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Creative problem solving in support of biodiversity conservation

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Biodiversity in developing countries is inextricably linked with development. Consequently, policies to conserve biodiversity must take into account national development objectives and vice versa. Policy makers in developing countries are forced to identify creative ways of conserving biodiversity while supporting development and eradicating poverty. Even more than elsewhere, arid countries must focus on biodiversity valuation for both direct (e.g. biotrade, biotechnology and tourism) and indirect (e.g. ecosystem function, aesthetics and cultural values) uses. While inappropriate policies can undermine the conservation of biodiversity, good policies do not ensure that it takes place. Particularly in arid regions, policy markers and managers must have diverse skills to address a wide variety of challenges. Adaptive management is essential for biodiversity conservation in arid environments. It requires regular, informed problem-solving over a wide range of issues, and this, in turn, requires adequate and accessible databases concerning appropriate indicators of environmental change.

Major headaches for planners are the intrinsic variability of arid environments, the long-term, changes that occur, and the often uncharismatic biota involved. Managers must be able to handle rapid and adaptive program planning and implementation, monitoring and evaluation, dissemination of information to authorities and the general public, and, often, training of junior and volunteer staff. Management education in support of the conservation of biodiversity in arid environments must focus on problem-solving skills and information management to ensure the depth and breadth of the training.

Introduction

The maintenance of biodiversity and ecosystem functions in arid regions is critical for sustainable development (Chenje & Johnson, 1994; Barnard, 1998*a*). Survival of resource-based livelihoods and the development of alternative livelihoods as population pressure increases are the concerns of national decision-makers in many arid regions of

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the world (Seely, 1998). Unsustainable use of resources, particularly water, undermines development, often due to the lack of an explicit policy framework (Rached *et al.*, 1996). For policy-makers to plan for genuine development and quality of life, they must take into consideration a number of factors. Ecological life-support systems, underpinned by biological diversity, need to be consciously and highly valued by policy makers.

While enlightened policy must explicitly rest on the conservation of biological diversity, human aspirations, and national political and development objectives will clearly be paramount for most policy-makers. In many arid developing nations, creative ways to conserve biodiversity must be identified, while development is supported and poverty is dealt with. Most such nations focus on development and the eradication of poverty, while biological diversity is neglected, due to a lack of understanding of the causal links between the three (Alcorn, 1994). Conversely, scientists often focus on expert methodologies and peer-reviewed outputs, which do not necessarily connect to development even if the research topic concerns it, and, therefore, do not reach resource managers and decision makers.

Realistic and comprehensive economic valuation of biological resources and ecosystem services will help political leaders and policy makers understand that biodiversity protection is essential for development and the alleviation of poverty (Folke *et al.*, 1996). Perhaps even more dramatically, case studies of how biodiversity loss can trigger a downward spiral of poverty and loss of self-reliance (e.g. Nabhan, 1998) will certainly assist parties to the Convention on Biological Diversity (UNCBD) in their task of integrating biodiversity comprehensively into national plans and policies. Most policy makers understand in a general sense how the fertility of land and water ecosystems determines their ability to support human livelihoods, but often do not relate the loss of diversity to losses of fertility and function (Aylward & Barbier, 1992; Whitford, 1996). This could be partly due to the complexity of ecosystems and how they change (Angermeier & Karr, 1994; Tilman, 1999).

A major hindrance to the task of biodiversity policy integration is a lack of common vision among sectoral policy makers of the role of natural resources in development. The extreme variability of the climate and natural resource base in arid environments also makes it very difficult to plan effective resource management strategies and policies. A lack of both awareness and information on the practicalities of sustainable development plagues policy reform in many arid regions.

Policy makers and managers in arid regions, even more than most, need a wide variety of problem-solving skills and a breadth of practical experience. Informed decision-making and creative problem-solving, essential tools for eradicating poverty and promoting development, must be rooted in insight about the biological underpinnings of environmental degradation. How can we foster this insight, to help ensure that biodiversity conservation will be integrated into decision-making at all levels?

This paper outlines some examples of how these questions are being addressed in Namibia, an arid African country (Barnard, 1998*a*). This approach is relevant to many other developing countries. Desertification is a major concern in Namibia (Quan *et al.*, 1994; Seely & Jacobson, 1994), and research and outreach activities within Namibia's Programme to Combat Desertification (Napcod) tackle this problem. Namibia has spectacular landscapes, and rich wildlife and marine resources, providing good opportunities for enhancing biodiversity conservation for tourism and sustainable utilization as well as for cultural reasons. Many rural people depend on the variable, natural resources, making it important to incorporate both socioeconomic and political dimensions (Sullivan, 1998). Ten years after Namibian independence, many changes in research and policy are gaining momentum (Table 1). Our paper makes reference to many publications that may not be widely available outside Namibia, as these are the materials that have the greatest local significance. Although these materials refer to Namibia, their applicability is broad, and their treatment is relevant to other countries with different ecosystems and political systems.

Table 1. *Changes in Namibian environmental research and policy during the 1990s*

Environmental research and policy	Before 1990	After 2000
Research	Sectoral experts	More holistic approach
Basic research	Increased knowledge	Interpreted and applied
Striving for	Excellence	Relevance
Publications	Peer-reviewed, scientific	Accessible information
Training/education	Sectoral	Problem-solving
Conservation of biodiversity	Species diversity	Key to ecosystem functioning
General population	Excluded	Involvement of managers and beneficiaries
Traditional knowledge	Recorded, not incorporated	Incorporated where applicable
Policy implementation	Control/regulation	Involvement
Conservation of land cover	In designated areas	Potentially, in all rural areas

Establishing a basis for informed decision making

Many policy makers, decision makers and managers are unaware of how critical ecosystem functioning and biological diversity are to improved livelihoods, freedom from poverty, and overall national development. In many arid countries, information on the relevance of biological diversity to development is often lacking. If information exists, it is often in inaccessible formats and locations.

Adequate information on biodiversity is a prerequisite for improved awareness in general, and for informed decisions, in particular. Adequate information is often missing, however, and basic research is not the only or necessarily even the best solution. Several approaches are available; some more useful than others. In Namibia, shortly after independence in 1990, a synthesis was undertaken of existing information about Namibia's biological diversity, overall environment, and natural resource management, and published in a user-friendly format (Barnard, 1998*a*). Integrated materials were prepared combining information about biodiversity, aridity and environment for decision makers and resource managers (e.g. Barnard, 1998*a*, *b*; Mendelsohn & Roberts, 1997). The subject of these materials was often very broad. Biodiversity management in Namibia, for example, includes water management, management of woody vegetation, range management practices, coastal zone management, economic valuation, and policy and legal reform. Desertification management may also include finance, livestock and tourism marketing, community organization and communication skills. Many publications prepared in Namibia in the past few years have been designed and used to generate holistic awareness, rather than to provide practical details or skills to the recipients (Appendix 1).

Other materials have been designed to enhance the skills and knowledge base of the users, and these required more effort for dissemination and interpretation, and have been less successful in reaching their intended ultimate targets and in fulfilling their objectives. It is in this category that materials for enhanced decision making and management are included (e.g. Brown, 1992). Yet other materials have been designed to serve as discussion points with communities to stimulate dialogue about the use of rangelands and related biodiversity and resources (e.g. Marsh & Amakali, 1995). Discussion materials were sometimes produced as videos for the communities (e.g. Botelle & Kowalski, 1995). These printed and visual materials were probably the most

successful communications overall because the way they were used ensured that the necessary information transfer occurred during the dissemination phase of the process.

The most important lesson learned from the preparation of these varied, informative materials is that the gathering and compilation of the material is far easier than its dissemination. Generating an understanding of the need for information about biodiversity and its consequences for development among decision-makers requires concerted efforts. In particular, much effort must be expended to ensure that the identified target audiences receive the material; understand how it is to be interpreted, used and applied; and then apply it. Particular attention must be paid to the mechanisms of dissemination and the follow-up of the dissemination process. As information exchange for improved biodiversity conservation contributes to the sustainable use of all natural resources, monitoring and evaluation of the preparation, dissemination, interpretation and implementation of the materials is essential. Lastly, the information base may be developed, disseminated and used for informed policy and decision making, but even good policies do not ensure that biodiversity conservation takes place.

Education for creative problem-solving

Adaptive management is essential when dealing with biodiversity conservation in arid environments, and this requires informed problem-solving over a wide range of issues at all levels of management. One approach used in Namibia to enhance adaptive management capacity is that of the Summer Desertification Project of the Desert Research Foundation of Namibia (DRFN). The goal of this project is to contribute to the establishment of a cadre of young environmental researchers who will use a problem-solving approach in their future professional activities (Seely, 1998). Each year, up to 16 university students or recent graduates spend 10 weeks on an environmental problem, and address it from social, economic and biophysical points of view. The students assist in problem identification, select the tools to be applied, and discuss their proposed project with a number of invited speakers who help to provide essential background in terms of policy, ongoing programs and government priorities. They then spend eight weeks in information gathering, analysis, writing up to their results; and presention in written, poster and verbal form (Amoomo *et al.*, 2000). A variety of decision makers is invited to the final presentation so that the creation of broad-based awareness is a part of the overall process.

Topics in the past few years have included water management in an ephemeral river catchment where resources are shared between two legislative districts, at least three different land tenure systems and 60,000 people. In other years, the students have addressed fencing in communal areas and its impact on the environment including biodiversity, the differing impacts and income generation opportunities due to elephants on communal and commercial farmlands, and the environmental options for resettled San (bushmen) where their nomadic way of life is no longer possible. Graduates of this project are in high demand for employment in various government departments, and many study further for higher degrees. Although they have not studied biodiversity *per se*, all graduates are able to weave consideration of biodiversity into their jobs.

Opportunities other than university and college are required for tertiary education and training for graduates from the University of Namibia and Polytechnic—which presently do not offer studies beyond a bachelor's degree or diploma—to gain hands-on experience in the environmental field by working closely with professional researchers. The Gobabeb Training and Research Centre, situated in the Central Namib Desert, offers such opportunities. Here, the DRFN offers intensive week-long courses, intern courses of 6–12 months, as well as support for postgraduate studies. Programs, such as the Tropenökologisches Begleitprogramm (TöB) of

the Gesellschaft für Technische Zusammenarbeit (GTZ), and the approach taken in Napcod staffing actively support such training efforts. Namibian institutions facilitate the involvement of foreign experts in this process. The goal is a well-trained cadre of Namibians in the environmental field, which will further biological conservation in the future.

Environmental education in the formal school system is also receiving attention, with mixed results. Because of the strong colonial influence in Namibia, many teachers confuse tree planting and litter campaigns with environmental education. One innovative project, known as Enviroteach, developed materials for use by teachers in secondary schools. Rather than focusing on the biophysical environment, this project emphasized how people's lives relate to the environment — through energy, water, population and biodiversity (du Toit *et al.*, 1995). The books illustrate to teachers how cross-curricular teaching can incorporate environmental considerations in a variety of subjects ranging from language studies to economics to the natural sciences. By working with schools and the surrounding community, a heightened awareness and the tools for better management of natural resources are widely disseminated.

Very important concepts for management education and policy making in all arid regions are the variability of arid environments and the long-term changes that occur on a scale of decades. These are difficult concepts to integrate into policy making for most people, and most governments have a short-term perspective in terms of planning for development and the future in general. Awareness, information and the integration of consultation into the policy making process are essential.

Managers must be able to handle program planning and implementation, monitoring and evaluation, dissemination of information to authorities as well as to the general public, and often training of junior and volunteer staff. Management education in support of the conservation of biodiversity in arid environments must provide a large proportion of problem solving skills to ensure the depth and breadth of training provided.

In Namibia, since independence, time has not been available to address all aspects of awareness, information gathering and dissemination, and consultation to ensure that biodiversity conservation is fully addressed at all levels. Instead, the approach of learning by doing, with corrective action being taken as necessary, has been applied. The following example illustrates how Namibia attempted to insert biodiversity into the policy making level across a wide spectrum of relevant sectors of the government and civil society.

Namibian National Biodiversity Programme

Namibia signed the Convention on Biological Diversity at Rio de Janiero in 1992, and in 1994 established its National Biodiversity Programme (NBDP). The NBDP is based at the Department of Environmental Affairs in the Ministry of Environment and Tourism. The national coordinator and her project staff coordinate the multi-institutional national Biodiversity Task Force (BDTF) with its topic-related working and focal groups (Fig. 1).

Broadly based participation is the key to the program. Its structure encourages the full involvement and assumption of responsibility by key technical- and management-level players involved in biodiversity-related work in Namibia. Working groups are designed to build momentum and a sense of ownership in different agencies, as well as to provide a forum for planning and information exchange in different fields. Results from the respective working groups are communicated to the BDTF from whence they are available for revision, feedback and use by policy makers and managers. With publication of the results in peer-reviewed journals, the information is available for wider discussion (e.g. Barnard, 1998*b*). All working groups prepared position papers and

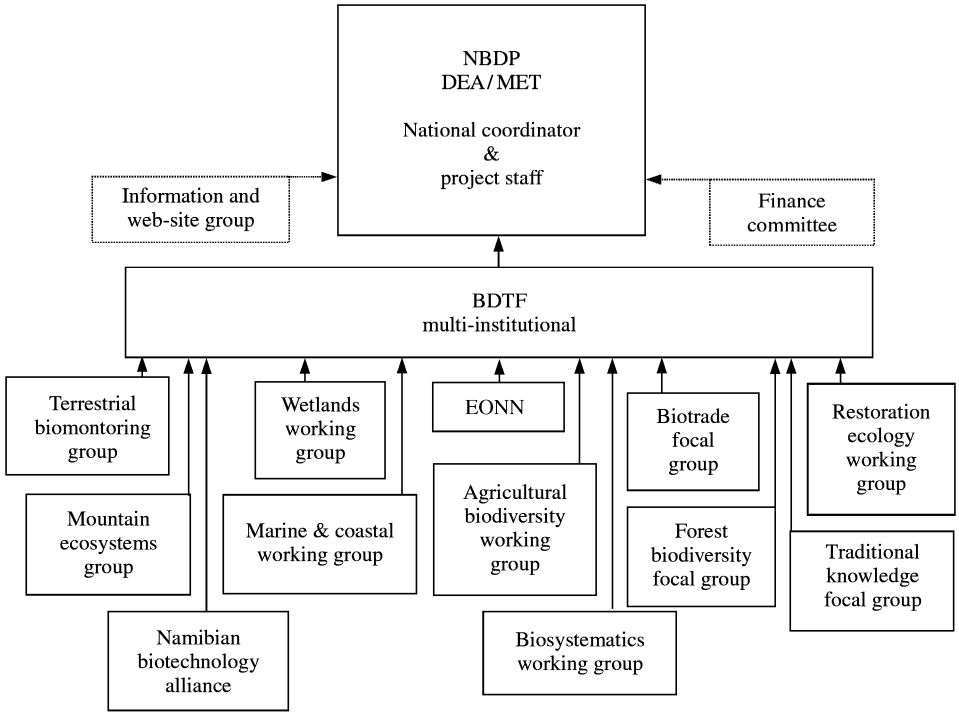

Figure 1. Organizational structure of the Namibian National Biodiversity Programme (NBDP): a participatory approach (DEA = Directorate of Environmental Affairs; MET = Ministry of Environment and Tourism; BDTF = Biodiversity Task Force; EONN = Environmental Observatories Network of Namibia.

recommendations for the National Biodiversity Strategic Plan. Expertise existing in Namibia is thus shared, and the information exchange process among various institutions and individuals is fostered.

Namibia is a developing country. Resources are scarce, and little funding is attributed to the environment if the need is not well defined, understood and communicated. Apart from its key role in sustaining human development, biodiversity conservation in Namibia is important for several additional reasons. Namibia's progressive constitution provides for the conservation of biological diversity and essential ecological functions (Article 95L). It is also party to most of the biodiversity-related international conventions, such as Ramsar, Convention on International Trade on Endangered Species, United Nations Convention to Combat Desertification and United Nations Framework Convention on Climate Change. Moreover, tourism is one of the biggest sources of domestic and foreign revenue. Much of our tourism industry depends on the environment and on biodiversity—not only the classic African game species, but also spectacular habitats and landscapes, and unusual endemic species. The aesthetic value of biodiversity is highly valued in Namibia for local and international tourism and/or recreation potential.

Although biotechnology and biotrade may not be the most obvious interests for Namibian biodiversity conservation, these aspects play a significant role in agriculture and the marketing of traditional natural products. The potential for sustainable use and marketing of traditional natural products could open up opportunities for Namibia's economy and local production. Agriculture, marine fisheries and tourism are three of the four largest sectors of Namibia's economy. Long-term productivity and sustainable

use depend on the maintenance of ecosystem functions, largely mediated by biota. It is important that people at various levels, ranging from decision makers to rural communities, recognize biodiversity and ecosystem health as fundamental needs. Research, conservation and management need to be tailored to such needs. It is important, too, to understand that biodiversity directly contributes to the survival and livelihood of Namibians, and is not only a philosophical idea generated by developed countries.

The NBDP has identified a number of principles, which need to be incorporated into its overall strategy and action plan. These principles partially adhere to the UNCBD, but also address additional aspects important to the conservation of biodiversity in a developing country. It has been recognized that a well-designed and coordinated national programme must first and foremost be tailored to Namibian conditions, rather than an international agenda and priorities. Another important principle is the fostering of an information-sharing culture, and not only via publications in peer-reviewed journals. Research results and information on data will be made available in a Namibian meta-database, coordinated by the Environmental Observatories Network of Namibia (EONN; http://www.drfn.org.na/gobabeb.html), a working group of the BDTF which is affiliated to the International LTER network (ILTER). The meta-database will facilitate the Namibian capacity to provide, access, understand and use long-term ecological data and information, and avoid wasteful duplication of efforts.

The UNCBD calls for the involvement of communities only in its section on traditional knowledge. It recognizes the importance and potential of indigenous knowledge systems and calls for the protection of such systems. However, the UNCBD does not focus on community participation. In the context of a developing country, community participation is essential for sustainable management and conservation of natural resources, including biodiversity. An example is how wildlife conservation is being connected to the livelihood of rural communities (e.g. Haverkort & Millar, 1994). In Namibia, this is being done in the Community-Based Natural Resource Management Programme (Hagen *et al.*, 1998).

Namibia's NBDP recognizes the need to respond to the requirements of human communities in its research and application, although it needs to translate this recognition into active practice. Since agriculture affects much of biodiversity conservation in Namibia, local farming communities are key stakeholders and implementers of the national strategic plan. At the same time as environmental awareness and education are being raised among the public, the capacity of resource users, expert technical staff and entire institutions is built. This is being done on both national and international levels.

In our opinion, the UNCBD is not particularly oriented towards developing countries, yet most of the world's biodiversity resources are situated in such countries. Greater synergy among environmental conventions would improve this. At a planning and technical implementation level, for instance, there are already well established links between the UNCBD, the UNFCCC, the UNCCD and Ramsar's national activities. The UNCCD focuses on community participation, and Namibia's desertification programme (Napcod) strongly emphasizes sustainable management of natural resources in close cooperation with affected people. Napcod is establishing local-level monitoring of natural resources, and is receiving direct support from the NBDP for this. This synergy has led to the development of a preliminary Index of Biological Integrity (IBI) as a tool for rangeland condition assessment in Namibia (e.g. Zeidler, 1999), based on its development in other countries (Milton & Dean, 1992; Majer & Beeston, 1996). Far from relying only on expert analyses, the Namibian IBI was designed in close collaboration with a farming community. Using a similar procedure, this preliminary IBI is being tested in other regions in Namibia, and will be refined and tailored to the needs and capacities of other local natural resource managers.

Conclusion

In arid regions, creative problem-solving using a wide variety of analytical and managerial skills is necessary for effective biodiversity conservation. Solutions require synergy among different kinds of environmental programs and between different levels of resource managers — decision-makers, technical experts, conservators, and communal and commercial farmers. Both policy and education must support this approach to ensure the sustainability of arid environments.

Namibia has a particularly good potential for creative problem-solving, essential for biodiversity conservation. This potential has developed since independence and is gaining momentum (Table 1). The relatively small cadre of individuals involved in decision making, research, training and creating of awareness on the environment, facilitates information exchange and cooperation. This is further enhanced by relatively few institutions housing/sharing many programs, with relatively few donors being involved. The results are broad portfolios, multi-tasking, and less division of labor. To function effectively, the small cadre depends on colloboration on national and international levels, thereby attracting outside ideas on local conditions. Most important for the process, is close collaboration and information exchange between experts, trainees, decision makers and rural communities that depend on biodiversity for their livelihood.

The approach towards furthering biological conservation outlined in this paper was largely derived from our observations and experience in Namibia. This approach is, however, applicable to many other developing countries in different ecological contexts and with different political systems. In these areas, creative problem-solving is not only necessary because of less formally established policies and guidelines, but is also necessary because it facilitates adaptive management. Its basic premise rests on appropriate training and information exchange across the board from top-level management to grass-root level people, whose activities affect biodiversity conservation.

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Appendix 1

Some examples of Namibian environmental literature with differences in the emphasis of awareness, knowledge and skill transfer for different target groups.

Biological Diversity in Namibia: A Country Study (*Barnard, 1998a*):

Compiled by the Namibian National Biodiversity Task Force (BDTF), this book is designed to present a snapshot of what is known about biological diversity in Namibia. Not intended to be

a scientific compilation, this book brings together previously fragmented information from a number of sources. In addition, it sets these data in a socioeconomic and legal perspective while identifying priorities for the coming century.

Environmental Updates:

These single-page broadsheets cover a variety of topics such as the United Nations Convention on Biological Diversity (UNCBD), the implications of Namibia's new Drought Policy or Global Climate Change for biodiversity in various habitat types in Namibia, or the range of rainfall variability that can be expected in Namibia within and among years. They were designed to address needs of parliamentarians who sometimes have little background in environmental matters and who have little time to read and inform themselves on such matters. The single sheets are distributed twice a month to the parliamentarians' mailboxes. Funding for these publications comes from a variety of donor countries operating in Namibia.

Information Files:

These single-page laminated information sheets are designed to provide feedback to local communities involved in participatory research projects on rangeland management incorporating biodiversity concerns under the auspices of Namibia's Programme to Combat Desertification (Napcod). The sheets are used to enhance discussion between the community, community mobilizers and researchers, and serve as a record for all participants. Extension officers working in the area are also using them to work with the focal community and other groups in the area.

Ephemeral Rivers and Their Catchments (Jacobson *et al.*, 1995):

This book and the companion map and video are the result of a doctoral research project and information on the concerns and interests of the communities living in the area. It represents a successful approach to addressing the concerns of integrated rangeland management and biodiversity conservation in an arid, communal farming area of western Namibia where wildlife and tourism provide a viable alternative to livestock as the sole source of income and sustenance. Of particular note was the involvement of various decision makers, from the Minister of Agriculture, Water and Rural Development to local extension personnel in the process of information gathering and interpretation.