme such as this will be a long-term effort and must be resourced to take the experimental growing through to a logical conclusion.

14. ***It is also recommended that NASSP supports a systematic consultation among stakeholders (including foreign buyers) aimed at improving marketing and/or local value-adding of devil's claw (either through declaring it a controlled product in terms the Agronomic Industry Act, or through a voluntary industry association, or by simply closing Namibia's borders to exports of unprocessed material).*** In conducting such consultations it is crucially important to re-assure the "real" market (i.e. product formulators) about the continued availability of raw material and high-quality extracts. It would also be useful to quantify (at least roughly) the economic implications of various local value-adding options. Again, the exact level of support required from NASSP will be clearer once the National Devil's Claw Situation Analysis has been completed and it is known whether IDRC will fund a related continuation of the project (as proposed at last year's second national workshop on devil's claw).

15. ***NASSP should also consider supporting the emergency dissemination – through agriculture and forestry extension workers as well as the mass media – of sustainable devil's claw harvesting guidelines (especially in areas where this has not been done before, such as the parts of the NCAs where H. zeyheri is harvested)***. The current guidelines were developed for *H. procumbens*, and while they are undoubtedly better than nothing, there is also an urgent need to study and develop specific guidelines for *H. zeyheri*.

Indigenous fruits

16. The current strategy for promoting indigenous fruits remains valid on the whole, even if the (in retrospect rather over-optimistic) indicative time schedule in the action plan has slipped somewhat. The work done so far has confirmed that it is sensible – given the many unknowns and the long lead-times involved – to spread the

bets around by using a "pipeline" approach (i.e. to target as wide a range of resources as possible, get them started along the promotion pathway, and then to make more concentrated efforts with those resources that elicit commercial research interest and/or market demand). There is also obviously merit in grouping together resources that can be processed with the same technology and/or promoted in the same market segments. These strategic thrusts can be extended to other plant resources, as well. (In this regard see also "The advantages of diversity" below.)

17. The Indigenous Fruit Task Team (IFTT) has provided efficient, functional and – most importantly – flexible guidance to project implementation and most of its members have participated actively in climbing a sometimes steep learning curve. Despite meeting on average eight times a year for the past three years, the task team's democratic (consensus) decision-making procedures have sometimes not been able to keep pace with the rapidly changing and hard-to-plan "process nature" of indigenous fruit commercialisation. A recently introduced "one week of silence is consent" rule has eased decision-making between meetings, but it might still become necessary (if and when the implementation programme becomes busier and more complex) to elect or appoint an executive committee mandated to make interstitial decisions.

18. As evidenced by e.g. the inclusion of *Hoodia* reportbacks on the IFTT's regular agenda, however, there is no longer sufficient justification for restricting the team's work to fruits only (initially done because the MAWRD funding was specifically allocated for indigenous fruit promotion). This is doubly true now that the US funding for the Useful Plants Development Project (UPDP) has been placed under the control of the IFTT, there is some movement on hiring a Useful Plants Coordinator for the NBRI, the DoF/FAO indigenous fruit-tree domestication project is about to start, MTI is contemplating a technology demonstration, training and incubation centre focussing on processing of indigenous resources, the EU-funded livelihoods programme in the Omaheke is to investigate commercialisation of several indigenous species, and additional support is available through NASSP to unblock bottlenecks. ***It is strongly recommended that NASSP:***

- ***a. funds the forthcoming national workshop in May***
- ***b. styles this meeting as a national workshop on indigenous plants***
- ***c. promotes and supports a decision at this workshop to transform the IFTT into the Indigenous Plants Task Team (IPTT)***
- ***d. helps the task team to secure high-level endorsement of an appropriately expanded mandate and terms of reference***

Were the IFTT to become the IPTT, it would still be advisable not to interpret its mandate too narrowly, as there are some cases in which beneficial synergies could result from including exotic species in the wider programme (e.g. if oil pressing is promoted then castor oil might be of interest to some enterprises; a marula pulp processor might benefit from pressing granadilla in the off-season, etc.)

19. The limited involvement to date of community-level institutions in the implementation of PIF has partly been by design: to contain *ex ante* transaction costs and to avoid stirring up too much interest before the project could deal with it, the S&AP recommended that initial efforts be channelled through existing community organisations whenever possible. The representation of primary producers on the IFTT (through the NNFU) has been relatively ineffective (as also on the DCWG). The danger has therefore arisen that the national programme might move ahead too fast for primary producers to keep up. In the next phase(s) of promoting the commercial use of indigenous plants it will become increasingly important to

mobilise and liaise with community structures and, by implication, to allocate more resources to doing so. ***It is recommended that NASSP supports community outreach efforts by the national programme to promote indigenous plants use, specifically by funding systematic contacts with conservancies, FSRE focal groups, women's groups, traditional healers, traditional authorities and other actual and potential grassroots stakeholders, and (provided extending the task team is endorsed by the national workshop) by financially supporting the participation of representatives of these stakeholders in IFTT (or IPTT) meetings.*** Such outreach is closely linked to the (eco-)regionalisation advocated in paragraph 8 above, while regional satellite centres are obvious conduits for the two-way communication required. The main cost of facilitating such community-level networking is time (and some transport), which can be contained by using interns (see "Training and capacity-building" below) to identify – in the course of their fieldwork, and in close cooperation with local extension staff – community-level groups that would like to get involved in local networks. While it is obviously not sustainable to subsidise the functioning of such groups on an on-going basis, it would contribute greatly to decentralised capacity building if at the least the (public) transport costs of community delegates attending regional meetings, and regional delegates attending national meetings, could be reimbursed by NASSP.

20. If NASSP were to support only one aspect of the planned PIF strategy in 2003 it should be the establishment of a manketti (*Schinziophyton rautanenii*) pilot processing project at Mashare Agricultural Development Institute in the Kavango region. The finer details of such a project – and the extent to which it can/will be supported by LuxDev – must however be clarified before a firm recommendation in this regard can be made, or a budget drawn up. ***It is recommended that NASSP convenes a meeting between LuxDev, MADI management, relevant MAWRD and DoF staff members and the PIF project coordinator to clarify the opportunities and constraints around such a manketti pilot project.***

21. Early results from the 2003 pilot processing of marula juice and pulp have been disappointing, mainly because it was a bad fruiting season and also a bad agricultural season, so that there was more than enough labour to process the limited quantities of late marula fruit (processing was done from mid-March to mid-April). Because of a general shortage of fruits, omaongo prices went up 60% to N$5/litre in informal markets in the NCRs, 25% to N$10/litre in Windhoek, and as high as N$15/litre in the South. People were consequently not keen to sell their marula, even when a price of N$1/kg was offered for fruit delivered to COSDEC in Ondangwa. On the positive side, the processing system worked well and larger samples of frozen and preserved juice are now available to send to prospective buyers. A number of valuable lessons have been learnt, but still need to be analysed and digested before they can be written up. It is anticipated that (provided NAB receives GRN funding as budgeted) the PIF core budget will be able to cope with repeating the pilot processing in 2004, and no direct support for this component would be required from NASSP until late next year. At this stage it is impossible to predict the exact level of support that will be required then. The cost implications of the proposed research collaboration with CIRAD are also unclear, but could probably be supported from the PIF or UPDP budgets (ideally with the continued support of French Cooperation).

22. The PIF strategy advocates flexible funding mechanisms that respond and adapt to emerging priorities. The current situation around indigenous plants is very

dynamic, and recently these priorities have been impacted by the following developments (to mention only a few):

a. Extension of the SANProTA focal species list to include marula, *Stychnos* (monkey orange, omauni) and *Parinari* (mobola plum) in addition to the four "first-generation" focal species, i.e. manketti, melon seed, *Kigelia* (sausage tree) and baobab; this potentially makes available substantial technical and market R&D funding to promote commercialisation of these species and their products, and may thus have a major – but as yet unclear – impact (one way or another) on how Namibia prioritises these focal species (i.e. spend additional funds on focal species where a competitive advantage exists, or hold back spending on other focal species until the SANProTA results are available)
b. The deliberations on ownership models at the second national workshop, and the workshop's endorsement of drafting a feasibility study and business plan for a natural products incubation company resourced and mandated to take commercial risks
c. The imminent start of the DoF/FAO indigenous fruit tree domestication project, which must spend its available budget by December and would thereafter require integration of its on-going activities into the national action plan
d. The start of the EU-funded livelihoods project in Omaheke and Otjozondjupa, which includes indigenous plant promotion activities and provides a cost-effective opportunity to extend national-level activities to the eastern parts of the country (especially if these are combined with devil's claw cultivation)

Hoodia, succulents and other xerophytes

23. At the moment it is unclear how the evolving bio-prospecting partnership between MAWRD and the South African CSIR will play out, whether the collaboration will include *Hoodia*, and if so, whether Namibia will agree to work exclusively with CSIR around *Hoodia*. It is also unclear what Namibia will get in return if it agrees to such exclusivity (i.e. if it does not challenge the CSIR-Phytopharm-Pfizer patented pharmaceutical development route by developing a natural product or food supplement from *Hoodia* with other partners). If at all possible, Namibia should try to keep all options open during negotiations.

24. Should the final *Hoodia* product be based on a natural plant extract (as opposed to a synthetic version of the P57 molecule) Namibia can legitimately expect – at a minimum – that the CSIR provides technical assistance to set up local *Hoodia* cultivation, and that it shares the cultivation income opportunity fairly with Namibian producers by agreeing to purchase *x*% of its raw materials requirements from Namibia. It is strategically important, however, that Namibia develops an independent capacity to propagate and cultivate *Hoodia*, so as to have an alternative route available in the event that it cannot reach an amicable agreement with the CSIR, or in case further development of P57 is based on a synthetic version, or simply because developing a natural product seems most beneficial to the national interest.

25. The recent benefit-sharing agreement between the CSIR and some segments of the region's San population rewarding the use of traditional knowledge did nothing to address the fact that the CSIR patent infringes Namibia's right to benefit from its national sovereign ownership of *Hoodia* genetic resources. It is ultimately up to the

Namibian government to decide whether it will go along with the CSIR patent (which might also result in cooperation around, and possibly benefits from, other resources), or whether it will be better to pursue an independent natural product development route with other partners (and then most likely lose out on cooperation with the CSIR). As a signatory to the CBD Namibia will of course also have to deal with the issue of traditional knowledge and benefit-sharing, but in the absence of national access and benefit-sharing (ABS) legislation it is hard to predict how this will eventually be resolved.

26. Should Namibia choose the natural product route it seems extremely unlikely, given South Africa's professed support for African unity, that a South African state-owned enterprise will sue a neighbouring government for using its own resources to develop its own people and economy. As long as Namibia's commercial partner is careful to avoid product claims that openly infringe the patent, and is resourced and prepared to defend a legal challenge from the Phytopharm-Pfizer group in an American or European court, it is likely that such a product will capture a significant share of the US "food supplement" or EU "herbal remedy" niche markets on the basis of its generic name alone. It has been estimated that this market niche could be worth as much as US$1 billion a year (which represents somewhere between 12% and 35% of the estimated market for a registered pharmaceutical product derived from *Hoodia* or containing synthetic P57).

27. Since *Hoodia* is a relatively rare and slow-growing plant, the total benefits that can be realised on the basis of wild-crafted material alone are severely limited. Such wild harvesting is also unlikely to be sustainable in the long run, given Namibia's low environmental law enforcement capacity. However, one can make a case for carefully controlled and government-supervised harvesting of wild *Hoodia* to research the bio-physical parameters of sustainable harvesting, provide propagules for tissue culture trials, and make available limited quantities of material to research partners for clinical trials, product development etc. Such research must be backed up by research into *Hoodia* propagation and cultivation, however, as the small quantity of wild-crafted material that is likely to be available will not interest a serious long-term commercial partner (as opposed to the innumerable opportunistic requests for dried *Hoodia* that have been pouring in since the plant started making headlines).

28. Even without *Hoodia*, Namibia's succulent flora is one of its most unique and yet under-valorised indigenous plant assets. Indigenous and especially endemic succulents are of interest to collectors worldwide, who pay prime prices for good specimens. Succulents have become increasingly popular for use in landscaping, a trend that is predicted to keep growing as water becomes scarcer and more expensive, and "dry gardening" therefore more popular. Many succulents are also in demand among ordinary gardeners, who buy small plants for the pleasure of raising them. Despite these known markets there are no Namibian nurseries specialising in succulents and it is difficult for Namibian gardeners and landscapers to buy Namibian succulents in Namibia (even those that are relatively common and easy to propagate). In many cases Namibian succulents sold in Namibian nurseries have been imported from South Africa. Many Namibian succulents (and other xerophytes, including the national plant, *Welwitschia*) are offered for sale on the internet by American nurseries (sometimes as ready-made collections of up to 100 species), with typical prices ranging around US$3-5 per plant (unsexed *Welwitschia* seedlings in pots cost US$25). Large, well-grown specimens of rare endemics fetch much higher prices (when they are available, usually illegally); such species could conceivably be

incorporated into local livelihood systems the way black walnut and other high-value timbers are used in other parts of the world (i.e. as a 50-100 year investment in retirement and/or a legacy for the grandchildren). Some "certification" system might be required to prevent illegally harvested wild plants entering the legitimate market chain, but in reality this is probably best achieved by creating an economic incentive for community-level enforcement of resource management regulations.

29. The bulk of Namibia's succulent biodiversity occurs in the south-western winter rainfall area, which has the highest level of endemic species and is regarded as a global biodiversity hotspot. These plants typically exhibit a high level of speciation and a very restricted distribution (some species occurring only on one side of a single hill). In addition to threats posed by mining activities and climate change, any attempt at wild harvesting of these plants is sure to threaten their survival. Because there is no reliable and legitimate supply of Namibian succulents, many collectors are forced to resort to informal markets (which are mostly illegal, since many of the more desirable species are protected plants). *Ex situ* propagation and cultivation of such succulents to make available a legitimate supply to collectors can therefore potentially prevent negative environmental impacts while providing incomes in areas with hardly any economic alternatives.

30. Despite low numbers in their natural habitat, endemic succulents are among the best prospects for bio-prospecting in Namibia, because they have evolved in the world's oldest desert and are adapted to extreme conditions. This implies that at least some of these plants might have unique or rare metabolic pathways that result in biosynthesis of interesting molecules. However, without an investment in cultivation to bulk-up supplies, and a systematic screening programme, these succulents and their economic potential will remain a "locked up" genetic asset, because the quantity of material that is available for tests is so small.

31. Succulents are not always easy to propagate (although many are very easy), but once they get going they are relatively simple to care for, even in areas where little else can be grown. Some of the most desirable species are slow-growing and require a long period of regular but non-intensive care before they reach a marketable size, or a size where they can command premium prices. This suggests an opportunity for smallholders to grow on succulents (which they can either propagate themselves or obtain from a community nursery) as a longer-term source of income. Crops that require limited land and water, and small but regular quantities of attention, are very suitable for household-level production, and as such favour the involvement of women, who are often unable to pursue other income sources due to their domestic responsibilities (in this regard it is interesting to note the successes that have been obtained in southern Namibia with small poultry projects run by women – they work because the chickens are kept at home and therefore get regular and personal care). Succulents are also relatively easy to market (because they can go without water for long periods it is possible to send succulents by post with excellent survival rates).

32. The NBRI has (with initial funding from the Southern African Botanical Diversity Network SABONET) started a programme to cultivate *Hoodia* and other succulents, partly for *in situ* conservation and rehabilitation reasons, and partly to maintain an *ex situ* gene bank for future use. Initial results have been very encouraging (although *Hoodia* especially is reputed to transplant poorly, and a lot of work remains to be done). The SABONET funding will come to an end soon. ***For the reasons outlined above it is recommended that NASSP provides funding to NBRI***

for the continuation and expansion of this programme, including employing a horticulturalist to act as Project Coordinator. It is envisaged that the project will eventually consist of a "mother" nursery at the National Botanic Garden in Windhoek, with satellite nurseries at conservancy or regional level. Ideally the project will gradually be expanded to include all xerophytes with economic potential. For more details see the proposal prepared by NBRI associate Steve Carr, which is attached as Annex E.

Indigenous vegetables

33. Of all indigenous plants, leafy vegetables undoubtedly make the largest contribution to household nutrition for the largest number of people. There is also a substantial informal trade in dried leafy vegetables, but the formal market potential has not been investigated and is unclear at this stage. These vegetables are currently harvested as weeds from cultivated fields and communal lands, are hardly ever cultivated (although their growth might be encouraged in various ways) and are therefore highly seasonal.

34. Other indigenous vegetables with economic potential include *Tylosema* roots, various tubers ("wild potatoes"), aloe flowers, young gourds, young melons, and horned cucumber (*Cucumis metuliferus*).

35. At this stage the main work required to promote commercial use of indigenous vegetables is to collect indigenous knowledge and germplasm, to grow the collected germplasm for preliminary selection, to multiply promising strains, and to investigate the processing, quality and packaging requirements of formal markets. ***It is recommended that NASSP supports the establishment of an indigenous vegetables programme at NBRI, focussing initially on leafy vegetables and adding other types later.*** For more details see a literature review and project proposal prepared by Herta Kolberg and attached as Appendix F.

Other indigenous plant products with economic potential

36. A non-exhaustive list of other indigenous plant product groups that could help to enhance the livelihoods of Namibian smallholders would include:

- lipids (marula, melon, manketti, *Ximenia* etc. are relatively well covered, baobab needs more work)
- essential oils (e.g. mopane, *Croton gratissimus*, *Ocimum* spp.)
- gums and resins (e.g. *Acacia, Combretum, Commiphora* spp.)
- fungi (e.g. Kalahari truffles, omajova)
- phyto-medicinal extracts (e.g. *Tribulus terrestis*, *Terminalia* rootbark)

Some of these are already under investigation. For others the most basic preliminary research still needs to be done. At this stage there is no need for NASSP to support any specific work on these resources (apart from the incidental support contained in programmatic activities at national or regional level). Further research into some of these resources will be carried out under the PIF and/or UPDP projects, as mandated by the national workshop.

The advantages of diversity

37. One of the specific tasks of this consultancy is to *make recommendations on the scope of activities of the indigenous plants component (i.e. should it include all plants and plant products or should it focus on a few?)*. By now the perceptive reader would have discerned that the author leans towards including all plants and all plant products in the overall national effort as early as possible, even though limited resources might necessitate prioritising and focusing on a few of the more promising candidates in the interim. An important reason for casting the net as widely as possible is that – provided it is done as part of a programme rather than in isolation – it does not cost very much to take a particular resource through the first few stages of the promotion process (i.e. include it in the database, do a literature and ethno-botanical review, document traditional knowledge and roughly assess the population status and potential market interest). Similarly, it does not increase the overall costs of e.g. propagation trials or phyto-medicinal screening very much to include additional resources (once the *ex ante*, equipment, management and other transaction costs have been covered).

38. Commercialising indigenous plants by definition involves developing markets for new products, which in turn is an inherently risky and time-consuming undertaking (and that fact partly explains why there have been so few private-sector initiatives in this regard). Not only is it difficult to predict the final market price of a new commodity, but there are many potential pitfalls along the way that cannot be foreseen at all: e.g. after centuries of traditional use in the Pacific islands, decades of selection and cultivation, and years of apparently unproblematic international market expansion, kava-kava was recently banned in Europe and the US after some rather inconclusive evidence emerged to link this mild euphoric with liver damage – if a national programme in one of the range states had focussed exclusively on kava-kava all of its efforts to date would largely have been wasted.

39. Diversity is a desirable attribute from many perspectives:
    a. from a biodiversity conservation angle, diversity helps to maximise positive, and minimise negative, impacts on species, gene pools and habitats, by spreading harvesting impacts over a number of resources and enabling more complex farming systems
    b. from a primary production perspective, diversity results in a better seasonal flow of work and income opportunities, a higher degree of pest and disease resistance in the overall production system (and hence a higher change of successful organic production) and less vulnerability to climatic variability (both long and short term)
    c. from a marketing perspective, diversity hedges against cyclical fluctuations in prices, enables generic or grouped marketing, and spreads long-term market risks, making them more manageable
    d. more markets for more products from more species mean more options for farmers to choose a production mix that suits their particular agro-ecological region, production unit, capital base, personality and/or inclination

40. In answer to the question above, it is recommended that the national programme on useful plants includes as many species as possible, but ***that NASSP concentrates its support on*:**

- ***devil's claw cultivation, trade (consultation with stakeholders about more in-country value-adding) and extension of sustainable harvesting guidelines to areas where* H. zeyheri *is harvested***
- ***the second national workshop on indigenous fruits/plants***
- ***manketti pilot processing***
- ***propagation and cultivation of succulents (including* Hoodia*)***
- ***selection and cultivation of indigenous vegetables***
- ***extension of the programme to eco-regional satellite centres***
- ***better interaction with community level stakeholders***
- ***and training as detailed below.***

Training and capacity-building support

41. If training and capacity building result in nothing more than improved human resources the development impacts will inevitably be diminished through attrition, as and when trained people move on to other positions. While such leakage is probably impossible to avoid completely, it is more beneficial (at least in the current context) to design a training programme in such a way that it also contributes directly to achieving the overall project goal.

42. CRIAA SA-DC has played and continues to play a central role in many initiatives related to the promotion of indigenous resources, particularly plant resources. Examples include marula oil production, sustainable harvesting and organic certification of devil's claw, melon seed trade, manketti oil processing, indigenous fruit promotion, SANProTA, wild silk project and others. CRIAA SA-DC has moreover engaged with this work at all levels, from grassroots organisation building and resource assessment, through SME and cooperative business development, technology design/manufacture and pilot processing, to local and export product and market development, media work and international policy advocacy on indigenous knowledge and intellectual property rights. As such this small Namibian-registered NGO is in an excellent position to coordinate training on indigenous plant development. At the same time CRIAA SA-DC's workload has expanded substantially and the organisation now has a need for additional human resources to carry its programmes forward.

43. Many Namibians graduates are unable to find employment in their chosen fields because they lack work experience. These young people stand to benefit immensely from hands-on involvement in a multi-disciplinary development environment, but many employers and organisations are reluctant to take them on because of the high transaction costs involved. On its part CRIAA SA-DC would be keen to train such graduates and provide them with an opportunity to acquire valuable experience, but has no discretionary funding to support such a programme.

44. ***The training approach proposed for the indigenous plants component is for NASSP to sponsor an internship programme for four recent Unam or Polytechnic graduates, who will be attached to CRIAA SA-DC on 6-month renewable contracts, during which time they will be systematically exposed to and tutored in a wide range of activities related to the commercialisation of indigenous resources.*** Interns will be expected to do a lot of community-level work, and to spend most of their time

in the field. This will strengthen the community outreach component of the national programme to promote indigenous plant commercialisation, help to spread extension messages and enable the kind of time-consuming research that is very hard to do as a routine part of project implementation.

Monitoring and evaluation

45. ***It is proposed that NASSP monitors and evaluates the suggested elements of the indigenous plants component as follows:***
a) Devil's claw cultivation:
IOA #1: After two years nursery-raised mother tubers are available for field trials; after five years at least one community-level nursery is able to raise mother tubers
MOV #1: Research reports to DCWG
IOA #2: After three years at least 30% of transplanted mother tubers are still alive; after five years at least 20% of transplanted mother tubers have survived being harvested at least once
MOV #2: Research reports to DCWG

b) Devil's claw trade consultation with stakeholders about more in-country value addition and/or retention:
IOA #1: At the end of year one stakeholders have reached reasonable consensus on the way forward
MOV #1: Stakeholder endorsement of action plan
IOA #2: By the end of year three a regulatory body/trade association has been constituted OR at least 25% of Namibian devil's claw is exported after undergoing further value-addition than was the case in 2002 OR at least 80% of Namibian devil's claw is sold directly to extractors (rather than European traders who sell on to extractors)
MOV #2: Reports, export statistics, trade figures

c) Extension of sustainable harvesting guidelines for devil's claw to areas where it has not been done before, especially NCAs where* H. zeyheri *is harvested
IOA #1: After 2005 season at least 50% of taproots are replanted and holes closed
MOV #1: Random surveys
IOA #2: Before 2006 season at least three communities are setting devil's claw harvesting quotas on communal land
MOV #2: MET permit records or reports

d) Second national workshop on indigenous fruits/plants
IOA #1: Workshop is held early May 2003 and proceedings are produced by end-June 2003
MOV #1: Proceedings

e) Manketti pilot processing
IOA #1: By July 2003 there is a clear plan on how and where to proceed with pilot processing
MOV #1: Costed proposal to IFTT
IOA #2: By April 2004 it is possible to assess the commercial viability of manketti alcohol, nut and oil processing under various price scenarios
MOV #2: Business plan for expanding pilot processing in 2004 season

f) Propagation and cultivation of succulents (including* Hoodia*)

IOA #1: By January 2004 at least one community-level nursery has started propagating at least five succulent species
MOV #1: Project coordinator's report
IOA #2: By November 2004 at least 10 more succulent species are being propagated at NBRI
MOV #2: Project coordinator's report

g) Selection and cultivation of indigenous vegetables
IOA #1: By June 2004 traditional knowledge has been documented and at least 10 accessions each of at least two indigenous vegetables have been collected and are available for cultivation trials
MOV #1: Project reports
IOA #2: By March 2005 samples of formal-market products are available for market testing
MOV #2: Products, reports

h) Extension of the programme to eco-regional satellite centres
IOA #1: By July 2005 at least two regional centres have incorporated indigenous plant promotion work in their formal work plans
MOV #1: Work plans
IOA #2: By January 2007 there are regional satellite centres in at least five regions
MOV #2: Reports

i) Better interaction with community-level stakeholders
IOA #1: By January 2004 at least four additional fieldworkers are in place in key communities/production areas
MOV #1: Field workers' reports
IOA #2: By May 2005 at least 10 community representatives have been assisted to attend meetings of the IPTT
MOV #2: IPTT minutes

h) Training
IOA #1: By August 2003 a training programme has been designed and the first four interns have been selected
MOV #1: Training programme, interns
IOA #2: By August 2004 at least two interns have produced thematic reports based on original community-level research
MOV #2: Reports

Outstanding issues and suggested answers

46. This section addresses specific issues raised in the terms of reference.

47. **How can a balance between sustainable wild gathering and cultivation of indigenous plants be achieved?**
Firstly it is important to realise that this question is only valid for some resources. For example, manketti trees are reported to start fruiting when they are around 30 years old – this resource can therefore only be wild gathered for the foreseeable future. On the other hand, marula is for all intents and purposes already a cultivated resource in most of its main production area (the NCRs) and occurs there in such densities that it is unlikely to face serious competition from other parts of the country. Large-scale marula plantations (such as those envisaged under the tree-planting initiative in the

ombuga – the saline grasslands north of Etosha pan) might eventually push smallholders out of formal markets and negatively impact on their livelihoods (but this particular initiative is unlikely to succeed due to bio-physical limitations and no-one else is currently known to be interested in planting marula on a large scale, which – given the large supply and limited market – is sensible). Devil's claw is the only resource where cultivation potentially has significant impacts on harvester livelihoods, but replacing the current level of wild gathering with cultivated material would require planting devil's claw on at least 15 000 hectares of land (assuming quite high yields and no market growth). At the moment it is unlikely that the economic incentive is large enough to stimulate cultivation at this scale. In the meantime Namibia should actively investigate cultivation methods that are suitable for adoption by existing harvesters. Because of the relatively lower costs of wild harvesting, and because devil's claw is a slow-growing perennial the primary production of which does not benefit much from economies of scale, it is unlikely that cultivation will replace wild crafting soon (except very gradually, and then only if cultivation methods are not made accessible to harvesting communities). For all other plants it is strategically desirable to encourage cultivation whenever feasible, and always after careful consideration of market demand. In all cases every effort should however be made to keep the opportunity accessible to poorer and more marginalised members of society.

48. **What more can be done to encourage processing and marketing by gatherers and producers?**

Firstly, more of the same, especially more on-going and pro-active market development in collaboration with SANProTA. Rural people will prioritise processing and marketing indigenous plant resources when such work offers a higher return than available alternatives – these returns depend on good prices being realised, and such prices largely depend on accessing high-value export niche markets. Secondly, as and when markets emerge and grow, primary producers and market intermediaries can be helped (primarily through the provision of information) to organise themselves into rational, sustainable, profitable and (preferably) equitable trade chains that can reliably deliver commercial quantities of natural products of acceptable quality.

49. **How should Namibia go about maximising the generic potential of its indigenous resources through, say, joint branding and marketing?**

First develop a sufficient number of commercialised resources with large enough markets to justify a generic marketing effort. Thereafter conduct generic marketing campaigns to boost Namibia's image as a reliable and cost-effective supplier of high-quality natural products derived from a pristine environment and produced according to the highest international (ecological, social, quality) standards. While the Namibian natural products trade alone is unlikely to reach the volumes required to justify generic promotion in the near future, there are short-term opportunities for natural products to "hitch-hike" along with more established industries such as meat or fish. In this regard NASSP should, through its institutional support component, do everything possible to facilitate a cost-effective mechanism for the organic, ecological and/or social certification of suitable Namibian products. Such "green" certification is highly desirable in the natural products market, but it should also be recognised that certification is no substitute for a solid reputation as a reliable and "hassle-free" commercial partner – if Namibia uses its existing competitive advantages (e.g. relatively superior infrastructure, good service providers) to build such a reputation, it would ease future commercialisation efforts.

50. **What more can be done to build Namibian capacity to develop new indigenous products after the project has finished?**

A very good option would be to create a privatised incubation centre (where government funding can be used to leverage both venture capital and a share-holding for primary producers); the centre would employ cutting edge technology to develop highly specialised products for new markets and would be mandated to take calculated commercial risks. The cost of such a venture will be high (N$10-20 million, including operating capital for three years) but initial investigations suggest break-even could be achieved fairly rapidly and the potential returns would be commensurate with the investment. The second national workshop approved (in principle) that a feasibility study and business plan should be compiled for such an incubation centre. The involvement of NASSP core staff in the formulation of these documents would be of immense value, and other NASSP activities will no doubt contribute to an enabling environment, but no further or more specific support is proposed at this stage.

51. **How can Namibia protect its genetic diversity and intellectual property with respect to its unique plant life while successfully exploiting the economic potential for the benefit of its citizens?**

First and foremost, by taking a pro-active approach to bio-prospecting (which entails facilitating access and negotiating benefit-sharing as much as it requires regulation and control). This resorts mainly under draft ABS legislation being prepared by the Ministry of Environment and Tourism, where other moves are also afoot to deal with this crucial aspect of indigenous plants promotion. NASSP and other stakeholders can help the process along by politely insisting that the issue of creating legitimate, efficient and officially sanctioned channels for bio-prospecting be resolved speedily. In the shorter term, negotiating a good collaboration with the South African CSIR (with an appropriate arrangement around *Hoodia* but a much wider focus) could also make a substantial contribution, due to this institution's superior technology platform, understanding of African technology limitations, and proven shrewdness in negotiating commercial agreements. It is however crucially important to be realistic about the economic potential of Namibia's "unique plant life":

- the country actually has a fairly low number of endemic species and (discounting for the moment any possible advantages derived from its unique geo-climatic history and evolutionary pressures) the odds are therefore low that a Namibian endemic will yield a "blockbuster" patented pharmaceutical drug that makes it all the way to commercial production (and even then the actual benefits would depend on the deal that had been made, and to what extent traditional knowledge had played a role in the process)
- on the other hand, Namibia shares a wealth of useful plant species with neighbouring countries and in most cases the traditional uses of these plants have been documented and placed in the public domain, making them less likely candidates for patent protection (at least without substantial additional investment in innovative science and technology)
- many of these indigenous-but-not-endemic species represent substantial "natural capital" in the form of resource endowments that yield products with known or potential markets
- almost all these natural products require further product and market development efforts (which in turn require substantial investments of time and money)

- products have a much higher chance of commercial success if they are developed in collaboration with partners who are financially and logistically resourced to promote and distribute them in appropriate international markets
- product-development partners may well desire to protect their investment and innovation with patents or other intellectual property rights – to a large extent such intellectual property is the source of the benefits to be shared
- in-country value addition is an obvious and often desirable benefit, but its extent should be guided by technological, financial and commercial feasibility rather than economic development dogma
- ABS legislation might be necessary, but is not sufficient – unless bio-prospectors are actively encouraged and assisted "to do the right thing" (flexibly, according to the particular circumstances) commercial opportunities might go to neighbouring countries with less restrictive and/or more active approaches
- Namibia must engage neighbouring countries in developing joint approaches to bio-prospecting and the commercial development of common genetic resources, but at the same time compete vigorously and make full use of its infrastructural and technological advances
- capacity-building is a legitimate form of benefit-sharing, but is too often construed as the establishment of under-utilised scientific facilities; building good networks of organised primary producers is often a more appropriate, cost-effective and sustainable form of capacity

The above notwithstanding, Namibia obviously has to defend its sovereign rights and national interests, as well as the traditional knowledge of its people, in cases where bio-piracy has clearly occurred.

ANNEX A

Terms of reference

Indigenous plants development strategy review

Introduction

1. The National Agricultural Support Services Project (NASSP) intends, during its inception phase, to undertake an integrated inception study. This study will consist of a series of themed consultancies and reviews that will contribute towards the projects overall workplan and to the revision of the detailed logical framework. One such study will be a review of Namibia's strategy for supporting and promoting the development of indigenous natural products, specifically those produced from indigenous plants.

Background and outstanding issues

2. The overall objective of NASSP, funded under EDF 8, is to enhance the livelihoods of smallholder households in the [Northern] Communal Areas of Namibia. NASSP is tasked specifically to increase the income that farmers derive from the commercialisation of indigenous plant resources in a sustainable way.

3. The specific purpose of the NASSP indigenous plant resources component is:

- To get more people involved and aware of commercial activities with indigenous plants and fruit;
- To improve commercial output of products like marula oil and devil's claw;
- To improve post-harvest and processing techniques;
- To increase demand for products based on indigenous fruits and plants;
- To improve coordination with neighbouring countries [on development of indigenous plant resources]; and,
- To have local people capable of managing the production chain for indigenous plant resources.

4. To achieve these purposes, it was envisaged that a number of projects would be implemented, including, for example: supporting the Indigenous Fruit Task Team, developing an indigenous plant resources awareness campaign, developing and testing a small press for marula juice, propagation of Devil's Claw, development of distilled products from Manketti, market studies, preparation of extension material.

5. However, since the preparation of the NASSP project document and through the efforts of the Ministry of Agriculture, the Indigenous Fruit Task Team (IFTT) and the Devil's Claw Working Group (DCWG), a number of these activities have been started. Notably, MAWRD have completed the first phase of the Promotion of Indigenous Fruit (PIF) project and will shortly have a national workshop to design the next phase of the programme. In the Devil's Claw sector, a survey of both markets and the resource condition has been completed. A key issue in tackling the problem of expanding production and marketing of indigenous plants, that of making organisations or community groups' function well, will be tackled by a consultancy to be funded under the EU Trade and Industry Development Project (TIDP). The results

of this consultancy may lead to further funding possibilities in this sub-component on the issue of 'groups' and business models in general.

6. Given the progress toward achieving its goals as laid down in the Indigenous Fruits Strategy and Action Plan (MAWRD, 2002), a review of activities is needed including a new action plan to be implemented by NASSP over the coming years.

7. Issues that are outstanding and for which answers are needed in order to focus NASSP interventions include:

- How can a balance between sustainable wild gathering and cultivation of indigenous plants be achieved?
- What more can be done to encourage processing and marketing by gatherers and producers?
- How should Namibia go about maximising the generic potential of its indigenous resources through, say, joint branding and marketing?
- What more can be done to build Namibian capacity to develop new indigenous products after the project has finished?
- How can Namibia protect its genetic diversity and intellectual property with respect to its unique plant life whilst successfully exploiting the economic potential for the benefit of its citizens?

Terms of reference

8. The consultant should complete the following tasks *inter alia*:

a) Consult widely with stakeholders (members of IFTT, DCWG and others) to ascertain the nature of support required from NASSP;

b) Review the existing Strategy and Action Plans for Indigenous Fruit and Devil's Claw and suggest elements that might be supported by NASSP;

c) Assess the usefulness of the Indigenous Fruit Task Team and Devil's Claw Working Group and suggest improvements;

d) Make recommendations of the scope of activities in this component (ie, should it include all plants and plant products or should it focus on a few?);

e) Draw up a programme of activities, including indicative costs;

f) Recommend training and capacity building support; and,

g) Progress towards the achievement of objectives for each NASSP sub-component must be monitored and evaluated, therefore, for each intervention proposed; recommend how NASSP will assess impact. Suggest at most two suitable indicators of achievement and how these can be verified. This should be compiled in a sub-component monitoring and evaluation plan.

h) Complete these tasks with sensitivity to gender issues paying particular attention to the way NASSP can empower women through its interventions.

Scope of services

9. The review will be conducted over a period of **three weeks**, including consultations with stakeholders, report writing and presentation of findings.

10. The draft final report should be presented not later than 1st April 2003. On receipt of comments from Namibia, the consultant will produce the final report (10 copies) and courier to NASSP. NASSP should also be provided with an electronic copy of both the presentation and the report. The final report is to be submitted before 6th April 2002.

Outputs

11. The consultant is expected to produce a summary report consisting of approximately 30 pages. All other information should be contained in annexes to the main report. A summary of the key findings of the mission is to be prepared before the consultant departs from Namibia and, if necessary, present to the NASSP inception workshop for validation by stakeholders.

Profile of consultancy skills

12. The consultants should have extensive knowledge and experience with production, development and marketing of natural products both in Namibia and elsewhere in Southern Africa.

ANNEX B

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ANNEX C

Persons met

Ben Bennett, NASSP TA
Dave Cole, SHDC Coordinator
Dr Kate Schreckenberg, ODI Research Fellow and MTI consultant
Herta Kolberg, NBRI
Dr Gillian Maggs-Kolling, NBRI
Ben Strohbach, NBRI
Steve Carr, NBRI
Marianne Strohbach, plant ecologist (by email)
Peter Erb, MET (DSS)
Sem Shikongo, MET (DEA)
Michael Kehoe, MTI (TIDP)
Dr Klaus Handschuh, MTI (TIDP)
Maisharou Abdou, FAO consultant
Esther Kamwi, DoF
John Uupinde, MTI (DID)
Dr Ousmane Kane, MTI consultant
Yves Baudot, MLRR consultant
Dr Alex Verlinder, NRSC (NFFP) and DRFN
Joyce Katjirua, MET (DEA), SABSP country coordinator
Gus Le Breton, SANProTA CEO
Cyril Lombard, SANProTA RMDO
Roger Gamond, KAP tecnlogist
Dr Yves Lozano, CIRAD
Christian Dohse, Wildlife and Environment Society of Malawi
Ibo Zimmerman, Polytechnic of Namibia
Thierry Dauplais, NOREESP coordinator

ANNEX D

Devil's claw cultivation proposals: synopses and comments

In the course of this consultancy four separate proposals were encountered dealing wholly or in part with the cultivation of devil's claw. These proposals are summarised below, with the contact details of their respective authors. In commenting on these proposals the consultant considered the following:

- It has already been demonstrated in principle that it is possible – though neither simple nor straightforward – to grow devil's claw as a cash crop under both irrigated and rain-fed conditions
- Such cultivation trials have met with an ambiguous response from stakeholders, primarily because devil's claw harvesting is an extremely important source – often the only source – of cash income for thousands of the most marginalised people in Namibia
- If devil's claw were to be domesticated and cultivated successfully (only) at a level of technology inaccessible to traditional harvesters, the danger exists that wild-harvesters will eventually be displaced from the supply chain by commercial growers, with severe socio-economic consequences
- However, were over-harvesting to cause local depletion of the wild resource, the economic consequences for harvesting communities in the surrounding areas would be just as dire
- The real challenge is therefore to develop a method of cultivating devil's claw that is accessible to people with limited capital and farming skills
- To achieve this, cultivation trials should actively seek the cheapest and simplest methods of propagation and cultivation
- Overcoming the technical challenges is only the beginning, though, because difficult and complex issues of land and resource tenure need to be addressed before harvesting communities will be able to take up the opportunity successfully
- To minimise setbacks caused by adverse climatic events or human error it would be advisable to run as many different trials in as many different locations as practical
- It would be highly desirable to systematically collect, collate and exchange the results achieved during these trials
- It would help tremendously if cultivation could be initiated with the unequivocal support of a major buyer, to assure would-be growers of a steady market and a premium price
- Since there are no registered pesticides for devil's claw, and it is unlikely that any manufacturer will register such remedies any time soon, production will have to done organically

Some of the work proposed (especially in the two proposals from Unam) involves fundamental scientific research that is beyond the remit of NASSP and will have to be funded from other sources. As a first step it is proposed that NASSP facilitates a discussion between the various researchers – preferably with the involvement of Prof. Dieter von Willert – aimed at developing a joint work plan with clearly delineated areas of responsibility and agreed mechanisms for collaboration.

Proposal 1:

Cultivation of *Harpagophytum procumbens* and *H. zeyheri* (Devil's Claw) to augment wild-harvested materials as income generation for marginalised communities

Proposed by
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Email: marstr@iway.na

Synopsis

A hands-on, practical approach in cooperation with Prof. von Willert, starting in 2003 and continung until 2007, is proposed. Ms Strohbach suggests (and illustrates) using low-tech centralized propagation and nursery facilities (initially based at Tjaka Ben-Hur Centre) to raise seedlings in pots for transplanting into 3m-wide cleared strips after one year, leaving 5-m wide grassed strips in between the rows to prevent soil erosion (and incidentally provide reserve grazing during the dry season). She envisages that fields will be fenced, possibly with cut bushes, and estimates a yield of about 40 kg dry matter per hectare on a 4-year rotation. She also suggests high-value, perennial fodder grass species for enrichment plantings on the grassy strips.

Comments

Ms Strohbach is a plant ecologist who has been involved in ecological surveys and quota setting for the Sustainably Harvested Devil's Claw (SHDC) project in the Omaheke region for five years, and also coordinated the resource survey part of the National Devil's Claw Situation Analysis. Her proposal is therefore firmly rooted in the on-the-ground reality of devil's claw harvesters, and can be implemented without much alteration. However, the project could be improved by diversifying the cultivation strategies (e.g. spot-plantings in grazing areas, protected by brush piles) and it would be advisable to conduct propagation trials in more than one venue to counter potential problems related to nursery management.

Proposal 2:

Optimization of the economic recovery from the devil's claw *(Harpagophytum procumbens,* DC*)* through domestication and elucidation of its conservation genetics

Proposed by
Dr Martin Mbewe (Biology Department, University of Namibia)
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Fax: +264-61-2063791
in collaboration with
Dr Martha Kandawa-Schulz (Chemistry Department, University of Namibia)
Tel: +264-61-2063536
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Synopsis

Dr Mbewe summarises a considerable quantity of information from the literature and then proposes an ambitious and multi-disciplinary programme of activities between 2003 and 2006, *inter alia* collection and analysis of extensive data on bio-physical, environmental and population density variables (including establishment of permanent sample plots), experiments designed to break seed dormancy (including measures to control fungal infections), molecular genetics analyses of phenotypes, Mendelian genetics experiments in glasshouse conditions and at the university farm to breed superior stock (and crossbreed *H. procumbens* with *H. zeyheri*), bioeconomic surveys among harvesting communities, community-level value-adding initiatives (in Otjozondjupa region) and the formulation of management guidelines. He also points out the learning opportunities for final year biology students.

Comments

Some of the research questions raised in the proposal (which was first circulated a year or two ago) have since been (partially) answered by work done as part of the national situation analysis. It is therefore advisable to revisit the proposal and reformulate certain objectives. From the perspective of NASSP the most interesting aspects would be the experiments to break seed dormancy, and possibly the crossbreeding of the two species. The proposal is silent about how genetic strains will be evaluated for their respective levels of active ingredients (it would be a great contribution to the development of the Namibian devil's claw industry if the facilities required to perform such analyses routinely and accurately were made available to all stakeholders). It also lacks clear plans as to how the academic work will be transferred to rural production areas. There are obvious synergies to be derived from using the seedling produced under research conditions for field trials, and vice versa.

Proposal 3:

Conservation strategies for devil's claw (*Harpagophytum procumbens*), also known as the grapple plant, through its cultivation as a domesticated cash crop and evaluation of its therapeutic effectiveness in ethno-veterinary medicine

Proposed by
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in collaboration with
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Synopsis

This proposal was submitted to the United Nations University's Institute for Natural Resources in Africa. It reviews the literature and suggests continuous demonstration to resource-limited communal farmers (initially in Okakarara) of the possibility to grow devil's claw as a cash crop (using wild-harvested taproots and side-tubers as propagation material), combined with tissue culture and/or improved germination techniques to amplify seedling production, and controlled field trials at university

farms (Neudamm and Ogongo). It also proposes genetic characterization using both field plant evaluation and biotechnological techniques. The project will help communal farmers, especially those directly involved in the harvesting of the medicinal plant, to get organized in order to have a strong bargaining position in trade. An attempt to standardize the utilization of the medicine in ethno-veterinary practices (through de-worming experiments) will also be undertaken. Information material on sustainable harvesting pratices and suitable cultivation methods will be prepared and made available to farmers. The proposal recognises the centrality of secure land and resource tenure to the success of a cultivation initiative.

Comments

The proposal contains many elements that would be compatible with the aims of NASSP regarding devil's claw cultivation, and some that would not. Its estimated cost (around US$36 000) would necessitate the involvement of an additional donor. As the Dean of Agriculture, Prof. Mwandemele would be in an excellent position to ensure maximum synergies between fieldwork and the more academic research elements. Neudamm and Ogongo both have useful facilities for cultivation trials, and although tissue culture experiments with devil's claw have not been very successful to date, a breakthrough in this regard could be of immense benefit to the overall programme. A possible cause for concern is the fact that the project is aimed firstly at the Okakarara area, where the land is controlled by Herero farmers and the San – the real holders of indigenous knowledge about devil's claw – are extremely marginalised in terms of resource tenure (which might result in them being excluded from this income opportunity).

Proposal 4:

The sustainable utilization of devil's claw

Proposed by
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Synopsis

This is a concept note proposing as yet unspecified work to find a cost effective propagation method that could be used for the propagation of devil's claw, either vegetatively (tissue culture or cuttings) or through seeds, with plantlings/seedlings or primed seeds given/sold to harvesting communities for cultivation. Investigations into hardening-off and transplanting are advocated.

Comments

The proposal is still in a very preliminary draft form and no comments can be made about the details. However, involving the Polytechnic in propagation would spread management risks, while there are also opportunities for synergistic activities with students doing practical work.

APPENDIX E

The propagation and cultivation (P&C) of succulents

by Steve Carr, NBRI research associate

The protection and conservation of Namibia's biodiversity and the encouragement of its sustainable utilization for the uplifting of the standard of living for citizens is a central goal of natural resource management in Namibia. Strategies of biodiversity protection and natural resource management and utilization encourage the utilization of natural resources in a sustainable manner. Conservancies are a mechanism allowing for the control over and utilisation of their natural resources by their members. In many parts of Namibia wildlife is emphasized as a sustainable natural resource generating income. Conservancies in southern Namibia, although part of a prime tourist loop, do not have sufficient wildlife resources as yet. They need to consider other natural resources for income generation. Much of southern Namibia has unusual and unique flora. Many of the plants found there have commercial potential. Efforts to encourage the legitimate and sustainable utilization of this resource need to be pursued. Cultivation efforts of selected species by conservancies could create income opportunities, while contributing to the conservation of these species by attaching a value to them.

A plant production initiative is currently underway at the National Botanic Garden in Windhoek. The NBRI host the initiative and provide institutional support and guidance as a part of their monthly report-back and planning sessions.

The context of the project:

The National Botanic Research Institute/Southern African Botanical Diversity Network (SABONET) Threatened Plants Programme has had a *Hoodia* propagation project at the Botanic Garden since August 2002.

The aim of the project is to:

- Contribute to the *in situ* conservation of the *Hoodia* spp. in Namibia through the selection and propagation of seedlings for cultivation purposes.
- To contribute to the *in situ* conservation by establishing populations for recovery plans.
- To contribute to the *ex situ* conservation of genetic diversity in the National Botanic Garden for future use.

With the development of the market for *Hoodia* products and the perceived value that this market may generate for plant material, the project is a pre-emptive initiative to reduce the anticipated harvesting pressure on "wild" populations by encouraging the cultivation of the plants. The project is in an initial phase with funding to July 2003. A 2nd phase will include and emphasise the decentralizing of propagation technology to conservancies in areas where the plant is found in southern Namibia to encourage its cultivation. Propagated seedlings will be supplied to the conservancies from the stock held at the National Botanic Garden, as will the necessary skills and expertise for their cultivation.

The scope of the initiative initially limited itself to *Hoodia* spp., however, propagation activities with other species from the Succulent Karoo floral "hotspot" are now also underway. The development of *Hoodia* cultivation in the conservancies in southern Namibia need not occur in isolation. There are a number of endangered and endemic species that can be cultivated to generate income while protecting the wild populations. There is a demand for these plants and, as it is difficult (almost impossible) to obtain them through legitimate outlets, many are "lifted" from the veld. Successful propagation and cultivation initiative by conservancies could supply live plants and seeds to commercial nurseries, collectors, landscapers and other interests, while contributing significantly to the conservation of the plants by making material available for regeneration exercises.

The cultivation of succulents is a medium to long-term project. It takes time for many succulents to grow to a size where they attract value or can be used for other purposes. Plants may take five to ten years to grow to a reasonable size. Nonetheless, there are some succulent species, such as Mesembs, which are faster growing and their cultivation can, therefore, generate income sooner.

Proposal to propagate and cultivate succulents and to decentralise such activities to conservancies in southern Namibia with a view to enhancing the livelihoods of smallholder households within the conservancies and to contribute to the conservation of the plants through their sustainable utilisation.

Undertake activities to propagate and cultivate plants for commercialisation. Markets for succulents already exist locally, regionally and internationally. Targeted species for P&C will include indigenous rare and endangered species, endemics, and plants with ornamental value and/or with known economic potential. Plant material can also be made available for a programme of systematic screening to assess beneficial attribute/compounds for further commercial applications e.g. medicinal and considerations for value-adding.

The aims and objectives of the project can be modified to incorporate the second phase.

Aim:

- To contribute to the strengthening of *in situ* and *ex situ* conservation of succulent flora by propagating and cultivating selected species,
- To promote the commercialisation of non-traditional, indigenous plant resources e.g. *Hoodia*, within NRM programmes, thus contributing to the diversification of agricultural activities and the sustainable utilisation of botanical resources.
- To contribute to the enhancement of the livelihoods of smallholder households by increasing income generating options through the marketing of the plants
- To contribute to the promotion and control of bioprospecting and biotrade activities to generate sustainable benefits to Namibia,

Objectives:

1. To propagate plants from seeds to establish effective propagation methods,
2. To establish requirements for optimal growth under cultivation,
3. To establish seedling populations at the National Botanic Garden in Windhoek,

4. To make available seedlings to identified parties for further cultivation purposes,
5. To assist with the development of propagation and cultivation facilities in conservancy areas,
6. To facilitate skills-transfer and expertise to cultivators where required.
7. To facilitate the marketing of the plants,
8. To provide plant material of targeted species as part of a systematic screening process to identify any compounds for applications in the cosmetic, pharmaceutical industries.

Objectives 1 to 3 are currently underway. More than a thousand potted *Hoodia* seedlings are being grown at the Botanic Garden, with a target of 4000 by the end of April 2003. A number of *Aloe* spp., *Euphorbia* spp. and Stapeliods are also being propagated. Records of growing conditions and requirements are maintained in order to assess the growing requirements and optimal conditions of the plants.

Objectives 4 to 6 will be initiated in the 2nd phase of the project (August 2003). Informal discussions have been conducted with the Namibian Development Trust to identify potential conservancies in southern Namibia and to organize possible meeting dates with the conservancy committees.

In order for the project to continue through the initial phase and into phase 2, funding is required to maintain the services of the project co-ordinator and for fieldtrip expenses to conservancies in southern Namibia. The project requires the full time services of a horticulturist specialising in succulent propagation, with experience of working with conservancies and knowledge of Namibia's biodiversity strategy. The co-ordinator's role is to promote the propagation and cultivation of succulent species and to decentralize such activities to conservancies as a component of phase 2. As the project is already underway it is necessary for the services of the incumbent to be maintained. Funding is being sought for this purpose. Further funding for the implementation of phase 2 is not included this proposal.

Support for the NASSP:

Supports the overall objective of efforts to enhance the livelihoods of smallholder households by promoting the commercialisation of indigenous plant resources / non-traditional crops (crop diversification?) e.g. *Hoodia*.

Specifically, it aims at the component of the NASSP to commercialise indigenous plant resources (non-traditional crops), while having a positive impact in terms of sustainability and the conservation of the environment.

Collaborators/stakeholders:
GRN – NBRI (housing the project, providing institutional support/facilities, botanical expertise, advice on project expansion), along with SABONET (already involved through the provision of funding for Hoodia propagation trials)
MAWRD/NASSP - further funding, extension services and guidance in project expansion
UPDP/IFTT(?) - project to fall within its ambit
MHETEC – support for value-adding research
MET– natural resource harvesting control, permits, propagation support (DoF)

CRIAA SA-DC – market identification and liaison, product development, arrangement and facilitation of systematic screening and plant analysis with ONP/HVH.
Ongongo College – possible option for micropropagation.
UNAM, Polytechnic – options for in-service training.
Conservancies – registered (or registering) conservancies initially in southern Namibia. Active partners and beneficiaries.
NGOs - NDT, NACSO, UNDP – project support, conservancy liaison, capacity building with conservancies, funding for facility development and running costs.

Project context to date:
Propagation and cultivation of a variety of succulent species, including *Hoodia* is already underway at NBRI/NBG. The objective of the project is to decentralise P&C activities to conservancies in southern Namibia. Two conservancies are currently being approached by the project co-ordinator at the NBRI through the NDT (one registered and the other in the process of registering). It is envisaged that attempts will be made to drawn in 3 more once their conservancy status is finalised. Should the conservancies regard this as a useful income generating activity to be undertaken, P&C facilities are to be developed in each conservancy. Faster and slower growing species will be targeted to realise income generation from the initiative within 2 –3 years.

Project expansion:
The project will initially focus on two conservancies in southern Namibia with a view to establishing a viable P&C set up. As/when other emerging conservancies are registered (or in the process of submitting applications for registration) their participation will be sort.

Successful P&C in the conservancies will allow for the natural expansion of the facilities. At a point it may be viable to establish a single collection point or nursery outlet in each region of Namibia to supply markets through the region and internationally. This may reduce costs in terms of transport, marketing and accessibility to the plants by the interested public.
There are a number of conservancies already registered through north-western Namibia (Damaraland and Koakoveld). P&C could be initiated with some of these. The areas have interesting succulent plants, although with a much lower diversity that the south. This is a natural route for expansion of the project over the next two to five years.

Training:
Capacity building will not be an isolated focus of the project. Capacity building will be undertaken by other NGO's already involved in these activities, such as NDT. Horticultural training and skills transfer will be offered by the NBRI horticulturist to identified conservancy members committed to the project. This will promote the continuity of the project and allow conservancy members to manage their plant resources as part of their broader natural resource management programme.

Marketing:
The marketing of the plants and market expansion will be undertaken by CRIAA SA-DC.
Benefit sharing arrangements within the individual conservancies will be decided upon by the conservancies themselves. Payments to individuals committed to the

P&C of the plants will need to be made. Should a centralised outlet be established, payment mechanisms and pricing will have to be negotiated with the conservancies at such a time, as will the staffing and development costs of such a development.

Legalities of propagation and sale:
Plant propagation material will initially be supplied from the NBRI. This will include seedlings and seeds. Permits (seed collection, nursery, selling, export etc) and other legal constraints will need to be clarified and redesigned if necessary, to facilitate the commercialisation of the plants. A clear and simple legal framework for the cultivation and sale (and removal of the plant material from Namibia by tourists, collectors etc) is essential to promote the commercialisation benefits and to enhance the control over illegal removal of plant material within the country. A cumbersome, confusing system will impact negatively on sales and create confusion among cultivators and the authorities, allowing for the easy exploitation of loopholes by unscrupulous parties.

Role of Project Co-ordinator:

To actively promote and direct activities pertaining to the propagation and cultivation of endemic and endangered succulent flora.
To investigate the germination and growth requirements of selected succulent flora.
To maintain a seedling population of selected succulents at the National Botanic Garden/elsewhere.
To initiate and facilitate propagation and cultivation activities with conservancies.
To transfer skills and apply expertise (training), including record-keeping and plant material collection as required, ensuring the successful implementation of the project.
To facilitate the promotion and marketing of the succulents cultivated by the conservancies by liaising with the relevant partners.
To contribute to the on-going activities at the NBRI related to Plant Product Development.
Facilitate marketing activities by liasing with CRIAA SA-DC
Providing plant material for a systematic screening process.
Liase with the research and extension Directorates of the MAWRD and the other collaborators and stakeholders.

Role of conservancy staff:
Day to day maintenance of plants
Propagation of plants
Seed collection
Record keeping (growing and sales)

Time frame (3 years):

Propagation is already underway and will be on-going.
Approaches to conservancies (2) are currently underway. Meetings to promote the initiative and to draw the conservancies into the project are being set up. (2-3 months)
Once co-op and commitment of conservancies is achieved the development of P&C facilities will be undertaken.
Approaches to other conservancies as the project expands.
Individuals in conservancies to be identified, thereafter on-going training will be given by NBRI horticulturist.

Initial propagation and cultivation material will be supplied to the conservancies by the NBRI, and required horticultural material/equipment supplied through funding form donor agencies.
Further propagation material will be provided by the conservancies themselves and by the NBRI (on-going and seasonal).
Collection procedures and training in this regard will be provided by the NBRI to ensure all material P&C is documented.
Training in record-keeping will be provided by the NBRI horticulturist.
The P&C of faster growing succulents encouraged initially along with slower growing plants to realise a financial return sooner. Marketing will target commercial nurseries, collectors, tourists, landscapers and garden designers, and will be facilitated by CRIAA.
Plant material for screening by organisations such as ONP will be made available by the NBRI.

APPENDIX F

[This document has been shortened. Additional work would be required on processing, packaging and the quality requirements of formal markets, as well as market liaison work.]

CONSERVATION AND EVALUATION OF GENETIC RESOURCES OF NAMIBIAN INDIGENOUS LEAFY VEGETABLES

LITERATURE SURVEY AND PROJECT PROPOSAL

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1. Background and Justification

The leaves of wild growing, indigenous plants are often used as vegetables by rural people (Shackleton *et al*., 1998; Mpuchane & Gashe, 1998; Van den Heever, 1995; Matlhare *et al*., 1999). Namibia is no exception. There are a large number of species that are used as leafy vegetables, but three species, viz. *Cleome gynandra*, *Amaranthus thunbergii* and *A. dinteri* are the most widely used over the entire country and among most ethnic groups (Dinter, 1912; Malan & Owen-Smith, 1974; Rodin, 1985; Van den Eynden *et al*., 1992; Von Koenen, 1996; Sullivan, 1998). Kakujaha-Matundu (1996) found that *Cleome gynandra* is eaten up to three times per week in the Okakarara area.

Since early colonial times, a large number of species with economic potential have been reported from Africa. Many of these species are tolerated as weeds in crop fields (Blench, 1997). For poor rural households, these species can provide an income and it has been reported also from Namibia that they are traded on local markets (Malan & Owen-Smith, 1994; Chweya & Eyzaguirre, 1999).

In the predominantly carbohydrate-based diet of rural Namibians, protein, vitamins and minerals, found in green leafy vegetables, are often lacking, causing malnutrition and various health problems (Mathenge, 1997; Madisa & Tshamekang, 1997; Van den Heever, 1995; Auwalu & Tenebe, 1997; Blench, 1997). These wild vegetables usually appear at the first rains and are fast growing, so that they are available for harvest before the cultivated staple crops, thus filling a gap in food production (Matlhare *et al*., 1999). With urbanisation, dietary patterns have also changed considerably, with rural households consuming indigenous leafy vegetables more frequently than urban households (Otto, 1979; Benhura & Chitsiku, 1991). Promotion of the consumption of leafy vegetables would thus serve to improve the nutritional status and standard of living of rural people (Hauptli & Jain, 1978). Cultivation, improved processing and storage and commercialisation of these species may lead to bigger markets in cities and towns (Otto, 1979).

Cultivation of exotic vegetables often requires more input than poor rural households can afford (van den Heever, 1995; Blench, 1997). There are a number of indigenous vegetables that do not require high inputs and are already known to rural people through harvesting from the wild. Development and more extensive use of these

species should be encouraged. This would then also contribute towards higher agro-biodiversity in crop systems, which is not only desirable from a conservation point of view, but increases food security at the household level (Blench, 1997).

Despite the evident importance of indigenous vegetable species, hardly any research has been done on them internationally (Hauptli & Jain, 1978; Chweya & Mnzava, 1997) and none in Namibia.

A. *Cleome gynandra* L.

A.1 Taxonomy & Botany

Cleome gynandra belongs to the family Capparaceae, although chemosystematic studies have shown that it differs sufficiently from other Capparaceae to warrant its separation into the Cleomaceae family as suggested by some taxonomists (Sharaf *et al*., 1997). There are 15 species of *Cleome* indigenous to Namibia, *Cleome gynandra* being the only white-flowered one among the yellow- and pink-flowered species (Craven, 1999). Recent synonyms, *Gynandropsis gynandra* (L.) Briq. and *Cleome pentaphylla* L., still appear in literature (Codd & Kers, 1970; Waithaka & Chweya, 1991).

C. gynandra is an annual, upright herb that may be considerably branched. Depending on environmental conditions, it is between 0.1 and 1.0 m tall at flowering. The plant can be densely covered with glandular hairs or rarely be glabrous. The leaves are digitately palmate, 3-5 -foliolate. Petioles are 2-20 cm long. Leaflets are elliptic, obovate to oblanceolate, 2-10 cm long and 1-4 cm broad. The terminal inflorescence can be up to 30 cm long with numerous flowers on long pedicels. The 4, clawed petals are white to pale pink. Stamens are 6 with long, purple filaments borne on a 1-2 cm long androgynophore, thus protruding well above the petals. The ovary is borne on a gynophore up to 2 mm above the base of the filaments. Style very short, terminating in a capitate stigma. At maturity the fruit is a pale brown silique, up to 12 cm long and 1 cm broad. Seeds are brown to dark grey, circular to reniform with sculpted surfaces and 1-1.5 mm in diameter. (Codd & Kers, 1970; Chweya & Mnzava, 1997).

There are conflicting reports on the chromosome number of *C. gynandra* with 2n = 20, 18, 22, 32 or 34 being reported (Chweya & Mnzava, 1997).

C. gynandra is a C_4 species, which are generally characterised by rapid growth and high dry matter production - three to five times more per unit leaf area and unit time than C_3 plants (Waithaka & Chweya, 1991). In *C. gynandra* this can partly be attributed to the diaheliotropic leaf movements that the species exhibits. Leaves move perpendicular to sunrays, thus ensuring maximum exposure to sunlight for maximum photosynthesis (Rajendrudu *et al*., 1996). This is a mechanism commonly found in plants that need to complete their life cycle rapidly before the onset of drought (Rajendrudu, 1996), as is the case in Namibia.

The species is not formally divided into subspecies or varieties, but there is some variation within the species. The most striking one observed in Namibia is a difference in smell. Within one population of morphologically similar plants, aromatic and non-aromatic individuals may be found (H. Kolberg, pers. obs.; P. Craven, pers. comm.). It is strange that this has never been reported in the literature.

In Kenya the intra-specific variation of purple and green stems has been recorded (Chweya & Mnzava, 1997).

A.2 Reproductive Biology / Growth & Development

A lack of research exists in this aspect of *C. gynandra* biology (Chweya & Mnzava, 1997). Casual observations and studies on other species of *Cleome* however lead researchers to believe that *C. gynandra* is both self- and cross-pollinating. The species seems to be protandrous with anthers dehiscing before stigmas become exposed and a number of *Cleome* species have been shown to be self-compatible. Pollinators seem to be mainly honey bees with spiders and wind being possible additional vectors (Chweya & Mnzava, 1997).

Reproduction is by seed with seeds germinating within 4-8 days. There seems to be a period of latency (5 months) with highest germination at 12 months after harvest (Chweya & Mnzava, 1997). Apical dominance seems to be weak and the plant starts branching in the second or third week of growth (Waithaka & Chweya, 1991).

A.3 Distribution and Habitat

The species is naturally widespread world-wide (most of Africa, Middle East, southern Asia) and has been introduced to almost all parts of the world (Chweya & Mnzava, 1997). In Namibia it occurs practically throughout the country (Fig. 1).

C. gynandra grows at altitudes from sea level to about 2400m (Waithaka & Chweya, 1991 on a wide range of soils, from sandy loam to loamy clay soils with high organic matter content. It can be considered a ruderal species which is commonly found where manure or household refuse accumulates (Dinter, 1912; Shackleton *et al.*, 1998) and may be abundant in cultivated

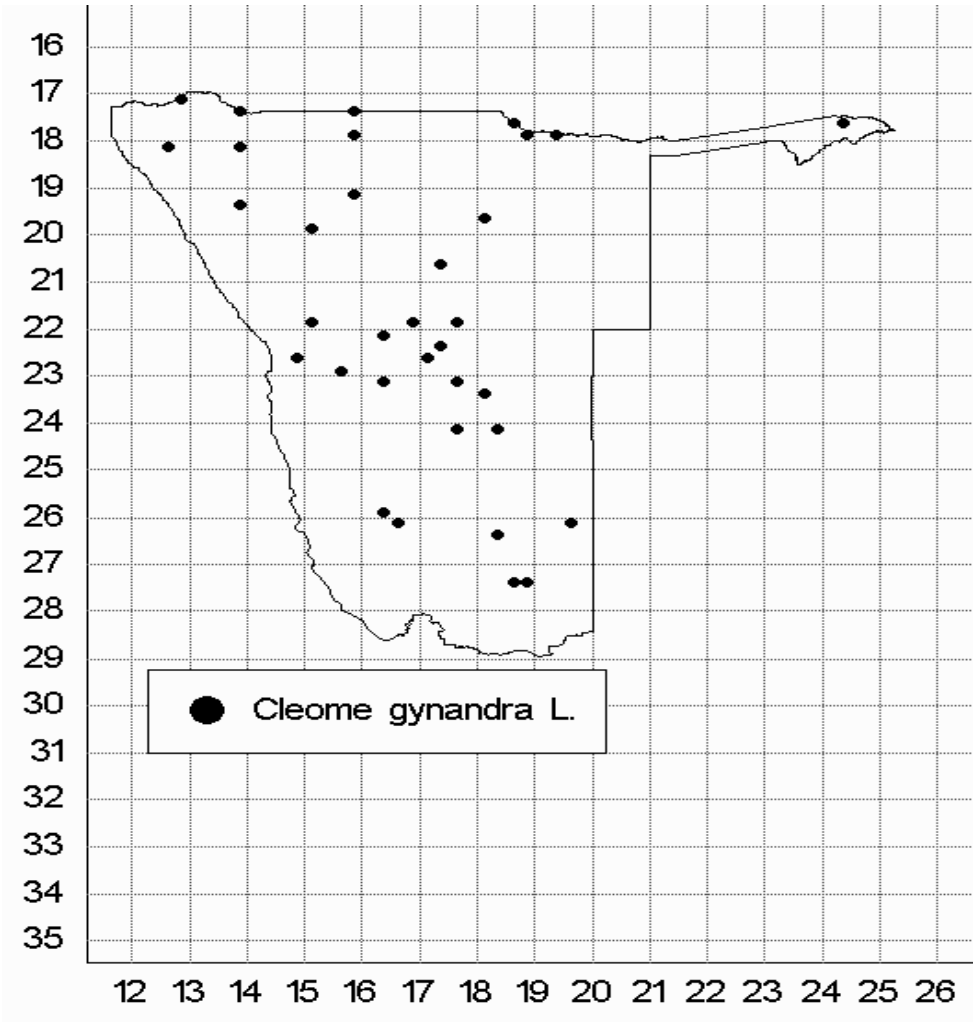

Fig. 1: Geographical distribution of *Cleome gynandra* in Namibia

fields (Rodin, 1985). Plants tolerate low temperatures but prefer temperatures of 18°C to 25°C. High light intensities seem to be advantageous to rapid growth, due to the plant's C_4 photosynthetic pathway (Chweya & Mnzava, 1997). *C. gynandra* cannot tolerate excessive drought, which causes plants to flower while as small as 10cm high and produce only a few, small leaves (Waithaka & Chweya, 1991; H. Kolberg, pers. obs.).

A.4 Common names

The English common names are cat's whiskers or spider flower and its wide distribution and usefulness to humans is reflected in the multitude of common names for it:
ombidi, omdidi (Kwanyama)
omboga (Ndonga)
ombowa, ombowa yozongombe, ombowayozondu (Herero)
!khauro.b, #hobo#hobo, !hunihai.b, gomabeb, goma|horo.b (Damara/Nama)
From: Malan & Owen-Smith, 1974; Rodin, 1985; von Koenen, 1996; Kakujaha-Matundu, 1996; Sullivan, 1998; P. Craven, pers. comm.

A.5 Uses

A.5.1 Leafy Vegetable

The leaves and young shoots are cooked and eaten (Dinter, 1912; Watt & Breyer-Brandwijk, 1962; Malan & Owen-Smith, 1974; Rodin, 1985; Von Koenen, 1996). In Kwanyama, the prepared food is known as "elopa" (Rodin, 1985). *C. gynandra* is often cooked mixed with other species, e.g. *Sesuvium sesuvioides* or *Amaranthus* sp. (von Koenen, 1996). Studies in Namibia revealed that this dish is eaten up to three times per week (Kakujaha-Matundu, 1996) while studies in the Lowveld of South Africa report it being consumed six to seven times per week (Shackleton *et al*., 1998).

Cooked leaves may be dried into flattened cakes (omavanda) and stored for consumption during the drier months or sale at markets (Malan & Owen-Smith, 1974; Rodin, 1985). During cooking and drying, considerable amounts of nutrients (mainly vitamin C) may be lost (Chweya & Mnzava, 1997). Since vitamins A and C are light sensitive, drying cakes in the shade may reduce this loss (Shackleton *et al*., 1998).

Leaves contain some antinutrients (phenolic compounds), which give the vegetable the bitter or astringent taste and lower protein digestibility and quality due to binding with proteins (Chweya & Mnzava, 1997). Cooking does reduce the bitterness (Watt & Breyer-Brandwijk, 1962). The leaves also contain glucosinulates (Chweya & Mnzava, 1997).

In Namibia, as in other African countries, *C. gynandra* is sold on local markets and provides an income for the poor and unemployed, often women who are the only breadwinners of rural households (Kakujaha-Matundu, 1996; Chweya & Mnzava, 1997; Nekesa & Meso, 1997; H. Kolberg, pers. obs.). Kakujaha-Matundu (1996) calculated a value of N$1 131.36 per season (December to March) for a household of 16 heads. He based this calculation on the 1993 prices of commercially available spinach and a consumption of the vegetable three times per week. Shackleton *et al*. (1998) reported that vendors of dried leafy vegetables in the Lowveld of South Africa on average earned approximately R413 per month with the maximum found to be R2063.

A.5.2 Medicinal

There are numerous reports of medicinal use of *C. gynandra* leaves and seeds elsewhere, but in Namibia its use as a medicinal species is not widely known (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997; van den Heever, 1997, 1999). Von Koenen (1996) mentions that an infusion of the roots is used to ease child birth.

A.5.3 Forage

The plant is browsed by livestock and game (Chweya & Mnzava, 1997; Sullivan, 1998; Matlhare *et al*., 1999; H. Kolberg, pers. obs.). In other parts of the world, a polyunsaturated oil is extracted from the seeds and the oil cake feed to livestock (Chweya & Mnzava, 1997).

A.5.4 Plant Protectant

Several studies have shown insecticidal, antifeedant and repellent properties of plant extracts of *C. gynandra* (cited in Chweya & Mnzava, 1997). Leaf extracts have repellent and aracicidal properties not only against mature ticks, but also their nymphs and larvae. Ethanol extracts are lethal to insects like *Bagrada* bug and diamond back moth. The extracted oils are said to permanently repel these insects from treated cruciferous crops (cabbages). The plant also has antifeedant properties against tobacco caterpillar and is toxic to certain aphid and bollworm species (Chweya & Mnzava, 1997).

A.6 Nutritional Value

A number of studies have compared the nutritional value *of C. gynandra* with that of exotic vegetables like spinach and cabbage (Chweya, 1985; Waithaka & Chweya, 1991; Chweya & Mnzava, 1997). Table 1 summarises the findings of various studies done on un-cooked leaves. Several other constituents have been isolated from *C. gynandra* leaves, the most important being listed in Table 2. Seeds have also been analysed for their protein and lipid content, but the active compounds, giving the species its medicinal properties, have so far not been isolated (Chweya & Mnzava, 1997).

Table 1: Nutritional composition of *C. gynandra* compared to other vegetables

Vegetable	**Vit. A** **mg/100g**	**Vit. C** **mg/100g**	**Iron** **mg/100g**	**Calcium** **mg/100g**	**Protein** **g/100g**
C. gynandra	6.7 - 18.9	127 - 484	1 - 18.8	213 - 434	3.1 - 7.7
Amaranthus spp.	5.3 - 8.7	92 - 159	4.1	288 - 800	4.0 - 4.3
Spinach	2.8 - 7.4	1 - 59	0.8 - 4.5	60 - 595	2.3 - 3.1
Cabbage	tr. - 4.8	20 - 220	0.5 - 1.9	30 - 204	1.4 - 3.3
Lettuce	0.2 - 7.8	3 - 33	0.5 - 4.0	17 - 107	0.8 - 1.6
pumpkin leaves	2.4 - 5.3	170 - 172	2.1	40	3.1 - 4.2

Adapted from: Arnold *et al*., 1985; Chweya, 1985; Wehmeyer, 1986; Waithaka & Chweya, 1991; Chweya & Mnzava, 1997; Mnzava, 1997.

Table 2: Composition of *Cleome gynandra* leaves

Nutrient	**Range of values**
Crude fibre (%)	1.3 - 1.4
Carbohydrates (%)	4.4 - 6.4
Potassium (mg /100g)	410
Magnesium (mg/100g)	86
Sodium (mg/100g)	33.6
Phosphorus (mg/100g)	12
Zinc (mg/100g)	0.76
Copper (mg/100g)	0.46
Oxalate (mg/100g)	8.8
total phenolics (mg/100g)	520 - 910

From: Arnold *et al*., 1985; Wehmeyer, 1986; Chweya & Mnzava, 1997

A.7 Cultivation

Studies have been conducted on cultivation of *C. gynandra*, mainly in Kenya (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997; Chweya, 1997; Mingochi & Luchen, 1997). In Namibia the species is not actively cultivated, but is tolerated or nurtured in crop fields and around homesteads. Leaves are harvested successively for a few months until plants start to flower. Plants are then left to set seed for regeneration in the next season (S.A. Ipinge, pers. comm.).

Propagation of *C. gynandra* is by direct seeding. Due to the root system having a large tap root and few lateral roots, the seedlings do not transplant well. Depth of sowing is crucial. The seeds are relatively small and sowing them too deep will result in uneven emergence (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997). Seed beds should be well prepared by digging over the soil, harrowing it to get a fine texture and adding manure. Addition of manure at a rate of 20 t ha^{-1} (20 kg m^{-2}) is recommended and has shown higher yields than fields treated with inorganic nitrogen fertiliser (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997; Chweya, 1997).

Seed is either broadcast or drilled in rows, 30cm apart. Seedlings emerge 6-8 days after sowing. About three weeks after emergence, plants are thinned to 10-15 cm between plants. The uprooted seedlings can be used as vegetable. About 4g of seed is needed for one square metre (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997).

Plants require adequate moisture, since water stress will result in lower leaf yield and quality. *C. gynandra* can however not withstand water-logged soils (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997).
Weed control, especially in the first six weeks, is essential, since *C. gynandra* is a poor competitor (Waithaka & Chweya, 1991; Chweya & Mnzava, 1997).

Leaves are harvested successively about 4-6 weeks after emergence when plants are about 15 cm high (Chweya & Mnzava, 1997). Cutting back or pinching will result in branching and delay of flowering, thus giving a higher and longer yield of leaves. Harvest may last up to five weeks (Chweya & Mnzava, 1997). Older plants however produce smaller and more bitter leaves (Waithaka & Chweya, 1991). With the application of manure, cumulative leaf yields of up to 30 t ha^{-1} were achieved with maximum weekly yield being reached about seven weeks after emergence (Chweya & Mnzava, 1997).

C. gynandra is prone to powdery mildews (Chweya & Mnzava, 1997). In Kenya, plants were observed to be affected by flea beetles (*Phylloptera mashonana*), pentatomids (*Acrosternum gramineum, Agonoselis nubilis*), locusts (*Schistocera gregaria*), nematodes (*Meloidogyne* spp.), green vegetable bugs (*Nezara* spp.), cabbage sawfly (*Athalia* spp.), cotton jassids (*Empoasca spp.*) and hurricane bugs (*Bagrada spp.*) (Chweya & Mnzava, 1997).

Harvested and cooked leaves are formed into flat cakes, dried in the sun and stored. The methods of drying and storage should be investigated to minimise the loss of nutrients in the process (Rodin, 1985; Waithaka & Chweya, 1991) and minimise contamination with bacteria and fungi which were found at high levels in dried leaf cakes in Botswana by Mpuchane & Gashe (1998).

B. *Amaranthus thunbergii* Moq. & *Amaranthus dinteri* Schinz

B.1 Taxonomy & Botany

A. thunbergii and *A. dinteri* are morphologically very similar herbs belonging to the family Amaranthaceae. The vegetable amaranths belong to the section Blitopsis Dumort. within this family (Hanelt, 1967). In Namibia these two species both seem to be used, but there are conflicting reports in the literature. There are eight species of *Amaranthus* in Namibia, of which four are naturalised aliens (Craven, 1999).

A. thunbergii is an annual, upright herb that may be branched and 40 - 100 cm high. Young parts are covered with long crisped hairs. The leaves are simple with 1-4 cm long petioles, obovate to spathulate, 10-45 x 5-30 mm with a tapered base and rounded tip; sometimes with a purple blotch. The inflorescences are short and borne in the axils of leaves and branches. The flowers are separated into male and female flowers. Male flowers have 3 perianth segments with conspicuous, awn-like points. Female flowers have 3 unequal perianth segments with a greenish midrib extended into a spreading, awn-like point. The fruit is shorter than the perianth and splits open transversely. Seeds are bi-convex and shiny black. (Adamson, 1936; Brenan, 1981).

A. dinteri is also an annual, upright herb, but usually much branched, especially near the base. Young parts may be pubescent, but never with elongate, crisped hairs. The leaves are simple on petioles up to 1,5 cm long, obovate to elliptic, 5-26 x 3-13 mm, base attenuate, apex rounded to mucronate, sometimes with purplish blotch. Inflorescences are borne in axillary clusters. Male flowers have 3 perianth segments with a very short tip. Female flowers have 3 ovate to oblong perianth segments, whitish with green midrib which is often branched towards the tip and forms a short, upright (not spreading) tip. Fruit are shorter than or equal to perianth, splitting transversely. Seeds are bi-convex, shiny black to brownish. (Adamson, 1936; Brenan, 1981).

The most reliable character in distinguishing these two species is the presence of long crisped hairs on at least the younger parts of *A. thunbergii* - even though they may be very sparse (Brenan, 1981).

No documented record of the chromosome numbers of these species could be found. Like *C. gynandra*, *Amaranthus* spp. also use the C_4 carbon fixation pathway which makes them adapted to high light intensities and temperatures and drier conditions (National Research Council, 1984; Zheleznov *et al*., 1997). According to Blunden *et al*. (1999) the genus *Amaranthus* is also a betaine accumulating genus. Betaines aid adaptation to saline and dry conditions. *Amaranthus* is probably the vegetable that can produce the highest amounts of protein and dry matter per unit area per unit time - about 1.6g protein.m^{-2} .day^{-1} (Messiaen, 1994).

A. dinteri is divided by Brenan (1981) into subsp. *dinteri* with two provisional varieties (var. 'A' and var. 'B') and subsp. *brevipetiolatus*. Only subsp. *dinteri*, with both varieties, has been recorded in Namibia. It would be interesting to establish if folk taxonomies in Namibia also distinguish different groups within *A. dinteri*.

B.2 Reproductive Biology / Growth & Development

Not much research has been done on the reproduction biology of vegetable amaranths. All the information that is available, has been obtained from studies on grain amaranths (Brenner & Widrlechner, 1998). Reproduction is by seed. The outcrossing rate of grain amaranths has been estimated at between 3.5% and 34%. Insects may be important pollinators (Brenner & Widrlechner, 1998).

Mapes *et al.* (1997) found that the life cycle of vegetable amaranths is in general longer than that in grain amaranths: 123 to 164 days compared to the average 138 of *A. hypochondriacus* (grain type). Maximum leaf area of the vegetable species *A. hybridus* was reached at 149 days.

B.3 Distribution and Habitat

The genus *Amaranthus* is common world-wide. In the tropics and subtropics of both the Old and New World, it is often cultivated, but is also a common weed in cultivated fields (Brenan, 1981). In more temperate regions it may also be found as a sporadic weed (Townsend,1988). While the grain amaranths originated in the New World, the vegetable types have their origin in the Old World (Hanelt, 1967).

A. thunbergii is widespread in Africa, from Ethiopia southwards to South Africa. It has also been introduced into Europe and Australia (Townsend, 1988). In Namibia, it occurs practically throughout the country (Fig. 2).

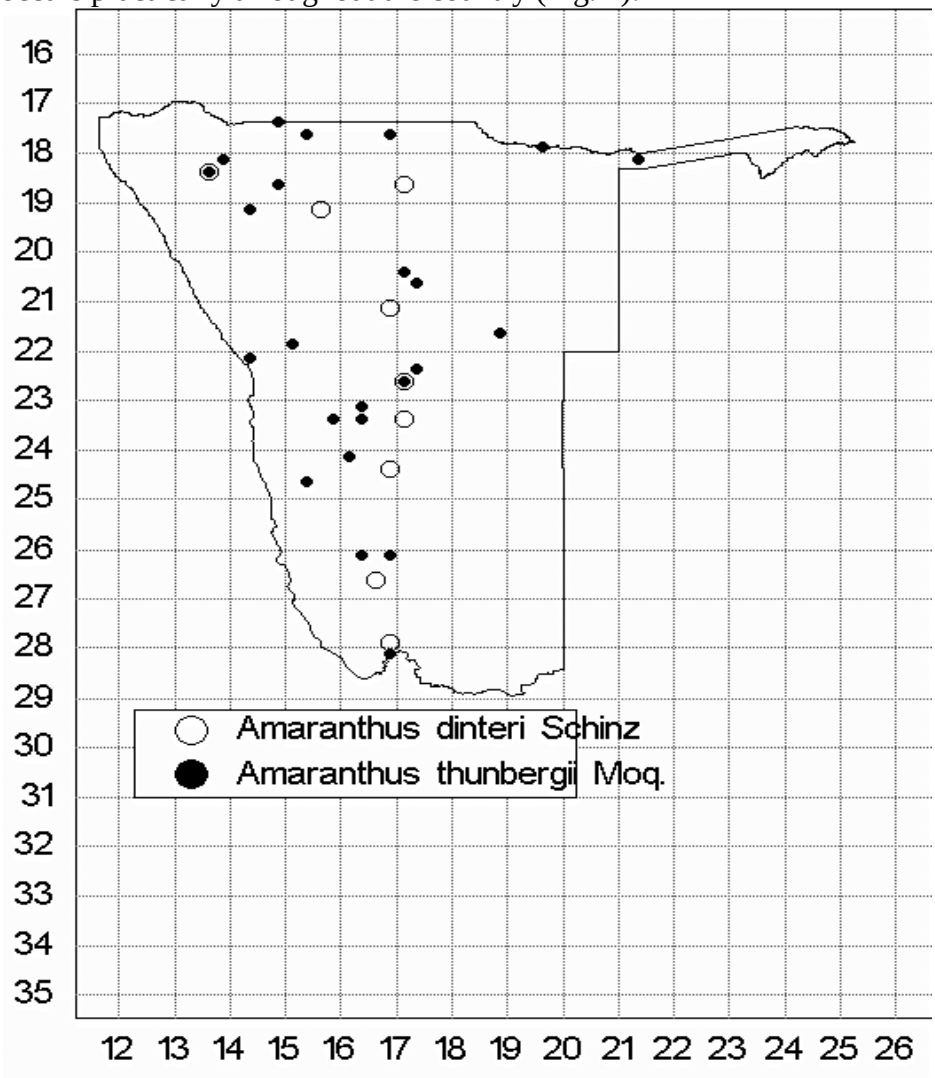

Fig. 2: Geographical distribution of *Amaranthus thunbergii* and *A. dinteri*

A. dinteri seems to be confined to South Africa, Namibia and Botswana (Brenan, 1981). In Namibia it has thus far been recorded from the central and western parts only, excluding the eastern, Kalahari areas, Kavango and Caprivi (Fig. 2).

A. thunbergii is found at altitudes form sea level to 1400m (Townsend, 1988). Both species often occur in disturbed soil, cultivated land or seasonally wet areas (Townsend, 1988). Both species are often found in association with *Cleome gynandra* in fields or cattle pens where manure accumulates (H. Kolberg, pers. obs.)

B.4 Common names

Ethnobotanical studies carried out in Namibia, generally have found one common name for all the species of *Amaranthus*. In English the genus is also known as pigweed or cockscomb. Other names reported in the literature for Namibia are:
/horob, =/khaubeb ||hâube.s, ||gâ ube.s, =/aube, |hai ||gâube.b (Nama/Damara)
embodi-lityaana, ekwakwa (Kwanyama)
mboga (Kwangali)
ombowa yakozondu, ombowa yozongombe, omunandi (Herero)
!oe!oeha (Kung)
(Dinter, 1912; Malan & Owen-Smith, 1974; Rodin, 1985; Van den Eynden *et al.*, 1992; Von Koenen, 1996; Sullivan, 1998; P. Craven, pers. comm.)

B.5 Uses

B.5.1 Leafy Vegetables

A number of *Amaranthus* spp. are being used as leafy vegetables world-wide (Sauer, 1967; Campbell & Abbott, 1982; Mapes *et al.*, 1997). In Namibia this use has been recorded for both *A. thunbergii* (Malan & Owen-Smith, 1974; Rodin, 1985; Kakujaha-Matundu, 1996) and *A. dinteri* (Dinter, 1912; Van den Eynden *et al*., 1992; Von Koenen, 1997), but it is possible that only one of them is used and that both species are recorded due to misidentification. It is recorded that stems and leaves or young, 5-6-leaved seedlings are eaten, cooked in salted water or dried after cooking for later consumption (Van den Eynden, 1992; Von Koenen, 1997). Matlhare *et al*. (1999) report that in Botswana *Amaranthus* leaves are never cooked before being dried for storage. This may be an alternative, nutrient-saving method that should be investigated. *Amaranthus* spinach is supposed to be preferred over spinach from *Cleome gynandra* by the Herero (Kakujaha-Matundu, 1996). Malan & Owen-Smith (1974) report it to be a delicacy among the Herero-speaking peoples of the Kaokoveld and that dried cakes may be traded.

In the Lowveld of South Africa, Shackleton *et al.* (1998) found that *Amaranthus* was consumed up to 14 times per week. In the same study *Amaranthus* was the most commonly tended or nurtured wild vegetable. In Namibia, Kakujaha-Matundu (1996) recorded from the Okakarara area that wild spinach was consumed three times per week by the household studied.

B.5.2 Fodder

Surprisingly, there are reports of livestock poisoning by *Amaranthus* spp., probably due to high levels of oxalic acid and nitrates, which need further

investigation (National Research Council, 1984). Watt & Breyer-Brandwijk (1962), Malan & Owen-Smith (1974) and Sullivan (1998) however report that *A. thunbergii* is eaten by cattle and goats without any ill-effect.

B.5.3 Leaf Protein Isolates

The protein in *Amaranthus* leaves is reported to be easily extractable and can be refined to provide a high quality protein concentrate. This is however species dependent and needs further investigation (National Research Council, 1984).

B.5.4 Plant protectant

Blunden *et al.* (1999) report the presence of betaines in several *Amaranthus* species. Application of betaines in low concentrations to plants, enhance their ability to resist fungi and root knot nematodes considerably. Although the two species under study were not among the species studied by Blunden *et al.* (1999), it is highly likely that they contain betaines too.

B.5.5 Medicinal

Watt & Breyer-Brandwijk (1962) report that *A. thunbergii* is used by Tswana to stimulate delayed childbirth. Kakujaha-Matundu (1996) lists crushed *A. thunbergii* leaves as being used like a plaster on wounds. Sullivan (1998) summarises non-Namibian medicinal uses.

B.6 Nutritional Value

Amaranth leaves are reported to have a very mild taste and are often preferred above other wild vegetables which may have a strong taste (National Research Council, 1984). *Amaranthus* leaves are also highly nutritious compared with other, commonly grown exotic vegetables (Table 1). In addition to the nutrients listed in Table1, further components of *Amaranthus* leaves are listed in Table 3. Because of the high dry-matter content of amaranth leaves, an equivalent amount often provides 2 to 3 times the amount of nutrients than other leaf vegetables (National Research Council, 1984).

Table 3: Composition of *Amaranthus* leaves

Nutrient	**Range of values**
Crude fibre (%)	2.6
Carbohydrates (%)	3.7
Potassium(mg/100g)	351
Magnesium (mg/100g)	124
Sodium (mg/100g)	13.3
Phosphorus (mg/100g)	62.1
Zinc (mg/100g)	0.72
Copper (mg/100g)	0.26

From: Wehmeyer, 1986

Like most dark green leafy vegetables, amaranths also contain some antinutrients like oxalic acid, betacyanins, alkaloids such as betaine, cyanogenic compounds, saponins, sesquiterpenes and polyphenols (National Research Council, 1984). Nitrate and oxalic acid content of amaranth leaves is comparable to that of other, commonly eaten leafy vegetables (Grubben & van Sloten, 1981) and cooking breaks down most of the nitrates while the oxalic acid is dissolved in the cooking water (National Research Council, 1984).

B.7 Cultivation

Outside Namibia, *Amaranthus* is more widely known as a grain crop (Sauer, 1967; Brenner & Widrlechner, 1998). Certain grain types (mainly *A. hypochondriacus*) originated in South and Central America and have been and still are cultivated extensively in certain parts of the world, like for instance in the United States of America, where 2000-3000 ha are grown annually (National Research Council, 1984; Brenner & Widrlechner, 1998). In rural areas where grain amaranths are grown, the thinned seedlings are often also consumed as vegetables (Grubben, 1980)

Three commonly used methods of cultivation of vegetable amaranths are direct sowing in rows, direct sowing with seed broadcast and transplanting of seedlings (bearing four true leaves) from seedbeds. The latter is however not commonly practised due to its laborious nature (Grubben & Van Sloten, 1981; National Research Council, 1984). The latter method does however have the advantage that weeds are less of a problem and the harvesting can start earlier (Campbell & Abbott, 1982). Vegetable amaranths are grown at densities of up to 100 plants m^{-2} when seedlings are harvested or 25 plants m^{-2} when leaves are harvested successively (National Research Council, 1984; Messiaen, 1994). Auwalu and Tenebe (1997) report a seeding rate for *A. cruentus* of 2kg ha^{-1} while Campbell and Abbott (1982) used 200seeds m^{-2}.

Seedbeds must be well prepared with the soil being of fine texture and as level as possible to prevent the fairly small seed from being washed away. The seedbed can be prepared with 2-5kg of organic manure m^{-2} (Messiaen, 1994) or fertiliser. Vegetable amaranths react to both fertiliser application and organic manure (Grubben & van Sloten, 1981; Auwalu & Tenebe, 1997). They require high levels of nitrogen and potassium (National Research Council, 1984). The leaf yield and leaf protein content increase significantly (5.6 t ha^{-1} and 29.1% respectively) up to a nitrogen application of 45kg ha^{-1}. Further increase in applied nitrogen results in a relatively small increase in leaf yield and protein (Auwalu & Tenebe, 1997).

Seeds must be planted at a depth of about 0.5 cm, but not deeper than 1 cm (Campbell & Abbott, 1982). Auwalu and Tenebe (1997) drilled seeds in rows, 10 cm apart and two weeks after sowing thinned seedlings within rows to a spacing of 10cm. Campbell & Abbott (1982) used a between-row spacing of 26cm.

Brenner and Widrlechner (1998) report that seed dormancy may sometimes be a problem in wild species of *Amaranthus*. Gallagher and Cardina (1998) found this dormancy to be seasonal. Exposure to light may be required for germination of

Amaranthus seeds, but this dependency may sometimes be overcome by exposure to higher temperatures (Gallagher & Cardina, 1998).

Grain amaranths, which have been cultivated for some time, have evolved ecotypes which can tolerate extremely high altitudes and alkaline sandy soils (pH 8.5) as well as acidic clay soils. Although it has not been shown for the two species under study, some amaranths have a tendency to withstand mild salinity. For good quality leaf vegetables, amaranths require moisture throughout the growing period, but do not tolerate water-logged soils. Plants also do not tolerate shade. (National Research Council, 1984).

Weeds need to be controlled during the initial stages of growth to give the slow-starting amaranth seedling a chance (National Research Council, 1984).

Harvesting can be done either successively by cutting individual leaves or ratooning (cutting of top part of branches) or by uprooting young plants (single harvest or 2-3 successive harvests) (Grubben & van Sloten, 1981; Campbell & Abbott, 1982). When *Amaranthus* is harvested from the wild in Namibia, whole young plants seem to be preferred to harvesting of leaves (H.Kolberg, pers. obs.). Under favourable growing conditions, the first harvest of young plants can be done three weeks after transplanting or four weeks after sowing (Grubben & van Sloten, 1981). Harvesting should be done early in the morning and in dry weather to give the wounds where leaves or stems have been cut, time to dry out and seal, minimising the incidence of fungal disease (Messiaen, 1994).

In hot climates *Amaranthus* is a fast growing crop which can potentially yield up to 40 t ha^{-1} of fresh leaves in as little as 3 - 5 weeks after sowing (Grubben & van Sloten, 1981; National Research Council, 1984). Average yields are between 4 and 14 t ha^{-1}. In the tropics, harvests can last for up to 6 months (National Research Council, 1984). Yield increases with plant age, but the quality decreases mainly due to the more fibrous nature of leaves and stems (Campbell & Abbott, 1982)

Amaranths seem to be less susceptible to diseases than exotic vegetables, however the following have been recorded (Grubben & van Sloten, 1981): damping off (*Pythium aphanidermatum*), wet-rot (*Choanephora cucurbitarum*), white rust (*Albugo bliti*). The same authors also recorded caterpillars/ leaf rotters (*Hymenia recurvalis*), stemborer/stem weevil (*Lixus truncatulus*), *Psara bipunctalis*, *Piesma dilutus*, *Spodoptera littoralis*, spider mites and leaf miners on *Amaranthus*. Ants and termites may be a problem in that they carry off the seeds (National Research Council, 1984; Messiaen, 1994). There is conflicting information in the literature on the resistance of *Amaranthus* to root knot nematodes (*Meloidogyne*) with some authors reporting it to be a problem (National Research Council) while Messiaen (1994) reports vegetable amaranths to be completely resistant to *Meloidogyne* spp. The latter may be true, considering that amaranths are betaine accumulators - a compound shown to be highly effective in prevention of root knot nematode attack (Blunden *et al.*, 1999). *A. hybridus* has been reported as being one of the common arable weeds that has developed resistance to triazine, a common herbicide used in maize cultivation (Jordan, 1996).

2. Research Needs

Various authors have identified gaps in existing research internationally (National Research Council, 1984), for Namibia however, no research on these species has been done and some basic aspects need to be researched whereas some adaptive research, using results from other species or in different environments, needs to be done in Namibia.

2.1 Collection and screening of germplasm is one aspect that needs to be done in Namibia where local material has to be conserved and evaluated for its agronomic potential.

2.2 The ethnobotany of these species in Namibia has been researched on a superficial level. More information is probably available from yet unstudied ethnic groups or areas and the aspect of nurturing of these species similar to a crop.

2.3 Cultivation practices known from other countries should be investigated for their adaptability to the Namibian environment.

2.4 New or alternate uses of these species, or developing them into a multi-use crop, need to be investigated.

2.5 Methods of processing and storage need to be studied to minimise the loss of nutrients.

2.6 The feasibility of marketing of these vegetables in urban areas needs to be looked at.

3. Limitations

In several languages the phrase "not worth an amaranth" exists, indicating the low esteem in which this species is held. The common name "pigweed" also indicates the perception that it is deemed fit only for consumption by pigs (National Research Council, 1981). In many circles, wild crops that have traditionally been used, are considered to be "backward", low-status foods and research is not readily funded, since it does not project the image of modern development using the latest in technology (Blench, 1997; Chweya & Eyzaguirre, 1999).

Shackleton *et al.* (1998) found that, although a number of households were nurturing wild vegetables, the number of households growing exotic vegetables was much greater. They attribute this to the common belief that wild vegetables don't need any human interference and still produce sustainable harvests.

Adoption of these species as a cultivated crop may be a problem, but it also took Americans a century to accept soybean and Europeans two centuries to accept the potato (National Research Council, 1984). The fact that people keep on using these species, is an indication that they must be aware of the value of these species, in nutritional or economic terms or both (Blench, 1997). Since Namibia is, agronomically speaking, a marginal area, future huge development in the well known, major crops of the world, is unlikely. It is here that minor crops, already adapted to

the conditions in the country, could become more important if given the proper attention in research and development.

When embarking on research in this field, it must be expected that there is a vast number of unknown, un-studied factors that could hamper research and prolong it unexpectedly.

4. Objectives of this research project

- Φ to collect and conserve germplasm of *Cleome gynandra* and *Amaranthus thunbergii* and *A. dinteri* from as much of its distribution area in Namibia as possible
- Φ to collect indigenous knowledge associated with the consumption and cultivation/nurturing of these species
- Φ to evaluate the collected germplasm, identifying superior genotypes for consumption and cultivation
- Φ investigate cultivation practices
- Φ contribute to improving, diversifying and sustaining rural livelihoods in communal areas of Namibia

5. Methods

Literature review

Literature was obtained through the NAWIC on inter-library loans and from NBRI library sources.

Germplasm collection

Germplasm of the species under study will be collected together with routine germplasm collecting of the NPGRC. Some seed has already been collected in the central parts of the country, but more needs to be collected from the north-east, north-west, west, east and south.
Germplasm collection will be done according to standard collecting procedures, which means at random from one population per sample. Seed from any outstanding or obviously different individuals may be collected separately. Passport data will be collected in the usual way.

Indigenous knowledge

A form will be designed to collect indigenous knowledge pertaining to the use and cultivation of these vegetables. It should include aspects of consumption preferences. This information will be firstly collected at points of germplasm collection. After identifying either geographical or ethnic gaps, these will be filled by attempting to get the same information even if no germplasm is collected at such sites.

Germplasm multiplication

Seed will be multiplied according to genebank standards. This will involve isolation of different samples while being planted out. Since the plants are relatively small, this may have to be done by isolation tents or cages. Pollination will have to be done by hand or if feasible, by insects (honey bees).

Evaluation

The criteria for evaluation will have to be established. This will depend on the outcome of the indigenous knowledge survey combined with agronomic performance traits like ease of cultivation, yield, time to harvest, disease and pest susceptibility.

Cultivation practices

Various cultivation practices have been documented elsewhere and need to be investigated and/or adapted to Namibian conditions. Aspects to be looked at are fertilisation (manure, inorganic at different rates), seeding rate and spacing, direct sowing vs. transplanting.

Dissemination of results

Results of this research are to be made available to primarily the farming community but also to the scientific world through publication of papers, extension messages and posters or pamphlets.