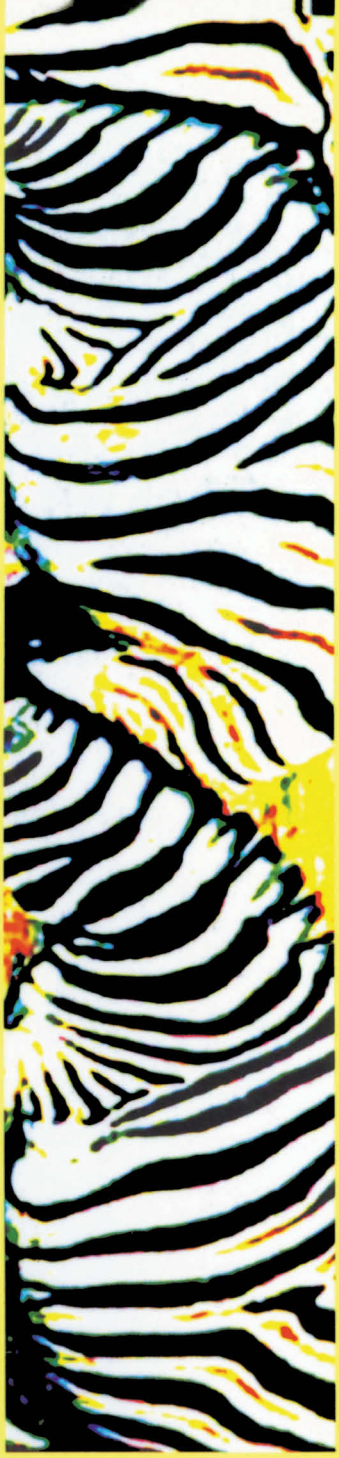
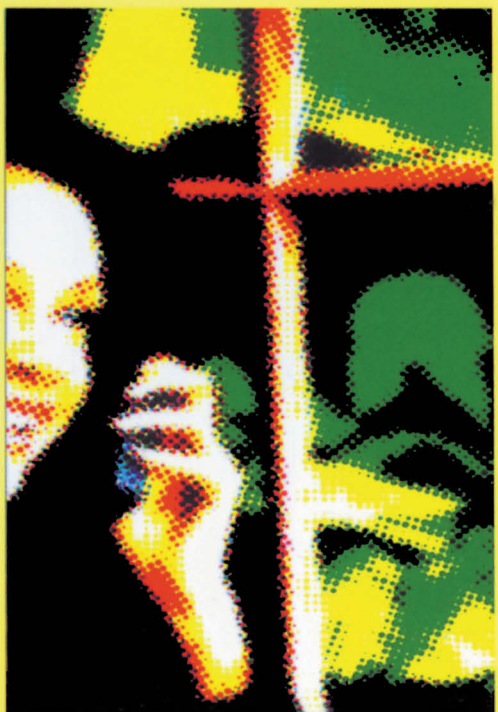
BIODIVERSITY AND GENDER FOR SUSTAINABLE DEVELOPMENT

Editors:

Rogers W'O Okot-Uma

RoseMarie-Rita Odiachi





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COMMONWEALTH SECRETARIAT
1999

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LIST OF ACRONYMS

CBD	Convention on Biological Diversity
CBO	Community-Based Organisation
CFTC	Commonwealth Fund for Technical Co-operation
CITES	Convention on International Trade in Endangered Species
COP	Conference of the Parties
EIA	Environmental Impact Assessment
ECZ	Environmental Council of Zambia
GEF	Global Environment Facility
GIS	Geographic Information Systems
ICRAF	International Council for Research on Agroforestry
IPR	Intellectual ¦Property Rights
IUCN	The World Conservation Union (formerly International Union for the Conservation of Nature)
MOREA	Ministry of Research and Environmental Affairs (Malawi)
MUIENR	Makerere University Institute of Environment and Natural Resources
NBSAP	National Biodiversity Strategy and Action Plan
NEMA	National Environment Managment Authority
NES	National Environment Secretariat
NGO	Non-Governmental Organisation
PIC	Prior Informed Consent
PRA	Participatory Rural Appraisal
SBSTTA	Subsidiary Body for Scientific, Technical and Technological Advice
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UWA	Uganda Wildlife Authority
WID	Women in Development
WWF	World Wide Fund for Nature

FOREWORD

Since the late 1980s the Management and Training Services Division of the Commonwealth Secretariat has been providing extensive assistance to Commonwealth governments confronting the challenge of securing sustainable development in the public sector. The Division's initiatives in short- and long-term training programmes, institution-building, advisory services in the area of the environment and sustainable development have been a major stimulus for governments in their individual efforts to integrate environmental concerns in their strategies for national development as well as in providing annual Status of the Environment reports for member countries.

The current widespread debate concerning the environment and options that will best fit national strategies for the challenge of the next century (Agenda 21) touches on the focal nature of the questions concerning the role and responsibilities of the governments of the future. The structure and processes of the overall environment sector underscore the characteristic nature of the requirements in terms of human resource skills as well as institution building capacities for member countries to be able to implement development plans, programmes, projects and activities for sustainable development.

The publication *Biodiversity and Gender for Sustainable Development* is a specialised deliverable which has grown out of many years of sub-regional, regional and pan-Commonwealth experience carried out under the auspices of the Management and Training Services Division of the Commonwealth Secretariat, variously focusing on Gender, Environmental Conservation, and Biological Diversity for Sustainable Development. It provides an unprecedented insight into the two subject areas of **Biodiversity** and **Gender**. The publication of *Biodiversity and Gender for Sustainable Development* takes cognisance of the Convention on Biological Diversity which recognises *"the vital role that women play in the conservation and sustainable use of biological diversity and affirms the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation"*. This is notwithstanding the fact that both women and men must exist in a mutually-beneficial partnership and strategic alliance that is poised to enable equal say in the decision-making process on the sustainable utilisation of biodiversity as well as facilitate equitable distribution of responsibilities for its conservation. This publication is supplemented by a documentation of case studies and country profiles under the title *Biodiversity and Gender for Sustainable Development: Selected Case Studies and Country Profiles.*

The pivotal role of gender in biodiversity merits special consideration in the formulation of conservation policies, strategies and projects at all levels. The publication *Biodiversity and Gender for Sustainable Development* exactly meets this requirement.

Michael Gillibrand
Special Adviser and Acting Director
Management and Training Services Division
Commonwealth Secretariat

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The publication *Biodiversity and Gender for Sustainable Development* is the product of many years of a *sharing of experience* under the auspices of the Management and Training Services of the Commonwealth Secretariat in the areas of Gender, Biological Diversity, and Environmental Conservation for Sustainable Development.

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The excellent material in the publication was provided by many individuals and/or organisations within East Africa. We wish to register our indebtedness to all the contributors and particularly to the following: Nancy Dorsey, Lecturer, Department of Women Studies, Makerere University; Beatrice Adimola, Environmental Specialist with the National Environmental Management Authority (NEMA), Uganda; Bukenya-Ziraba of Botany Department, Makerere University; George Sikoyo, David Hafashimana, Herbert Tushabe and Samuel Mugisha all of MUEINR; Paul Mafabi of the National Wetland Programme, Uganda; Betty Gowa of NEMA and Bishop Clare of the Department of Women Studies, Makerere University. Although in editing, every attempt has been made to retain the accuracy of the contributing authors, final responsibility for any introduced errors or inaccuracies rests with us. The inclusion of any statement within this publication does not imply that this is an exhaustive analysis, synthesis or presentation of current trends, best practices or best modes of approach to Biodiversity and Gender within the context of sustainable development.

Rogers W'O Okot-Uma, Chief Programme Officer &
RoseMarie-Rita Odiachi, Senior Programme Officer
Management and Training Services Division
Commonwealth Secretariat

CONTENTS

OVERVIEW

OVERVIEW

This overview presents a wide array of issues and the different approaches used to tackle them, under the following six main sections:

Part One: Introduction to Environmental Management, with particular reference to Biodiversity Conservation.

Part Two: Gender Perspectives and Case Studies on The Role of Women in Environmental Management.

Part Three: Threats to Biodiversity.

Part Four: Strategies for the Protection and Conservation of Biodiversity.

Part Five: Policy Issues on Environmental Conservation with a focus on Women and Biodiversity.

Part Six: Capacity-Building for Biodiversity Conservation in Africa.

PART ONE: INTRODUCTION

Part One introduces the general idea of environmental management in the following chapters:

1. Our Environment

The first chapter on "Our Environment" describes the environment in its totality, encompassing the solar system (which includes several planets revolving around the sun) and the life systems on the surface of the planet earth (i.e. the biosphere). The planet earth is placed in the context of the entire universe enabling the appreciation that the earth is just a tiny unit of the universe. The composition of the various components of the earth, namely the biosphere (i.e. the thin layer of the earth's surface which consists of life forms); the hydrosphere; the lithosphere; and the atmosphere are briefly described. The evolutionary process, in which human kind is believed to have come last, is also described. It is noted that today's biodiversity is a manifestation of this long evolutionary process through which several species have arisen while others have become extinct. Species, throughout this process, have established relationships with their surroundings in dynamic equilibria which have enabled ecosystems to function. The global biodiversity status is briefly described, indicating that out of the 1.7 million species that are believed to exist on

earth, 85% are arthropods (particularly insects). Human species constitute only a tiny fraction of overall global biodiversity. Finally, it shows how the survival of human beings and other living organisms is dependent on the use of both renewable (living) and non-renewable (non-living) resources which are supplied by the environment. Therefore, the basis for the long-term survival of human kind is sustainable and equitable use of the existing natural resources.

2. Introduction to Gender: Issues and Concepts

This chapter highlights the key issues and concepts on gender in society in general so as to provide the context for participants to appreciate the basis for the current role of women in environmental management and how that role is down-played. It traces the historical development of the women's emancipation movement since the early 1970s. It outliness the various initiatives that have taken place including: the United Nations Decade for Women: Equality, Development and Peace (1976–1985); the "Nairobi Forward-Looking Strategies for the Advancement of Women (1985); and the Fourth World Conference on Women, popularly called the "Beijing Conference" of 1995; and the "1995 Commonwealth Plan of Action on Gender and Development".

3. Introduction to Biodiversity: Definitions and Concepts

This chapter defines the key terminologies and describes some of the common concepts related to biodiversity conservation. Biological diversity is defined as *"the variability among living organisms from all sources, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."* The distinction between biodiversity and biological resources is clarified, the latter referring to tangible biotic entities such as seeds, genes, maize, fish, elephants, etc., only sub-sets of all the earth's genetic resources, organisms or populations, while biodiversity refers to the variability among them. The three levels of biodiversity, namely: genetic, species and ecosystem diversity are also described. Other concepts including conservation; protection or preservation; nature management; sustainable use; in situ and ex situ conservation; protected areas; and buffer zone management are outlined and distinctions among them were clarified. The six IUCN categories of protected areas are described.

4. Introduction to Biodiversity: Biodiversity Values and Sustainable Development

This chapter provides the justification for bothering to conserve biodiversity. It discusses the economic, socio-cultural, aesthetic and scientific values of biodiversity and analyses the link between biodiversity conservation and development. The various utilitarian values (such as food, medicine, fuel etc.) and non-utilitarian or intrinsic values (such as recreation, scenic beauty, ecological roles, etc.) are described. The functions of biodiversity are alternatively described as productive; support (i.e. ecosystem support systems); regulatory (e.g. carbon cycle maintenance); and scientific (e.g. providing genetic reservoirs for future breeding). It notes that most of the economic activities in Africa such as agriculture, tourism, etc. are dependent on biodiversity. Thus, biodiversity plays a critical role in the economic development of most African countries. The term sustainable development is described, emphasising the fact that ecological sustainability is the prerequisite for sustainable development and is largely dependent on the maintenance of biological diversity so as to meet both the consumptive and non-consumptive needs of humankind, now and in the future. Biodiversity conservation therefore means keeping options for future human survival open.

It acknowledges that sustainable utilisation of biological resources should be in consonance with the principle that those resources will continue to be available for subsequent generations. It recognises that there is need to achieve development without compromising environmental integrity. This can be done by practising environmentally-sound activities such as ecotourism, agriculture and agroforestry.

PART TWO: GENDER PERSPECTIVES

Part Two focuses on gender perspectives and includes the following chapters and case studies:

5: Gender and the Environment

This chapter is a continuation of the first introductory chapter on gender issues and concepts. It explains the paradigm shift from placing emphasis on women *per se* to gender analysis, including the social basis for development of gender roles and relations, the roles of the education system, sex, tradition and culture. This has led to transitions from concepts like "women in development (WID)" to "gender and development (GAD)". It shows how gender roles are taught and learnt from an early stage in the home, then later in schools and places of work. The lack of information on the roles of women in society is blamed on a male-dominated

society where the media world, politics, academia, etc. are predominantly run by men who often are not gender-sensitive.

Case Study 1: The Cogtong Bay Mangrove Management project in the Philippines

This case study illustrates the role of women as the principal managers of the coastal and marine biodiversity in the Congtong Bay in the Philippines. Due to the widespread use of the mangroves for timber and the unregulated conversion of the habitat to fishponds, it was degraded and fish resources declined. This not only had a big impact on coastal biodiversity but also jeopardised the livelihood of many local people, particularly women. A project called "Cogtong Bay Mangrove Management Project" was initiated to improve the management of the Bay's coastal resources by organising local communities to undertake coastal resource management activities. Although the project made no deliberate attempt to integrate women in its planning and implementation, they became automatically involved because of their traditional roles. When they attended the project meetings as proxies of their husbands, they made decisions which influenced the project activities. They were very active in mangrove rehabilitation and afforestation and in adopting mariculture techniques demonstrated by the project staff. However, they were unfairly excluded in obtaining the critical benefits from the project, namely, security of tenure over the rehabilitated mangrove areas and access to credit since they were not members of the associations in their own right. Even without receiving direct benefits provided by the project, they nevertheless still demonstrated their commitment to conservation of the coastal biodiversity on which their survival is dependent. The case study demonstrated the following general lessons about women's involvement in conservation and development projects:

- Ignoring women's roles in the designing and implementation of projects can result in missed opportunities. Although women were ignored in the Cogtong project design, they were ultimately instrumental in the success of the project.

- The views and interests of all stakeholders, especially women, should be sought in the design and implementation of projects. If this had been done in the Cogtong project, the designers would have discovered early the importance of involving women, facilitating them to access the credit in their own right and explicitly defining their benefits from the project.

- Women, like men, need direct access to and control over resources in order to benefit fully from project interventions. In Cogtong Bay, women needed full membership in the community associations and ownership of

Mangrove Steward Certificates in order to have equal access to the credit needed to enhance their productivity and incomes and in turn act as economic incentives for them to conserve and sustainably use the coastal biodiversity.

- A key element in the success of conservation efforts is to link the economic value of natural resources to their ecological values so as to make local people aware and to appreciate why conserving biodiversity is critical to their very survival and well-being.

PART THREE: THREATS TO BIODIVERSITY

6: Threats to Biodiversity and Underlying Causes of Biodiversity Loss

This chapter identifies and analyses the direct threats, as well as the underlying causes of biological diversity loss. It looks at the direct causes and the possible solutions to address them and the the indirect causes or underlying factors of biodiversity diversity loss.

Direct Threats to Biodiversity

A. Habitat loss and fragmentation

1. Deforestation
2. Land reclamation e.g. wetlands
3. Urbanisation – increased populations need more land for settlements.

B. Pollution

1. Oil spillage
2. Industrial waste
3. Domestic waste
4. Fertilisers
5. Pesticides
6. Motor vehicles

C. Invasion by alien/exotic species, e.g.

1. Water hyacinth, a South American plant in African waters
2. Paper mulberry, an Asiatic species in Ugandan forests
3. Nile perch in Lake Victoria

D. Destructive exploitation and over-use of natural resources

1. Stream/riverbank cultivation

2. Charcoal burning
3. Land-mining for clay and sand
4. Bush-burning
5. Coral reef mining using dynamite, especially in Tanzania
6. Uncontrolled fishing in many inland lakes
7. Inappropriate farming on marginal lands

E. Modern agriculture and forestry practices

1. Eutrophication of water bodies as a result of run-off from heavily artificially-fertilised farms
2. Exotic tree species replacing indigenous natural forest plantations
3. Monoculture
4. Genetically-engineered organisms or improved varieties, causing the neglect of indigenous germplasm

F. Natural factors

1. Climatic change – global warming, drought and floods
2. Wild fires
3. Natural disasters, e.g. earthquakes
4. Active volcanoes

Possible Solutions to some of the Direct Threats

1. Strong policies and strong institutional framework, not driven by politics. There should be public consultation in making the policies.
   (a) Deforestation – afforestation, agroforestry, community awareness and empowerment especially of women, proper land management, etc.;
   (b) Land tenure – for wetlands create riparian reserves;
   (c) Pollution – strong policies and a legal framework (laws, fines, arrests, EIAs, incentives); setting environmental standards; recycling; appropriate dumping sites; community awareness; biosafety regulations;
   (d) Urbanisation: population awareness policy; establishment of industrial parks;
   (e) Invasion of alien species – strengthen the monitoring ability at customs posts and zoo/phytosanitary services.
   (f) Destructive exploitation and over-use:
      – good farming methods (crop rotation and agroforestry)
      – use of fuel-saving stoves
      – promotion of community ownership of resources

- promotion of alternatives like biogas, solar, and hydro-electricity
- minimising waste, i.e. efficient resource exploitation.

Indirect Threats (Underlying Causes of Biodiversity Loss)

A: Population growth

This results in pressure on land and ultimately on protected areas. People will begin using fertilisers to increase crop production and over-harvesting resources such as fish.

B. Poverty

It was noted that poverty is a major cause of environmental degradation, including biodiversity loss. It leads to failure to:

(i) access alternative means of survival;

(ii) eradicate illiteracy, which in turn leads to low incomes and often large families;

(iii) improve purchasing power

- lack of ownership of productive land;
- pushing people to marginal areas.

C. Inappropriate macroeconomics policies

(i) Investment policies: there is a need for EIAs and environmental standards.

(ii) Foreign trade: exploits biodiversity, e.g. unregulated trade in timber in Cameroon.

(iii) Taxation and subsidies policy: logging and fishing companies should be highly taxed, while people who invest in tree-planting projects and other environmentally-friendly projects should be taxed less.

(iv) Under-valuation of biodiversity: economists do no value forests apart from their timber value. There should be some kind of value attached to, for example, medicinal plants. Nationally, biodiversity has no place in the national economic planning process.

D. Inequity in resource ownership/management and benefit-sharing

Communities who have co-existed with biodiversity resources are often alienated from these resources by the use of inappropriate policies and legislation by national governments. This loss of ownership by communities often leads to unsustainable use practices.

E. Deficiencies in knowledge and application

(i) inadequate research

(ii) disregard of indigenous knowledge

(iii) weak media – delays in information flow

(iv) failure to develop well-informed policies
(v) lack of awareness and know-how

F. Poor policies and bad/weak institutional arrangements

(i) lack of institutional co-ordination, e.g. Uganda Wildlife Authority and Forest Department leading to institutional conflicts;
(ii) lack of an integrated approach to stakeholders and private sector participation;
(iii) lack of community involvement;
(iv) imposed policies and projects;
(v) lack of funds.

G. Poor land-use planning

For example, allocation of land for building houses or roads where there are rare/ endangered species.

H. Political instability

(i) refugees;
(ii) poor politics, e.g. situations whereby a politician will allocate a protected area for consumptive use with the hope of winning votes from the beneficiaries.

I. Cultures, Attitudes and Traditions

Some cultural norms and traditions encourage the destruction of biodiversity, e.g. the hunting of certain species to provide skins for cultural ceremonies.

PART FOUR: STRATEGIES FOR THE PROTECTION AND CONSERVATION OF BIODIVERSITY

This part outlines the various methods, strategies and approaches for the protection and conservation of biodiversity. It also discusses current developments in biodiversity research innovations and biotechnology assessment and transfer.

7: Conservation Approaches and Strategies I: *In Situ* Conservation in Protected Areas

This chapter enables readers to understand the essence of *in situ* conservation measures and to appreciate the importance of these strategies. *In situ* conservation refers to the management of ecosystems and species in their natural habitat and includes the creation of national parks, wildlife reserves, forest reserves, wildlife sanctuaries and communal wildlife areas.

8: Conservation Approaches and Strategies II: *Ex Situ* Conservation Methods

This chapter enables readers to understand the essence of *ex situ* conservation methods and to appreciate the importance of these strategies. *Ex situ* conservation involves the removal of species from their natural habitats and attempting to conserve them in facilities such as banks, arboreta, botanical gardens, acquaria and zoos.

9: Conservation Approaches and Strategies III: The Community Conservation Approach

This chapter aims to create awareness of these relatively new approaches to conservation which encourage the involvement of local communities in the conservation and management of natural resources. These approaches are based on the philosophy that "successful conservation within and outside protected areas cannot be achieved without the participation, co-operation and support by the local people". A distinction is made between "passive participation", where local people are simply involved in already externally-designed projects often to enlist their support, and "active participation" where they are empowered to initiate, plan and implement projects responsive to their needs. They have the "power" to influence decisions that are likely to affect them. Some examples of passive approaches now commonly used in community conservation are identified, including revenue-sharing arrangements; compensation schemes; resettlement schemes; employment of locals in the projects; credit schemes and community micro-development projects.

10: Community Conservation and the Use of Incentive Measures: Case Studies

Two case studies i.e the Kilum/Ijim Mountain Forest project in Cameroon and the CARE Development Through Conservation (DTC) Project in Uganda illustrate community conservation approaches and experiences (see Appendix 5). The Kilum/Ijim Mountain Forest project case study illustrates that it is possible to use participatory management practices to promote the conservation and sustainable use of forests and their biodiversity. Local people around the forest were organised into Forest Users Groups which were supported and entrusted with responsibility to manage and exercise control over the use of their respective community forests through Community Forest Agreements between the local users (including primary, secondary and tertiary users) and the government. The project had several positive outcomes. There is now more open dialogue between the different stakeholders; there has been no new encroachment of farms into the forest; there is eagerness among farmers to adopt new farming practices such as agrofrestry; and there is widespread recognition by local communities that it is possible to use resources from the forest on a sustainable basis without having to destroy it.

The CARE/DTC case study from Uganda illustrates the importance of using incentives and alternatives as a way of encouraging and motivating the local communities to conserve and sustainably use resources in and around protected areas (Bwindi Impenetrable National Park, BINP). The project aimed at promoting sustainable agriculture, soil conservation, and watershed management in the areas around BINP with the view to increase farmers' cash incomes, provide alternative employment and replace products and services lost as a result of the creation of the national park. Development and conservation committees were established and the following activities were promoted by the project; on-farm planting of forest species; establishment of tree nurseries; establishment of woodlots; establishment of exotic trees on farm; establishment of vegetable nurseries; improved soil conservation; improved banana management; improved bean varieties; improved potato varieties; improved cooking stoves; and the development of village-level community action plans. By providing development/livelihood alternatives to the local communities as a way of compensating them for the benefits they had to forego by losing access to the park, the project reduced the hostility towards the park and instead created better understanding and appreciation of its economic benefits. While ultimately aiming to achieve effective conservation and sustainable use of biodiversity, the project at the same time sought to meet the immediate development needs of the local communities.

PART FIVE: INNOVATIONS IN BIODIVERSITY RESEARCH

Part Five focuses on salient features relating to innovations in biodiversity research. It covers discussions on biodiversity identification and monitoring, expositions on ethnobotanical and ethnopharmacological research, and discussions on environmentally sound technology assessment and transfer in biodiversity.

11: Biodiversity Research Innovations I: Biodiversity Identification and Monitoring

This chapter presents the concept of inventories of species at particular sites as essential data sets for conservation and resource management. A prerequisite for the development of such inventories is the knowledge of biodiversity details in a given area.

The prime methodology for the acquisition of such knowledge recognises the need for undertaking surveys, among others. The chapter underscores the limitations of the survey methodology, which usually reveals large numbers of species, many of which may be undescribed, particularly invertebrates and lower plants. The chapter, moreover, underpins the observation that for well-known taxa such as invetebrates

and flowering plants, it is relatively straightforward, using experienced biologists (taxonomists), to make an inventory of an area and establish details of a species present. In spite of the pertinent limitations, various methodologies have been developed for diversity identification.

12: Biodiversity Research Innovations II: Ethnobotanical and Ethnopharmacological Research

This chapter introduces some of the on-going research innovations in ethnoecology, ethnobotany and ethnopharmacology. Ethnoecology is a very broad discipline including all studies describing local people's interaction with the natural environment, including ethnobiology, ethnobotany, ethnoentomology, and ethnozoology. Ethnobotany refers to the study of local people's perception of the cultural and botanical knowledge, including, for example, the local names given to plants and the various ways in which plants are classified and used by the people. One of the most recent ethnobotanical research innovations, *The People and Plants Initiative*, a joint project of the World-Wide Fund for Nature (WWF),UNESCO and Royal Botanic Gardens, Kew (U.K.) builds up the capacity for work with the local communities on botanical aspects of conservation, especially in countries with tropical forests. Demonstration projects are on-going in Uganda, Malawi and Zambia. The four main interrelated undertakings in ethnobotany, namely, basic ethnobotany; quantitative ethnobotany; experimental ethnobotany; and applied ethnobotany were described.

13. Environmentally-Sound Technology Asssessment and Transfer for Biodiversity Conservation

This chapter describes the current advances in biotechnological research and outlines the importance (benefits) and risks associated with using biotechnology products. It includes information on advances in genetic engineering and how it has provided tools for producing more food, fibre and pharmaceutical products from less land/natural resources, thereby addressing the need for biodiversity conservation. It has resulted in improved varieties of food plants and animals with many new properties such as enhanced resistance to pests and diseases; modified protein and oil content; improved nutritional properties; and higher resistance to environmental stress such as drought, high salinity, or cold. For example, research in different countries has resulted in pest and disease-resistant crop varieties of pawpaws (in Brazil); cotton (Brazil); tobacco (China); bananas (Costa Rica and Nigeria); corn and rice (Indonesia); pineapples, tomatoes as well as Irish and sweet potatoes. Biotechnology also has a potential of providing new pharmaceuticals and other chemical substances synthesised *in situ* within crop plants or animals in environmentally-acceptable ways.

Despite these advantages, it cautions that biotechnology has also proved to have serious ecological, health and socio-economic hazards. The creation of transgenic organisms (or Genetically Engineered Organisms, GEOs) through genetic engineering, for example, has several ecological effects on agriculture, including the possibility of some transgenic crops becoming noxious weeds, thus affecting wild ecosystems. The adaptive traits to "wild type organisms" give some of them a competitive advantage and cause them to overrun natural communities of fauna and flora thus reducing natural biodiversity. Furthermore, plants engineered to express toxic substances such as insecticides and pharmaceutical products could poison non-target organisms, including beneficial ones. Plants engineered to contain viruses and/or fragments of viruses (in order to become virus resistant) could also facilitate the creation of new viruses. Futhermore, transgenic crops pose a threat of loss of wild plants and farmers' varieties which are major sources of crop genetic diversity which loss would deprive the world of some of the most valuable resources needed for improving agriculture and for securing future food security. Genetic engineering may also favour monocultures and erode agricultural diversity, and especially threaten the global centres of crop diversity located in developing countries.

In view of these likely dangers due to biotechnology, there is need for regulatory mechanisms to streamline (especially trans-boundary) transfer and handling of products of biotechnology. Governments, especially developing countries, need to build up capacity in biotechnology to assess and manage any potential risks if technology transfer is to be beneficial to all.

PART SIX: POLICY ISSUES ON BIODIVERSITY

Part Six focuses on policy-related issues and concepts as they relate to gender and biodiversity conservation. It covers discussions on the Convention on Biological Diversity and other biodiversity-related conventions; national biodiversity strategies and action plans; regulation of access to genetic resources; environmental impact assessment and valuation of biodiversity, including cost-benefit analysis.

14: Policy Issues in Biodiversity Conservation 1: The Convention on Biological Diversity

This chapter introduces the Convention on Biological Diversity (CBD). It describes how the Convention evolved from the negotiation stage, to its signing in 1992 and entry into force in 1993, highlighting some of the critical issues that emerged. The basic principles and objectives of the Convention are outlined, stressing the principle that countries have sovereign rights over their biological diversity and the third objective of ensuring fair and equitable sharing of benefits from genetic

resources, which make the CBD unique from other Conventions. The current status of the CBD ratification and implementation is set out and the five major organs through which it is administered, namely, the Conference of Parties (COP); the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA); the Secretariat; the Clearing House Mechanism and the Financial Mechanism (GEF) are described. Finally, the basic elements in the different articles of the Convention are discussed.

15: Other Biodiversity-Related Conventions

This chapter describes the main elements of the other major biodiversity-related conventions and treaties in existence other than the CBD. These include:

- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the "Ramsar Convention");
- Convention concerning the Protection of the World Cultural and Natural Heritage (the "World Heritage Convention");
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- Convention on Conservation of Migratory Species of Wild Animals (the "Bonn Convention");
- International Tropical Timber Agreement ("ITTA"); and
- African Convention on Conservation of Nature and Natural Resources (the "African Convention").

16: National Biodiversity Strategies and Action Plans

This chapter sets out the basic elements and the process of formulating national biodiversity strategies (NBS) and action plans (NBAPs). Formulation of NBSAPs is a requirement under Article 6 of the CBD but countries can opt to integrate biodiversity considerations into their existing plans, policies and programmes instead of developing separate NBSAPs or they can decide to do both.

An NBS is a statement of the mission/vision, guiding principles and the overall goals and targets, as well as analysis of the issues, opportunities and impacts of different options and, finally, selection of priority actions and investment to achieve the desired goals. The NBAP spells out the specific steps that need to be undertaken to implement the selected strategies. It addresses questions such as: Who will undertake the selected actions? Over what time-frame? By what means and with what resources (human, financial, technical, facilities, etc.)? What will be the implementation schedule? If any, what regional and international co-operation will be required? It stresses that NBSAPs should explicitly outline implementation

measures, establish specific targets and develop clear monitoring and evaluation mechanisms. The process should be interactive and participatory, involving all the different stakeholders.

17: Integrating Biodiversity into Sectoral and Cross-Sectoral Policies, Plans and Programmes

This chapter outlines some of the guiding principles for achieving integration of biodiversity into sectoral and cross-sectoral policies, plans and programmes and also examines some of the challenges in achieving this integration. It observes that biodiversity is a resource with many interests and its conservation is a concern of several institutions/sectors. It is impossible for one institution to intervene at any one level without affecting others. It is therefore justifiable to endeavour to seek integration and co-ordination. There is need to harmonise sectoral interests and to mobilise sectoral support. Ways of how to achieve integration are explored and a review of sectoral policies and/or formulation of specific policies on biodiversity to help to focus attention on biodiversity is recommended. Cross-sectoral linkages through delegation or management agreements or memoranda of understanding between institutions should also be established. Education and awareness are also necessary. It is essential to develop a matrix correlating policies at the microeconomic, macroeconomic, social, legal and training levels. Other ways to achieve integration may include institutional reforms; stakeholder consultation; training; and integrated land-use planning approaches. Some of the major contraints to achieving integration are identified as rigid sectoral mandates and self-interest; lack of alternatives; commercialisation; inappropriate valuation of biodiversity; and lack of political will.

18: Environmental Impact Assessment of Biodiversity

This chapter demonstrates the need for Environmental Impact Assessments (EIA) as a tool for analysing the potential environmental impacts of development activities (policies, projects, and programmes) on biodiversity to ensure that they are predicted and taken into account before the activities are implemented. An EIA is an analytical tool that allows a precautionary approach to development after analysing and taking into account the ecological, social and economic aspects. The idea is to ensure that the environment (including biodiversity) is not adversely affected by developmental activities. The EIA process includes identification/ prediction of potential effects of development activities on the environment, assessment of their impacts, identification of mitigation measures, and establishment of environmental monitoring and evaluation systems. The different levels of EIA, namely, environmental impact review (EIR), environmental impact evaluation (EIE) and environmental impact study (EIS) are described. The different stages of EIA

as they correspond to the project cycle, including the initial environmental screening; preliminary environmental assessment; full environmental impact assessment (if necessary); assessment of the distribution of the impact; design of mitigation measures; and the establishment of environmental monitoring systems are also outlined.

19: Regulation of Access to Genetic Resources

This chapter introduces the key elements of Article 15 of the Convention on Biological Diversity on regulation of access to genetic resources. This particular article is very important for developing countries. Before the Convention came into force, the world's genetic resources were treated as a common heritage of humankind and were open to access without restrictions. Developed countries, because of the advanced biotechnology, were the net beneficiaries, yet developing countries (LDCs) bore the burden of maintaining the biodiversity. Having succeeded in entrenching the principle of national sovereign rights over genetic resources in the CBD, LDCs need, as matter of priority, to move very fast to put in place policy, legislative and institutional frameworks to regulate access to their genetic resources and ensure equitable sharing of benefits from these resources. The key concepts used in article 15, namely, "prior informed consent"; "mutually agreed terms"; environmentally-sound uses; and how these are established are explained. The chapter shows how to proceed to formulate national legislation on access, outlining specific areas that require attention. The different types of Research Agreement, namely, Academic Research Agreements (ARAs); Commercial Research Agreements (CRAs); and Material Transfer Agreements (MTAs) are described.

20: The Role of Valuation in Policy Formulation for Biodiversity Conservation

This chapter explains why valuation of biodiversity is important and introduces some of the valuation techniques that are relevant in policy formulation and analysis of projects and decisions made in biodiversity conservation. Valuation is defined as the assignment of a monetary value to economic goods and services, and in particular to environmental resources. The purpose of valuation is to identify "the correct" prices for these goods and services. The value attached to a good is measured from the people's preferences for these goods and services provided by the environment in question, which can be expressed in monetary terms. Determination of the total economic value of a resource (TEV) enables planners and politicians to make more rational decisions since it allows them to compare the monetary value of biodiversity or environment with the monetary values of other goods and services. TEV includes both the marketed and non-marketed goods and is categorised into the following values: Direct Use Values (DUV); Indirect Use Values (IUV); Option Values (OV); and Non-Use Values; NUV (including

existence value; vicarious use value; bequest values; stewardship values; cultural values and intrinsic values). In summary, TEV = [DUV + IUV + OV] + [NUV]. Finally, participants were introduced to some of the valuation methods according to which type of market (conventional, implicit or constructed) the values rely on, and by considering how they make use of actual potential behaviour. In conclusion, it was acknowledged that environmental economics and the valuation of environmental effects on biodiversity play a critical role in providing a common denominator for comparing a variety of different outcomes from the viewpoints of many sectors, and also play a key role in facilitating pragmatic and efficient trade-offs among alternatives and policies. The limitation of economic methods have to be understood and continually kept in mind if they are to be used successfully in valuation processes. Value judgements about distribution and irreversible effects are unavoidable, but quantification in monetary terms of as many variables as possible is important in crystallising those issues involving implicit value judgements, which may otherwise be ignored.

21: Incorporating Costs and Benefits of Biodiversity Conservation into Economic and Policy Decision-Making Processes

This chapter outlines the concept of Cost Benefit Analysis (CBA) as a tool in biodiversity policy formulation and decision-making. It observes that biodiversity conservation is a resource allocation problem in that it involves challenges of allocating biological resources amongst competing needs. Therefore, it requires analysis of the costs and benefits involved in order make rational decisions for the most efficient, equitable and sustainable ways of conserving and using the available genetic resources. The basic steps involved in the Cost Benefit Analysis of policies, projects and programmes are set out, namely:

(i) setting clear CBA objectives;
(ii) consideration of options;
(iii) specification of effects of each option;
(iv) evaluation of effects of each option;
(v) elimination of less desirable options, and finally
(vi) making a decision after other necessary consultations.

Some of the fundamental constraints to CBA which analysts and policy-makers have to consider ways of handling them at the policy level are discussed. They include discounting; sustainability; irreversible effects; risk and uncertainity; and equity and asset transfers to future generations.

PART SIX: CAPACITY-BUILDING FOR BIODIVERSITY CONSERVATION IN AFRICA

Part Six covers those subjects that contribute to the strengthening of institutional capacity and enhancement of specific technical skills of the participants to improve the planning and implementation of biodiversity conservation activities. It includes such topics as education and training; curriculum development; institutional development; networks for biodiversity conservation and the application of biodiversity data-bases; remote-sensing; and Geographical Information Systems (GIS) for biodiversity conservation.

22: Education and Training in Biodiversity Conservation

This chapter describes the role of environmental education (EE) in promoting sustainable management of natural resources and improving the capacity of the people to address environment and development issues. It is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. The Convention on Biological Diversity recognises the key role education can play and urged Parties, in Article 13, to "promote and encourage understanding of the importance of and the measures required for the conservation of biological diversity as well as its propagation through media and the inclusion of these topics in educational programmes... and to co-operate ... in developing education and public awareness programmes". The objectives of EE and the ways in which it can be used to further develop the knowledge of women so as to empower them to use the resources sustainably are set out. Women can contribute a lot to the transmission of indigenous knowledge, social values and development of human resources. These are important attributes that need to be promoted and enhanced.

23: Curriculum Development for Biodiversity Conservation

This chapter demonstrates the need for a thorough review of existing curricula to ensure that biodiversity/environmental issues are integrated. It acknowledges that it is important to design the curriculum with the people, especially in the non-formal sector. Simple guidelines that need to be considered in designing curriculum for biodiversity are provided. Issues of the curriculum content, objectives, resources and evaluation must be discussed and examples of activities on biodiversity must be provided. In designing the curriculum, the content should build on existing courses or programmes in schools and institutions. The curriculum developed must be continuously evaluated to determine the extent to which its overall goals and objectives have been achieved, to detect the usefulness of the outcomes which were

not originally specified and to determine the effectiveness of the implementation of the programme.

24: Network Development for Biodiversity Conservation

This chapter shows what networks are and how they operate. Networks can be horizontal or vertical. The key characteristics of a network are identified and discussed. Members in a network must have easy access to the information they require from the network and should be able to add value to it. They must be willing to learn and share experiences and a network should have clear, mutually-agreed objectives. The importance of networking in biodiversity conservation initiatives is stressed. It facilitates exchange of information and experiences; it increases awareness about new and emerging issues; it helps to focus the often dispersed efforts; helps to minimise duplication of resources, for example in research, and finally, it allows synergy among partners to find solutions to common problems. Some of the key issues that need to be considered in attempting to establish networks are outlined. There is need to consider what structure or form the network will take; where the hub or co-ordination point will be located; the sources of information; mechanisms of information transfer; protocols of information exchange; ownership of information in the network; standardisation of data, monitoring and publicity. It emphasises that a successful network must provide valuable services to its members.

25: National and Regional Biodiversity Databases

This chapter introduces the role of biodiversity data-banks in the biodiversity planning and monitoring process, outlining the difference between data and information. Different types of databases (sub-national, national, regional, international and meta data-bases) and how information flows from one to the other are covered. The functions of biodiversity databases were discussed, i.e. they help to improve the biodiversity information base so as to facilitate effective biodiversity planning, allow judicious decision-making and help in monitoring the status and trends of bidiversity and its use. The process of establishing a biodiversity data-base was described, outlining the basic elements that need to be thoroughly investigated before attempting to establish a database. A demonstration was made to the participants at the National Biodiversity Data Bank at MUIENR on how to use databases.

26: Application of Remote Sensing and Geographic Information Systems (GIS) Technologies for Biodiversity Management

This chapter describes the application of remote-sensing (RS) and Geographic Information Systems (GIS) tools in biodiversity conservation. While RS is a data-collection technology, GIS is a computerised data-handling technology. These two technologies can be used to measure and monitor biodiversity parameters at the species and ecosystem level but not, as yet, up to the genetic level due to the low resolution used. It outlines the different types of remote-sensed data, including aerial photographic data; satellite imagery data, etc., the latter now being the most commonly used. Different types of remote sensors (e.g. Landsat TM, MSS, SPOT, AVHRR, Radar), which are mounted on satellites at varying heights in space to collect and transmit data to ground receiving stations, are mentioned. The basic steps followed to extract information from remotely-sensed data using GIS are listed. A selected number of case studies are presented which illustrate the salient features and techniques that form the core of remote sensing and GIS. The case of Sango Bay area in Uganda is a project which was conceived with the objective to integrate remote sensing, GIS and field diversity survey techniques. The case demonstrates how spatial information of Sango Bay habitats was updated using Landsat TM data and was then integrated in a GIS, with the biological and socio-economic data obtained from field surveys to produce a Biodiversity Zoned map of the Sango Bay area of Southern Uganda, including nature reserves, buffer zones, wildlife corridors, and other land uses. Some of the GIS techniques which are directly relevant to biodiversity management are outlined, including the digital elevation model creation (DEM); buffer zone creation; home range analysis; and overlaying.

PART ONE

INTRODUCING OUR ENVIRONMENT

CHAPTER 1

Our Environment

Dr. P. M. B. Kasoma
Acting Director, MUIENR

INTRODUCTION

The earth and its moon are part of the solar system. The earth is one of the planets moving around the sun, which is a central star. This constitutes the solar system. The solar system is an orderly, harmonious system of matter. However, it is also part of countless star systems with their satellite planets which compose our galaxy. It is estimated that there are one hundred thousand million (10^{11}) galaxies within the maximum radius of the observable universe! In this context therefore, the earth is an insignificant speck!

Within our solar system however, the earth is not insignificant, it occupies a position which enabled the appropriate conditions for life to exist. The existence of life on earth in turn transformed the surface of the planet. The behaviour of the earth in relation to the sun imposes rhythmical changes in exposure to light and dark, day and night, summer and winter. Other characteristics of the earth, such as its rotation on its axis, create the characteristic atmospheric and oceanic circulations. Furthermore, the earth receives a constant and major output of energy from the sun. It is this energy that is the source of life for most organisms.

OUR PLACE IN NATURE

Life consists of a thin film over the surface of the earth. This film is the biosphere. Other major elements of the earth's surface are the lithosphere, hydrosphere and atmosphere. The global veneer of life is significant in that despite its relatively small mass it has profound impacts on the nature of the lithosphere, hydrosphere and atmosphere (Fig. 1).

In terms of age, the human race is a very recent arrival on earth, having been preceded by most other organisms. Arthropods, for example have existed for more than 400 million years and have survived several major mass extinctions. The oldest known organism, from the fossil record, is a bacterial organism about 3 billion years old. The oldest hominid is less than 4. million years old, whereas the human race is only 0.1 million years old!

Today's biodiversity is the manifestation of a long evolutionary process through which many species have become extinct and new species have arisen. The structure of biodiversity has changed through time as species have continually evolved. During this evolutionary process, species have built a variety of inter-relationships and relationships with their surroundings that have enabled them to survive. These relationships have evolved into balanced but dynamic equilibria which enable ecosystems to function. In terms of numbers, the human species is negligible. There are other species that numerically dominate the earth. For example, of the described species, arthropods constitute 85 per cent of the total global fauna and 65 per cent of the total known biodiversity (based on 1.7 million species). When diversity is calculated on the basis of the estimated global total (12.5 million species) arthropods alone make up 91 per cent of all the living animals and 79 per cent of the global biodiversity (Groombridge, 1992) (Figures 2 and 3). Mammals and the human species in particular constitute only a small proportion of the vertebrate fauna.

Despite that, humans have been able to evolve the intelligence and numerical abundance that has enabled them to dominate the earth. The only problem is that no single species possesses all the necessary ecological attributes to sustain ecosystem dynamics. All species individually have definite roles to play and it is the multiplicity of these roles that sustain the system. Humans are a species and part of nature. We humans draw our own human spirit from nature (biodiversity and its natural settings), as Wilson (1984) ably described this point in his book "Biophilia". The natural settings for biodiversity are made up by the atmosphere, hydrosphere and lithosphere (Fig. 4). It is from here that the resources that enable the existence of life are drawn.

The atmosphere has a specific composition. It is 78.09 per cent nitrogen, 20.95 per cent oxygen, 0.93 per cent argon and 0.03 per cent carbon dioxide by volume. Other gases constitute less than 0.003 per cent by volume. Through natural or human-induced activities, minor constituents of the atmosphere may also include dust, pollen, bacteria, spores, smoke particles, sulphur dioxide, hydrogen sulphide, hydrocarbons, and larger amounts of CO_2 and ozone depending on weather, volcanic activity, local industrial activity, and concentration of human, animal and motor-vehicle population. This does not include water vapour which is an important constituent in all normal atmospheres.

The hydrosphere has water as the major constituent. It is difficult to estimate the amount of water in the hydrosphere but Table 1 gives the estimated quantity of water in the world. The water varies in composition depending on where it is found but wherever it occurs, its natural composition varies within set limits beyond which it would be considered to be polluted.

The lithosphere is merely the rigid crustal plates of the earth from which the earth's terrestrial surface, soil, is made. Soil has both biotic and abiotic components which are essential for sustaining plant growth. The productivity of a soil will depend on its composition. This composition is susceptible to alteration by human activities.

The survival of any living organism necessitates the use of certain materials both living and non-living for sustenance. These are called resources. As far as human beings are concerned, resources may be renewable or non-renewable. The former can be used almost indefinitely because they have the capacity to regenerate. The latter are in finite quantities and are liable to be exhausted. Our environment supplies these resources and we have the choice to use them rationally or irrationally. The rational and equitable use of the earth's resources is the key to the long-term survival of the human species.

PROPOSED FURTHER READING

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Ferguson-Bisson D., 1992. *Rational Land Management in the Face of Demographic Pressure: Obstacles and Opportunities for Rural Men and Women* (Ambio Vol. 21(1))

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PART TWO

INTRODUCING GENDER AND BIODIVERSITY

CHAPTER 2

Introduction to Gender: Issues and Concepts

Dr. Nancy R. Dorsey
Department of Women Studies, MUK

THE GENDER VARIABLE

We live in a gendered world. Everywhere we look, we see differences between how males and females are situated in society, what they do, where they gather in groups, to what degree they have access to and control over resources, etc. Although it is easy to accept as fact that men and women are actually different in some ways and to appreciate the differences, what is increasingly difficult to accept is that women around the world are discriminated against in particular ways simply because they were born female. This last fact is one basis for the global women's movement. In the last quarter century, women from all parts of the globe have begun to meet and talk, to recognise the commonalities in their lives, and to begin to challenge patriarchy – male-dominated society – and women's subordinate position in it.

Society is a construction. It is never static; it is always changing. Gender is also a construction. There is a growing movement to close the gender gap, to built more equity societies where men and women, boys and girls have more equal opportunities and rights. Although more gender equity is a goal of those working for social justice, there is another critical reason for bringing women up. Many in the development field have begun to see that development efforts that leave women in a subordinate position in society do not lead to sustainability.

INTRODUCTION

The Marshall Plan, an aid plan instituted by the United States to speed the rehabilitation of Europe following World War II may be mentioned here. In the years that followed its inception about 50 years ago, the Marshall Plan was used as the model for "development" efforts in the new countries emerging out of colonialism. Development based on "modernisation" has proved less than satisfactory in the LCDs for a number of reasons. Ideas about development have changed a good deal in this half century.

In 1970 an important book, *Women's Role in Economic Development* by Danish economist Easter Boserup, provided a wake-up call to development practitioners that "development" was not gender-neutral. Boserup's book documented a nearly global phenomena, that women and men did not benefit equally from development, but in fact, the lives of many women actually deteriorated in the face of development.

During the United Nations Decade for Women, 1975–85, UN member states were asked to collect gender-disaggregated statistics in order to see how the lives of males and females were differently constructed. These statistics revealed some of the ways in which women's opportunities were limited, in comparison with men. The following statements emerged as a response to this new information:

- Women constitute half of the world's population.
- Women perform nearly two thirds of the world's work hours.
- Women received one tenth of the world's income.
- Women own less than one hundredth of the world's property.

Clearly, many women were disadvantaged and development efforts were not reaching them.

The Nairobi Conference in 1985 served as a watershed for women. Since the beginning of the UN Decade for Women (1975), women were learning how to talk with one another. The global women's movement was born in the process. The ten years plus since the Nairobi Conference have revealed that this event was highly significant for African women who have moved forward on a number of fronts.

Several other UN-sponsored international conferences have begun to address the special problems that women face. The Earth Summit in 1992 highlighted the close relationship between women and the environment. In fact, the links between the women's movement and the environmental movement have had a long history. The 1993 Vienna Conference on Human Rights was the first international forum in which strong statements were made about women's rights being human rights that deserved attention and protection. A major policy change took place at the 1994 conference on Population and Development in Cairo. Prior to that time, family planning had been the major approach in population programmes. The Cairo Conference did not abandon its emphasis on safe family planning programmes, but highlighted the need to raise women's status through education and increased opportunity. There was a consensus that this new emphasis would not only lead to smaller families but to better health and well-being for all family members.

It should not be overlooked that a major paradigm shift has been occurring during this period about how "development" is perceived and approached. The new model for development which puts women in the centre of development efforts – along with men – continues to meet high levels of resistance. Thinking of a world where women are on an equal footing with men is extremely difficult for many who benefit from the present situation.

Initiatives on women and biodiversity is very timely. These should be viewed as part of the changing paradigm. In Africa and in other parts of the world, rural women posses a rich knowledge of the environment in which they live intimately. They are in daily contact with the soils, water, fuel wood, and plant species, and they educate future generations about the natural resources at hand. In fact, the survival of women and their families depends on the women's ability to be devoted caretakers of their environment. For successful preservation of African natural resources, women should be recognised as important managers of the environment, and their knowledge and wisdom sought.

However, many times environmentalists seek out women only to get some work done. It is well known that women in Africa already have workloads that are too heavy. Can we continue to move the paradigm shift along by listening to the women and learning what they know, and at the same time finding ways to lighten their workloads? For Africans who consider themselves serious environmentalists, perhaps the most important work of all is to recognise what women on this continent are already doing to conserve the environment, to acknowledge their contribution and to support their efforts. What is contradictory is that resources for environmental programmes in Africa are rarely used in support of what rural women of Africa are already doing. If the above description of women and the environment in Africa is true, what will it take to shift the emphasis?

As participants in the development arena, we should all be humbled by the overall dismal record of development efforts to date. There is no doubt we are well educated and intelligent. However, for us to achieve sustainable results, it appears that we must do better analysis and get smarter. Something about the way we are doing things needs adjustment. Currently, top-down approaches are being challenged as misdirected. Science and technology consume a large share of the resources available, with what results? Where will the answer come from? The best thinkers in Africa must get busy and find real solutions for sustainable development. What better approach could there be than fully involving your traditional environmental managers who are already on the frontline fighting the daily battle to conserve the resources they need for tomorrow? Of course, that means the women.

The table below which focuses on gender roles and relations provides food for thought.

Gender roles and relations

Women	Men
Work very long hours Use most of their resources for basic development: health, education etc. Do 80% agricultural production in some countries	May work long hours May use resources for basic development No sanction if use resources family well-being for personal consumption
Have limited access to education, training	Sci/tech training for men educ employment & employment op ag extension for men
Sector perceived	of as
Private Traditional The past The problem	Public Modernising The Future The Solution
Resources	invested
not here	here

This table suggests that women work very long hours. Some men also work very hard, but if they do not, society does not sanction them. Women use most of the resources under their control for what is considered basic development. Some men also use their resources for basic development, but if men use their resources for personal consumption, society does not sanction them. Women, the most productive workers, have limited access to education, training, and employment. Science and technology training favours men who also have more educational employment opportunities. The majority of agricultural extension goes to men who are not themselves the agricultural producers. Resources flow to men (away from women) to the sector that is perceived of as public, modernising, the future, the solution. An analysis of the table would suggest that resources are not being invested in support of the most productive workers, i.e. women, or those who are the most committed to basic development.

Gender needs

Moser (1993) describes a critical distinction between practical and strategic gender needs as follows:

PRACTICAL GENDER NEEDS require technical solutions to an immediate perceived necessity. In meeting these needs, existing gender roles are not challenged and there are no moves towards empowerment or equity.

STRATEGIC GENDER NEEDS are political in nature, challenging the relationship between women and men, particularly with regard to the distributions of power and access to and control of resources and benefits. The purpose is to transform the gender division of labour and overcome the subordination of women and men.

EXERCISE	**GENDER NEEDS**	
	Practical	Strategic
Access to credit for household	X	
Access to credit for women		X
Training women in carpentry/mechanics		X
Health care facilities for children		X
Husband writing will in favour of wife		X
Handicraft training	X	
Family planning	X	
Family food provision	X	
Housing and basic needs		X
Participation in household decision-making		X
Literacy classes for women	X	X
Introduction of maize mill	X	X
Earning income for household needs	X	X
Participation in the political process		X
Nutrition/health care training for women		X
Nutrition/health care training for men		X
Universal primary education	X	X

Source: Moser, C O N. 1993 *Gender Planning and Development: Theory, Practice and Training.* NY: Routledge

There is clearly work to be done. Can future environmental programmes be designed to coincide with the realities of rural life? Can bureaucratic short-

sightedness be transformed into new initiatives to support and energise the work Africa's mothers have been doing since time began?

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CHAPTER 3

Introduction to Biodiversity: Definitions and Concepts

Erie S. Tamale
World Wide Fund for Nature

BIOLOGICAL DIVERSITY: DEFINITION

Biological diversity (or biodiversity) embraces the totality of different forms of life (plants, animals and micro-organisms, including the genetic variability within individual species) and of ecosystems. The Convention on Biological Diversity defines biological diversity as *"the variability among living organisms from all sources, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."*

There is a distinction between biological diversity and biological resources. The latter includes genetic resources, organisms or their parts, populations, or any other biotic component of ecosystems. Biological resources are tangible biotic entities such as seeds, genes, maize, fish, elephants, etc. and are only sub-sets of all the earth's genetic resources, organisms or populations, whereas biodiversity refers to the variability among them. There are three levels of biological diversity: genetic diversity, species diversity and ecosystem diversity.

Genetic diversity

Genetic diversity is the hereditary variation within living organisms of specific species, i.e the genetic differences among populations of a single species and among individuals within a population. Genes are the principal units of heredity, passed from an organism to its offspring. Every individual organism has a slightly different combination of genes. Genetic diversity allows species to adapt over time to environmental stresses and makes changes (mutations) possible. It forms the basis of (natural) selection and thus of breeding and other forms of (genetic) manipulation by man, for example for agricultural purposes (varieties, cultivars and strains, including clones and hybrids). Genetic diversity in both wild and bred species is vital. Species and varieties of agricultural animals and crops were transposed from one ecosystem to another over many centuries and wild species in cultivated areas are often under pressure.

Species diversity

Species diversity is the variety of taxonomically distinguished species, whether wild or domesticated. As well as their popular names, species have distinct scientific names (for example the rubber tree is *Hevea brasiliensis)*. Lower-order differences result in sub-species and varieties or, in agriculture, cultivars. There are different ways of measuring species diversity in a geographical area. One example is "species richness", i.e the number of different species occurring within a particular sample area.

Ecosystem diversity

Ecosystem diversity refers to the diversity of ecosystems. An ecosystem is a dynamic functional unit of different living components (plants, animals, micro-organism communities) and processes (photosynthesis, evolution) interacting with their non-living environment (soil, air, water, etc). Ecosystems diversity describes the multiplicity of interactions between species in areas which can be regarded as forming an ecological entity, for example a woodland ecosystem, a savannah, coral or mountain ecosystem. It comprises a community of organisms and their physical environment which interact together as a unit. Systems cannot be defined as precisely as species or genes.

Three partly overlapping categories of ecosystem can be distinguished, based on the degree of change wrought by humans.

1. Natural areas, or wild lands: these are more or less undisturbed wildernesses. Examples are virgin forests or jungles, Antarctica, Serengeti.

2. Semi-natural areas: these are areas in which the natural ecosystem has been changed by man, in which the characteristics of the original ecosystem (for example native species or the structure of the vegetation) are still recognisable. Examples are managed forests (with the laying of roads and selective felling), and areas intensively grazed by livestock such as the Sahel zone.

3. Man-made areas: the ecological characteristics of such areas have been so changed by conscious intervention, such as changes in the mix of species and in the processes, that little of the original structure and few of the original species are to be found there. Examples are plantations, meadow lands, arable land, fish-ponds, villages and cities.

NATURE CONSERVATION AND MANAGEMENT

The terms 'conservation of biological diversity' and 'nature conservation or nature management' are used often synonymously. Biodiversity conservation includes the protection and sustainable exploitation of natural resources and the management of the genetic diversity of both wild and domesticated species. Nature management involves the protection, regeneration and development of both the living and non-living nature. Both terms imply the integration of biological objectives into other sectors. **'Conservation'** embraces the ideas both protection and sustainable use while '**preservation**' is closer in meaning to protection. **'Protection**' is used for saving specific components of the biological diversity, in particular regions and species in reserves and national parks or by means of special measures.

In the Convention on Biological Diversity, the term '**sustainable use**' was defined as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological resources, thereby maintaining its potential to meet the needs and aspirations of the present and future generations.

In situ conservation

In situ biodiversity conservation refers to the management of ecosystems and species in their natural habitats, varying from strictly protected areas (such as national parks and nature reserves) in which a whole range of uses are not permitted, to natural areas which are traditionally managed and utilised by the local population or in semi-natural ecosystems, e.g. cultivated areas, managed for the conservation of genetic diversity on farm. In situ conservation includes the maintenance and recovery of viable populations of species in their natural environment, and in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. A **habitat** means a place or type of site where an organism naturally occurs.

Ex situ conservation

A part of the biological diversity can be stored up elsewhere outside their natural environment (ex situ), for example in botanical gardens, zoos, seed and gene banks and other man-made cultures. This is important, particularly for agriculture and biotechnology. Ex situ conservation results in impoverishment of the genetic diversity and evolutionary processes are halted. Ex situ conservation is complementary and offers additional certainty in situations in which 'in situ' conservation is uncertain.

Protected areas

The conservation of natural ecosystems is the most effective means of maintaining as large as possible a range of biological diversity. A significant part of the natural biological diversity must be conserved in protected areas. These are geographically defined areas which are designated, regulated and managed to achieve specific conservation objectives which vary from no human use to controlled exploitation.

IUCN Categories of Protected Areas (IUCN 1993)	
Category I	Strict Nature Reserve/Wilderness Area: protected area managed for scientific purposes.
Category II	National Park: protected area managed for ecosystem protection and recreation.
Category III	Natural Monument/Natural Landmark: protected area, mainly managed for the conservation of a specific natural phenomenon.
Category IV	Habitat and Species Management Area: protected area mainly actively managed for conservation.
Category V	Protected Landscape/Seascape: protected area mainly managed for the conservation of a landscape/seascape.
Category VI	Managed Resource Protected Area: protected area mainly managed for the sustainable use of natural resources.

Buffer zones

The appointment of effective buffer zones is increasingly tending to form an integral part of the land-use planning around protected areas. Protection is integrated with rural development in these zones. This principle is developed, for example, in the concept of a 'biosphere reserve' with zoning for different degrees of use. The purpose of the buffer zones is:

- the removal of pressure on the protected area;
- the removal of nuisance for the population;
- to allow the population to benefit from the protected areas (in particular hunting).

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CHAPTER 4

Biodiversity Values and Development

Dr. P.M.B. Kasoma
MUIENR

INTRODUCTION

Every living organism is dependent on the functions of ecosystems. Biological diversity is valued differently according to the level from which it is considered (local, national, global) and the criteria applied (material against non-material, commercial versus self-sufficiency, etc.). The non-utilitarian value assigned to nature represents its 'intrinsic value.'

Functions of biodiversity

Information functions. Inherent in biological diversity is the information contained in the vast profusion and complexity of flora, fauna, ecosystems and processes. The millions of plant and animal species on earth each have their own unique genetic composition. The majority of species are still unknown. So far, some 1.7 million plant and animal species have been described. Estimates of the total number of species differ widely; the World Conservation Monitoring Centre estimates the total to be about 12.5 million.

Regulatory functions. The regulatory functions relate to the maintenance of processes within ecosystems. The vegetation on slopes regulates moisture levels and prevents erosion, the so-called screening function; mangrove swamps are important spawning grounds for fish. In an ecosystem there is a balance between the different species due to grazing, competition and predation.

In man-made ecosystems, diversity of species (for example of soil organisms) contributes to balances between crops, biotic and abiotic factors.

Support functions. Every type of organism belongs to a specific community of plants and animals. Ecosystems form a complex of support systems within which plants and animals live: savannah-lands for antelopes and livestock, coral reefs for many species of fish, forests for numerous plant and animal species. If the demands placed by plants, animals or man on the carrying capacity of these life support systems are too great or if the ecosystems are harmed, diversity declines.

Individual plant and animal species also have a support function (for example cattle for certain insects, trees for insects, epiphytes and creepers).

Productive functions. Production and consumption is taking place continuously at all levels. Organisms use products to survive. When man uses these products, it is often at the expense of his fellow organisms.

BIOLOGICAL DIVERSITY AS A BASIS FOR SUSTAINABLE DEVELOPMENT

Agenda 21, a global plan of action that was adopted at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro urges that development at both national and international level should be guided by the principle of 'sustainable development', as defined by the Brundtland Commission: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

A prerequisite for economic and ecological sustainability is the maintenance of biological diversity for human needs, both consumptive and non-consumptive, as well as for its intrinsic values.

The main functions of biological diversity have already been stated to be: the production function, the regulatory function, the support function and the information function. This means that biological diversity forms the basis of sustainable development. Ecological sustainability can only be achieved by a careful evaluation of the relative importance of the functions concerned and by satisfying the ecological conditions for their conservation.

The fight against poverty, which is the first priority in development co-operation, is closely related to economic development, to the maintenance of the means of subsistence, and to an equitable sharing of the environmental space. With the wide range of uses which it provides, biological diversity means a diversity in basic supplies and the spreading of risks for many people in developing countries. Of crucial importance, finally, are the still largely unknown functions and future uses of nature. The conservation of biological diversity therefore means keeping options open for future generations.

Biological diversity forms an essential element of the common heritage of present and future generations in developing countries, and is therefore an integral component of sustainable development (common heritage of humankind).

There are very compelling arguments for an active conservation of biological diversity:

- the living world in all its diversity, provides a livelihood, both present and potential, for mankind;
- the biosphere must be maintained in such a state as not to jeopardise human survival;
- the continued existence of biological diversity should be guaranteed on its own merits, in particular as far as all present species are concerned with their evolutionary potential (World Charter for Nature).

Important reasons why development activities should be actively concerned with maintaining biological diversity are:

- Biological diversity is an essential component of, and a measure of, environmental quality in developing countries.
- The effects of the decline in biological diversity hit hardest those groups which are both most directly dependent on their natural environment and its products and have no resources for protection measures or for alternatives.
- Biological diversity is often greater, both per unit land area and in absolute terms, in tropical and sub-tropical countries than in countries in the temperate climatic regions.
- The geographical origins and centres of biological diversity for many cultivated crops are in the tropics and sub-tropics and these form the basic source for crop improvement.

CHAPTER 5

Women and Coastal Biodiversity Conservation: A Case Study of the Cogtong Mangrove Management Project

Erie S. Tamale
World-Wide Fund

INTRODUCTION

In recent years, there has been growing recognition of the importance of women in natural resources management. Over the years, women have been responsible for propagating various species and cultivars of food and cash crops, conservation of medicinal plants, raising of livestock, planting trees and managing forests for firewood, fruits and resins, as well as conservation of wetlands and coastal ecosystems for subsistence fishing and other products.

In the Philippines, women's key roles in the local economy and support of the households is dependent on the use of local resources. In Cogtong Bay, which is located in the Central region, mangroves and other coastal resources represent a rich and valuable natural resource for both traditional and commercial uses. By providing spawning grounds, mangroves support many fish species, crustaceans and other aquatic biodiversity. Besides, they provide timber, fuelwood, poles, posts and traps. The leaves of the *nipa* – a variety of mangrove, are woven, dried and marketed for roofing of rural houses. The sea-grass meadows in the coastal areas contain valuable marine products such as rabbitfish, mullet and blue crabs.

The widespread use of the mangroves directly contributed to their destruction and the depletion of fish resources in most parts of the Philippines, thus jeopardising the livelihood of many local people, particularly women. The major causal factors are: felling of the mangrove trees for timber; unregulated conversion of mangroves for fishpond development; illegal and destructive fishing methods; and open access to the resource. Besides having a devastating impact on the coastal biodiversity, these factors have created frustration and uncertainty among local people whose survival depends on these resources.

BACKGROUND

In 1989, a project called "Cogtong Bay Mangrove Management Project" was initiated to improve the management of the Bay's coastal resources by organising

local communities to undertake coastal resource management activities. The project was initially (1989–1991) supported by USAID through the Philippines Department of Environment and Natural Resources (DENR), and implemented by an NGO called Network Foundation. The World-Wide Fund for Nature (WWF) – Philippines provided the bridge funding for the continuation of the project from 1991–1992.

The project had three major objectives:

(i) To organise the local communities of eight coastal *barangays* (an administrative sub-division) to undertake coastal management activities.

(ii) To assist local communities to:
(a) rehabilitate 400 ha of mangrove forest;
(b) construct 80 clusters of concrete artificial reef modules;
(c) initiate the culture of commercial oysters and green mussels;
(d) control the use of illegal and destructive fishing methods.

(iii) To identify and test new approaches to mangrove rehabilitation and management.

Women and the use of biodiversity in Cogtong Bay

In Cogtong Bay, like in many other coastal areas, marine biodiversity provides the source of livelihood to the local populations for food, fuel and other products. Women's household roles as providers for family subsistence and their income-generating endeavours are dependent on the availability and quantity of these resources.

Women in Cogtong Bay engage in different activities: fishing, *nipa* weaving, snakeskin trade, fish and oyster-marketing, mariculture and firewood collection. All these activities involve the use of natural resources. Changes in the patterns of women's involvement in these activities often depend on shifts in accessibility to those resources. Declining resource availability, for example, lower fish catches, has often been an important factor for women to seek non-resource-based employment such as running sari-sari stores, providing child care and laundry services and trading.

Fishing and the collection, processing and marketing of marine products such as shellfish, are the key economic activities for women in Cogtong Bay. They reserve a portion of the fish harvest for household consumption and sell the surplus. Farming – backyard gardening and livestock-rearing are the other important

subsistence and wage-earning activities undertaken by women – are also dependent on availability of land and water. The depletion of the coastal resources, therefore, has direct impact on women's roles.

Women's knowledge of local marine resources is quite extensive. They have good knowledge of the various items obtained from the sea including fish, oysters, mussels, clams, sea crabs as well as products obtained from the mangrove ecosystems, including poles, firewood, *tamiloc* (an edible substance from the mangrove trunk), mud crabs, oysters and shells which are used for home consumption and for sale. Generally, women in Cogtong Bay attach greater importance to the economic value of the natural resources than their ecological value. They directly link their concern over habitat loss and resource depletion to a decline in economic activity, for example a decline in fish catch due to dynamite fishing and scarcity of shells due to the illegal conversion of mangroves for fish-pond development.

PROJECT IMPLEMENTATION AND WOMEN'S INVOLVEMENT

The Cogtong Mangrove Management project had four major components namely:

(i) the Mangrove rehabilitation and management component;
(ii) the mariculture component (oyster and mussel culture);
(iii) Artificial Reef Installation; and
(iv) prevention of illegal fishing and construction of illegal fish-ponds.

Community organisations (fishermen's and farmers' associations) were set up in 11 *barangyas*. Each association was headed by officials selected from among the members. Membership was open to men who implicitly represented family membership to the associations. Although very few women were officials of the associations, they often attended and actively participated in the meetings as proxies of their husbands. Men were usually absent, out fishing in the sea. Even when the majority of attendees were women, the decisions taken at such meetings were always upheld.

However, since membership was in the men's names, women were not, in their own right, entitled to the direct benefits provided by the project. For example, they could not be directly issued with Management Steward Certificates (MSC) which guaranteed security of tenure over the rehabilitated mangrove areas managed by the association members. Similarly, they could not obtain access to the credit facilities provided by the association for maintaining the aquaculture of oysters and mussels and for enhancing productivity and family incomes.

Regardless, women actively participated in the four main activities of the project but at varying levels, most in mangrove afforestation and oyster culture and least in establishing artificial reefs. They attended training sessions on how to raise mangrove propagules, they obtained the seedlings from the project nurseries and planted them in the designated areas. Women were the primary workers in the mangrove planting activities. They regarded all the activities as part of their family responsibilities where family members support each other.

Women undertook mariculture as a joint enterprise with their husbands. The men did the more difficult work of installing the stakes in the likely breeding grounds in the bay and hanging the collectors on stakes while women strung together the discarded oyster shells to make collectors and did much of the harvesting, processing and selling of the oysters and mussels produced. Most of the mariculture trainees at the courses organised by the project were women.

The installation of artificial reefs (L-shaped concrete structures that represented an advance over the less permanent bamboo structures) was largely men's work. It involved loading the reefs on boats and dropping them into the bay at designated sites. Women provided moral support and cooked community meals on the days men installed the reefs. Women also participated in preventing illegal fishing and illegal fishponds by reporting any infringements in their areas.

LESSONS LEARNED

The following general lessons about women's involvement in conservation and development projects were learned from this case study:

- Ignoring women's roles in the designing and implementation of projects can result in missed opportunities. There is often considerable advantage in involving women but conscious efforts must be made right from the project initiation to identify their roles, responsibilities and needs. In the Cogtong Bay Mangrove Management project, although women were ignored in the project design, ultimately they were instrumental in its success.

- The views and interests of all stakeholders, especially women, should be sought in the design and implementation of projects. If this had been done in the Cogtong project, the designers would have discovered early the importance of involving women, facilitating them to access the credit and explicitly defining their benefits from the project.

- Women, like men, need direct access to and control over resources in order to benefit fully from project interventions. In Cogtong Bay, women needed full membership in the community associations and ownership of Mangrove Steward Certificates in order to have equal access to the credit needed to enhance their productivity and incomes and in turn act as economic incentives for them to conserve and sustainably use the coastal biodiversity.

- It is important to link the economic value of natural resources to their ecological values so as to make local people aware and to appreciate why conserving biodiversity is critical to their very survival and well-being. In the Cogtong Bay, women's concern over habitat loss and resource depletion was directly linked to a decline in economic activity, for example decline in fish catch and scarcity of shells due to the illegal conversion of mangroves for fishpond development which in turn raised their interest to reverse these processes which threatened their future survival.

CONCLUSION

Women in Cogtong Bay are the principal managers of the coastal biological resources. Because they depend on these resources, directly or indirectly, to meet their subsistence and economic needs, they are concerned about the depletion of the resources. They understand better the economic value of the natural resources than their ecological value and are aware that resource depletion has direct impact on them economically.

Although there was little deliberate attempt by the project designers and staff to integrate women in the project, they became automatically involved in the project because of their central roles in resource management and their socio-economic importance in community life. Even without actually acquiring official membership to the community associations, they attended the meetings, made decisions and undertook the project activities. They were very active in mangrove rehabilitation and afforestation and in adopting mariculture techniques demonstrated by the project staff. However, they were unfairly excluded in obtaining the critical benefits from the project namely, security of tenure over the rehabilitated mangrove areas and access to credit since they were not members of the associations in their own right.

Even without receiving direct benefits provided by the project, women in Cogtong Bay still demonstrated their commitment to the conservation of the coastal

biodiversity. However, they would be more willing to pursue conservation activities if they were combined with opportunities for income generation. A key element of the success of conservation efforts, therefore, is to combine conservation with economic development endeavours of the local communities, particularly women.

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PART THREE

THREATS TO BIODIVERSITY

CHAPTER 6

Threats to Biodiversity and the Underlying Causes of Biodiversity Loss

Erie S. Tamale
World-Wide Fund

INTRODUCTION

Biological diversity in Africa, and many other parts of the world, is experiencing serious threat of decline and extinction. This is manifested by the reduced viability, endangerment and extinction of several species and communities of plants and animals, and by the breakdown in the functioning of ecosystems. Large acreages of forest, wetland, coastal and agricultural ecosystems as well as arid and semi-arid areas have been degraded and as a result several plant and animal species have been lost, others are endangered and genetic diversity has seriously eroded. Available evidence indicates that about 17 million hectares of tropical forest are being cleared annually and scientists estimate that at this rate, up to 10 per cent of the biodiversity in forests may face extinction in the next 30 years.[1]

The current losses of biodiversity have both direct and indirect causes. The direct causes include:

1. Habitat loss and fragmentation
2. Invasion by alien/exotic species
3. Destructive exploitation and over-use of the natural resources
4. Pollution
5. Modern agriculture/forestry
6. Natural factors – climate change, wildfires, natural disasters, etc.

The indirect causes (or underlying factors) include:

1. Population growth and high consumption rates
2. Poverty
3. Inappropriate macroeconomic policies
4. Inequity in resource ownership/management and benefit-sharing
5. Deficiencies in knowledge and its application
6. Poor policies and bad institutional arrangements.

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[1] Reid, 1992; Wilson and Peters, 1988

Often combinations of these processes/factors occur simultaneously, linked by causal relationships. The overall effect is often more than the sum of the partial impacts.

DIRECT CAUSES

1. Habitat degradation and fragmentation

The main cause of the loss of biological diversity is the degradation of natural habitats for plants and animals due to human activities. In many countries, there have been considerable loss and fragmentation of wild lands. The fragmentation of an ecosystem results in the development of 'wildlife islands' in which populations of wild species become isolated from their fellows elsewhere. As a result, the species become more vulnerable to external influences due to reduced genetic diversity and inbreeding. If habitats become too small (without a wider context of large areas), many species are lost.

The loss or fragmentation of habitats can result from:

- the conversion of wild lands into land for agriculture, ranching, industry, roads or housing;
- the drainage, reclamation or filling-in of wetlands;
- exploitational activities which cause extensive damage to ecosystems, such as mining, logging in natural forest ecosystems or the use of dynamite for fishing in coral reefs.

2. Over-exploitation of Natural Resources

Over-exploitation is an important cause of the impoverishment and destruction of ecosystems and species. If meadows are too heavily grazed, for example, their carrying capacity will be exceeded. If too great a pressure is placed on perennial grasses, they do not recover, and in the long run this leads to the degradation and desertification of areas where rainfall is very seasonal. Sea-fishing has already exceeded the sustainable catch rates in a number of important fisheries and are thus threatened. The endangered status of many species is caused by over-exploitation. Examples of threatened species due to over-exploitation include: the fur-bearing animals, e.g. the vicuna, otter and felines; marine turtles which are at risk due to the fact that both their meat and their eggs are eaten; the black rhinoceros whose population has declined by 97 per cent over 30 years (1968: 65,000; 1992: 2,000) and the Indian elephant whose population has reduced by 30 per cent over 8 years. International trade and high market prices for these species or their parts has been

the major stimuli for their over-exploitation. The exploitation methods used also unintentionally harm other species. For example, the use of drag-nets several kilometres in length for fishing results in the death of many marine mammals and birds. Activities in rainforests often have disastrous consequences for the local forest biodiversity.

3. Pollution

Biological diversity is increasingly threatened by water, soil and air pollution. Settlement and industrial areas deposit or discharge large quantities of pollutants, which radically alter the natural environment (water bodies, air, soil etc.), with effects which include: an increase in primary production; changes in the species composition; degradation of vegetation; the development of toxic algal blooms; and adverse effects on the fauna. The discharge of waste by industry and others and the use of fertilisers and pesticides by agriculture can have wide-ranging consequences for biological diversity. Most pollutants eventually end up in the water ecosystems which include high diversity of aquatic life. On the other hand, emissions of the greenhouse gases has resulted in changes in climate. Acid deposition, a consequence of emissions from traffic, industry, power stations and agriculture, is also causing problems for the soil and for vegetation in rapidly developing countries (as has been documented in Brazil).

4. The introduction of exotic species

The introduction of exotic species of flora and fauna can have major consequences for local species. This can occur not only through the inadvertent introduction of 'undesirable' species of animal, but also through the conscious introduction of domesticated species. Islands, with their small populations of often endemic species, appear to be particularly vulnerable. The introduction of exotic species often occurs as an unintended side-effect of agricultural or other production activities. Examples include:

- Virtually all the indigenous flora on the Cape Verde Islands have disappeared following the introduction of goats which systematically devour all the vegetation.

- The giant land turtle population on the Galapagos islands is under threat because rats introduced there eat their eggs.

- The Nile perch, a predatory fish introduced intentionally into Lake Victoria, has led to the disappearance of many native species of fish.

- The water hyacinths are affecting the aquatic biodiversity of many freshwater ecosystems in Africa.

5. Climate change

There are grounds for believing that the emissions of the so-called greenhouse gases into the atmosphere as a result of the combustion of fossil and other fuels and of expanses of forest can result in changes in the earth's climate. It is not known whether complex natural ecosystems will be able to adapt to such a rapid change in temperature and hence in climate. If there is a rapid rise in sea level (1–1.5 metres over a hundred years) this will have major consequences for coastal, delta and estuarine areas, mangrove swamps and coral reefs.

UNDERLYING CAUSES OF BIODIVERSITY LOSS

The root causes of the depletion of the biological diversity are often socio-economic and political. The socio-political acceptance of the need to conserve biological diversity is often still low in many countries and this is contributing to degradation of biodiversity.

1. *The unsustainably high rate of human population growth and natural resource consumption*

Global population will continue to grow for at least the next half century and the rates and magnitude of this growth have serious implications for biodiversity. As numbers have increased, humanity has appropriated an ever-increasing share of the earth's resources. People consume, divert, or destroy an estimated 39 per cent of the terrestrial productivity, a trend which is unsustainable. The world's biotic system simply cannot accommodate an ever-growing claim on primary productivity to meet further growth in human population and consumption. New patterns of development are essential if projected population growth is to be accommodated without straining the planet's carrying capacity.

2. *The steadily narrowing spectrum of traded products from agriculture, forestry and fisheries*

The global exchange economy that has emerged over the past century, based on principles of comparative advantage and specialisation, has increased both uniformity and inter-dependence.

In agriculture, producers now specialise in the relatively few crops that provide an edge in the world economy and as result, the number of crop species declines and traditional agricultural systems die out. The use of fertilisers, pesticides, and high-yielding varieties to maximise production and profits over the short-term exacerbates biodiversity. Similarly, large global markets have fostered the development of what might be called blanket fishing.

3. *Economic systems and policies that fail to value the environment and its resources*

Many conversions of natural systems such as forests or wetlands to farmlands and rangeland are economically and biologically inefficient. There are several reasons for the mis-valuation of biological resources. First, many biological resources are consumed directly and never enter markets. Second, biodiversity's benefits are in large part "public goods" that no single owner can claim. Wetland protection, for example, benefits the public tangibly and quantifiably, but the benefits are so defuse that no market incentives for wetland conservation ever develop. This undervaluation then justifies government policies such as tax incentives that further encourage wetland conversion to use with greater "market" value. Correctly valued, biologically diverse natural systems are major economic assets. But when undervalued, biodiversity conservation is seen as a cost rather than an investment.

4. *Inequity in the ownership, management and flow of benefits from both the use and conservation of biological resources*

In most countries, ownership and control of land and biotic resources, and all the benefits they confer, are distributed in ways that work against biodiversity conservation and sustainable living. The rapid depletion of species and the destruction of habitats are the norm in many countries where a minority of the population owns or controls most of the land. A second problem arises from the concentration of resource control and responsibility for environmental policy decisions being primarily in the hands of urban dwellers. A third issue is the way international trade, debt and technology transfer policies and practices foster inequities that resemble those found within nations. If the developing countries continue to be shut out of international markets, deprived of access to technology, and burdened with debt, they will have neither the means nor the incentive to conserve their resources for the future.

5. *Deficiencies in knowledge and its application*

Scientists still do not have adequate knowledge of natural ecosystems and their innumerable components. Even where knowledge exists, it does not flow efficiently

to decision-makers who have in consequence often failed to develop policies that reflect the scientific, economic, social and ethical values of biodiversity. A final difficulty stems from public reluctance to accept policies that reduce excessive resource consumption, no matter how logical or necessary such policies may be.

6. Legal and institutional systems that promote unsustainable exploitation

Ecological and economic realities clearly call for a cross-sectoral approach to biodiversity conservation and management. Yet, many national and international institutions operate along rigidly sectoral lines. A second problem is the over-centralisation of government and corporate planning, which hinders local implementation, discourages local participation, and closes the process to citizen's groups and non-governmental organisations. A third problem is the structural weakness of most agencies and organisations. Their efforts are commonly fragmented and overlapping; what conservation planning they do is neither comprehensive nor strategic, and they do not integrate *in situ* and *ex situ* conservation tools and technologies. Many developing countries still lack adequate policies, legal frameworks and other instruments for ensuring protection of the environment and the sustainable use of its resources. In many countries, customary laws that conserved biological resources well have been replaced by less effective legal systems. Because of these and institutional constraints, biodiversity conservation has typically been piecemeal and concentrated on traditional wildlife protection techniques.

PART FOUR

STRATEGIES FOR THE PROTECTION AND CONSERVATION OF BIODIVERSITY

CHAPTER 7

Conservation Approaches and Strategies I: In Situ Conservation in Protected Areas

Dr. P. M. B. Kasoma,
Acting Director, MUIENR

According to Chambers' Biology Dictionary, conservation is "the protection of natural ecosystems from the hand of man with the intention of preserving them as heritage or as a practical gene-bank and the wise management of ecosystems, allowing use at a level which does not impair the future capacity to produce".

Humans are gregarious by nature and often the interests of society override those of the individual. This is why throughout history, many societies have recognised certain geographical areas of special importance to them, often protecting them against abuse by individuals through religious sanction. This idea of protected areas has been enhanced in modern times because of the recognition that the human species can be extremely destructive to the **biosphere**, that part of the earth able to support life. Ecologists tend to categorise different parts of the biosphere in various ways in order to facilitate the understanding of its functioning, e.g. a **biome** is the largest land community region, e.g. tundra, savanna, grassland, desert, temperate forest or tropical forest. There is also a conceptual view of a plant and animal community, emphasising the interactions between living and non-living components and the flow of materials and energy between these components known as an **ecosystem**. Ecosystems are normally characterised by **habitats.** Habitats are the localities or sites with a particular type of local environment and occupied by particular organisms. The smallest geographical unit of the biosphere that can be delimited by convenient boundaries and is characterised by a certain flora and fauna is the **biotope**. It is these units: biotopes, habitats, ecosystems and biomes that comprise the biosphere and which protected areas attempt to conserve.

The first "formal" protected area was Yellowstone National Park established in 1872 in the USA. The European immigrants to America wanted to maintain some areas in a pristine condition because they realised that much of the natural habitats they had found were disappearing. The main characteristic of this park was that people were not allowed to live there (except park staff) and this formed the model on which most other countries established their national parks.

The main problem was that with increasing populations, it was difficult to find pristine areas unoccupied by humans. This realisation led to the evolution of various

other types of protected areas that could accommodate the human element, in one way or another. The result has been a multiplicity of types of protected areas.

In order to rationalise the nomenclature of protected areas, the IUCN, then International Union for the Conservation of Nature but now the World Conservation Union, came up with a standardised set of categories in 1978. These have been undergoing reform up to the 4th World Congress on National Parks and Protected Areas in 1992 in Caracas, Venezuela. McNeely *et al* 1994 review these categories.

Over the past 35 to 40 years, the number of protected areas established has continued to rise in spite of mounting pressures of expanding human populations. There is also an increasing recognition that protected areas cannot continue to be "set apart" from humans. They are increasingly being seen as integral to strategic approaches to resource management whereby natural areas would be managed to support development in a sustainable way.

Many countries have declared extensive systems of protected areas and continue to develop and expand them. Approaches have been different in different countries because of varying needs, priorities, as well as differences in legislative and institutional frameworks and financial resources. The common factor is that specific areas are designated as "protected" for a variety of functions, including conservation of biological diversity. This is collectively called *in situ* conservation, literally meaning conservation in the original location.

There are various ecological factors which need to be taken into consideration when designating protected areas, for example, size of the area, whether it has minimum viable populations of the species being protected, nature of land-use in surrounding areas etc.. All these factors need to be considered in order to decide whether the area is viable in the long-term or not.

Having said all that, it would be unreasonable not to mention that protected areas in Africa are having a rough time. There have been moves in recent years to bring people and parks together. A strong consensus is emerging that African parks must involve local people in management decisions, that local people must benefit from parks, and that the support of local people is essential to long-term existence of protected areas in Africa.

The reality is that few parks have applied these new methods. Re-training staff, rewriting management plans, developing community benefits are all expensive activities. Because of the difficult economic circumstances, very few conservation agencies in African nations have had the resources to revamp the protected area system in line with new theories.

With the emergence of National Environment Action Planning and various other Conservation Strategies, various governments are realising the importance of making resources available to conservation. Donor support is also becoming more crucial in conservation efforts. One hopes that with proper planning at national and local levels, conservation and sustainable development will be achieved.

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CHAPTER 8

Conservation Approaches and Strategies II: Ex Situ Conservation Methods

Dr. P. M. B. Kasoma,
Acting Director, MUIENR

INTRODUCTION

It is apparent that *in situ* conservation of species requires large expanses of land which often have to be managed effectively to attain their objectives. It is also true that for some species, the existence of large expanses of land may not be enough to guarantee their survival. Various large mammal species such as the rhinoceros, African hunting dog and cheetah continue to decline dangerously despite the continued existence of viable habitat. It is in such instances that various forms of *ex situ* conservation can be useful. This is a form of conservation whereby species or their germplasm are removed from the natural surroundings and are maintained elsewhere in artificial circumstances. There are a number of ways in which this can be done depending on the species in question.

Gene Banks

Botanists and agriculturalists preserve genetic information and endangered plant species by storing their seeds in refrigerated environments with low humidity. Currently gene banks of most known and many potential varieties of agricultural crops and other plants exist in various parts of the world. Unfortunately, these are mostly in developed countries because gene banks are expensive to maintain. Another problem is that not all species can be preserved in such circumstances.

Botanic Gardens

In many African countries, botanic gardens were initiated by the colonial administrators as a means of introducing crop plants from various parts of the world to determine how well they would perform in the host countries. In many cases this legacy continued well after independence but increasingly, the role of these gardens in conservation of biodiversity is being recognised. Attention is being focused on over-harvested species, rare species and potentially-useful species of plants. Staff of botanical gardens are often engaged in research in nutritional or pharmacological properties of plants. It is possible to collect seeds of threatened species so that they

can be propagated for re-introduction into wild areas where they originally occurred. Gardens that are exclusively devoted to the cultivation of trees and other woody plants are called arboreta (singular: arboretum).

There are about 1,500 botanical gardens and arboreta in the world, holding about 90,000 plant species. They help in preserving some of the world's genetic diversity. However, the storage capacity they have is limited and funding available to them is too little to preserve most of the world's rare and threatened plants.

Zoos and Animal Research Centres

As botanic gardens attempt to conserve plant diversity, so do zoos try to conserve animal diversity. Worldwide, zoos house about 540,000 individual animals. However, most of these belong to species that are not threatened or endangered. Increasingly though, zoos and animal research centres are being used to preserve a representative number of individuals of critically endangered animal species. They do this either by captive breeding or, in the case of some species, egg-pulling. In captive breeding some, or at the extreme all, individuals of a threatened species are taken into captivity and encouraged to breed. The young may then be re-introduced into the wild. This happened for example with the Arabian Oryx which had been hunted almost to extinction in the late 1960s but was saved by captive breeding programmes in American zoos. The Giant Panda is also faced with extinction and attempts are under way to breed it in captivity. Golden lion tamarins, threatened in Brazil, have been bred in the National Zoo in Washington for reintroduction to the wild. In the case of birds, it may be possible to collect eggs from the wild and hatch them in zoos or research centres.

As with plants, keeping populations of endangered animals species in zoos and research centres is limited by lack of space and money. First of all, it is necessary that a minimum viable population be kept in captivity to prevent extinction through accident, disease or loss of genetic variability through inbreeding. Since caring for animals is such an expensive undertaking it is often impossible for individual zoos to keep a minimum viable population. They overcome the problem of inbreeding by co-operating in exchanges of individuals.

Ex situ conservation is encouraged by the Convention on Biological Diversity in Article 9 as an adjunct to *in situ* measures. It is important to realise that, although it makes significant contribution to the conservation of biodiversity, especially as far as critical species are concerned, it cannot be a substitute for *in situ* conservation.

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N.B. Herbaria and Natural History Museums also have a role to play in biodiversity conservation. The visits to the Botany Herbarium and Zoology Museum at Makerere should illustrated this.

CHAPTER 9

Biodiversity Conservation Strategies III: The Community Conservation Approach

Erie S. Tamale,
World-Wide Fund

INTRODUCTION

Over the last couple of years, biological diversity has received significant attention and different approaches to ensure its effective conservation and sustainable use have been proposed. Hitherto, the traditional approach to conserving biodiversity (at species and ecosystem level) has been "protected area management". Many protected areas (PAs) including national parks, forest reserves, game reserves, wildlife sanctuaries and others have been established in almost all countries. Unfortunately, most PAs were established with little or no regard to the local people living in or around them. Protected area management authorities emphasised a policing role and fencing off of the PAs to exclude the local "intruders" (Wells *et al*, 1992). Local people found themselves displaced and deprived of access to resources such as pastures, water, medicines, wild foods etc., vital for their survival (IIED, 1994). This, as expected, created direct conflicts between the local people and protected area managers (foresters, game wardens, park managers, etc.).

It is widely acknowledged that successful long-term sustainable management of biodiversity within and outside protected areas depends on the participation[1], co-operation and full support of the local people (Wells *et al* 1992; World Bank, 1992). Community conservation has been hailed as the plausible approach to meeting the needs of local people while ensuring conservation and sustainable utilisation of biological resources. Several experts have advocated for integrating local communities into protected area planning and management (Lusigi, 1981; Matowanyika, 1989; Kiss, 1990). It has been acknowledged that protected areas cannot co-exist with communities which are hostile to them and that when placed in proper context, PAs can make significant contributions to the welfare of the people living next to them (Hannar, 1992; Barzetti, 1993).

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[1] Community participation is referred to here as the active process of "....empowering people to mobilise their own capacities, be social actors rather than subjects, manage the resources, make decisions, and control the activities that affect their lives" (Cernea, 1985).

PEOPLE AND BIODIVERSITY

Throughout the history of humankind, local people have had intrinsic relationships with the biological diversity around them. These relationships embrace, among other things, cultural identity, spirituality and socio-economic subsistence. Biological diversity has formed an integral part of very survival and well being. Until recently, however, the relationship between local people and protected areas such as national parks has often been ignored by resource managers. In the rush to conserve the remaining untouched areas, governments have decimated the indigenous rights of local people including their cultural diversity, customary land-tenure systems as well as their traditional knowledge and practices (Barzetti, 1993). People have been seen as "intruders" who are engaging in illegal, irrational and environmentally-destructive practices which are incompatible with the protected area management objectives.

Inevitably, direct conflicts between the local people and resource management authorities (including forest officers, park wardens and game guards) have emerged in many areas. Local people have continued to exercise their customary rights to the resources in the protected areas while resource managers, on the other hand, have striven to enforce the strict government resource management rules[2]. Unfortunately, local people have continued to violate the rules, thereby rendering law enforcement less practical and too costly.

Even where some progress has been made in involving local communities in PA management, there are some unfair practices that need to be urgently redressed. For example, the intellectual property rights of the local people who are allowed to remain near or within the PAs are often violated. Ethno-botanists and other scientists have made several discoveries based on the indigenous knowledge and cultures of local people (including traditional healers, hunters, farmers, etc.). However, many scientists have patented their products without due compensation to the original owners of the knowledge (Barzetti, 1993).

The Convention on Biological Diversity recognises the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles as well as their knowledge, innovations and practices which contribute to the conservation and sustainable use of biological diversity. It calls on countries,

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2 For example, in Amboseli National Park and Tsavo West National Park in Kenya, park authorities have been at war with the Masai pastoralists (Wells, et al., 1992) in Lake Mburo National Park in Uganda the Bahima pastoralists were originally denied access to pastures in the park (Kamugisha and Stahl, 1993) while in Zakouma National Park in Chad, local people were obliged to re-settle to new areas (West and Brechin, 1991; IIED, 1994).

knowledge, promote their wider application and encourage the equitable sharing of benefits arising from the use of such knowledge and innovations.

FORMS OF COMMUNITY PARTICIPATION IN CONSERVATION PROJECTS

The significance of community participation in conservation projects depends on **how** it takes place, **when** it occurs in the project cycle, at **what level** and *who among the community* participates. Therefore, in designing strategies for promoting community conservation, it is necessary to analyse the different dimensions and forms of participation, identify the different social actors and determine structural/functional constituents of the local communities as management units (Egger and Majeres, 1992; Cernea, 1995).

Community participation in biodiversity conservation projects can take different dimensions and can occur at different levels depending on: (i) the phase of the project cycle in which the community is involved; (ii) project functions and tasks; (iii) degree of control in decision making; and (iv) methods or procedures used (Tobisson and Rudqvist, 1992).

On the basis of different stages of the project cycle, local communities can participate in the following major activities namely: information-gathering; planning and design; consultation; decision-making; implementation; monitoring and evaluation (Cohen and Uphoff, 1977; Paul, 1987).

Secondly, people can participate in different tasks of a project such as provision of manual labour, for pay, in physical activities such as construction, machine operation, protection and control (e.g. forest protection) etc., or they can be involved in executive management of the project, for example in the maintenance of project assets.

Thirdly, but rarely, local people can be "requested" to participate in decision-making in different ways, including provision of information and viewpoints (e.g. needs/problem identification; priorities and ranking; design of activities; distribution of benefits); making choices between different alternatives/options; having conventional decision-making power with respect to all project aspects; and sharing responsibility for management and control over project resources (Tobison and Rudqvist, 1992).

Finally, participation can take different forms depending on the procedure and method used, e.g. consultation; public meeting; workshop; PRA or participatory research (Salmen, 1987, Chambers, 1992).

CONVENTIONAL APPROACHES TO COMMUNITY CONSERVATION

Since the early 1980s, several participatory approaches to biodiversity conservation have been developed, ranging from passive participation where people have little input into decision-making and control, to active participation where local people are given a chance to take part in joint problem analysis, development of action plans and decision-making. (Pimbert and Pretty, 1994)

Passive community participation approaches are characterised by involving local people in externally-formulated plans or projects to enlist their support to achieve the project objectives, rather than enabling them to share power in decision-making and control (West and Brenchin, 1991). These approaches are aimed at conserving biological resources by minimising opposition by local communities to protected area management legislation and tenure arrangements. Participation is often limited to consultation of local people to provide information or to employment of local people as cheap labour.

Passive participatory approaches have been typified by schemes such as income-generating projects, compensation schemes, revenue-sharing, re-settlement schemes, substitution of traditional practices with modern technologies, and conservation education. (IIED, 1994)

The compensation approach is based on the principle that people will protect wildlife if they are paid to so or if they are compensated (through cash payments, donations, provision of better services or otherwise) for the loss of access to the park resources. It is assumed that by providing compensation, the economic incentive to exploit wildlife illegally will be eliminated.

The second approach that has been widely employed is the creation of job opportunities and provision of alternative income-generating activities (such as bee-keeping, silk farming, tanning, blacksmith, handcraft-making, etc.) for local people near protected areas. This approach is often complemented by providing revolving credit schemes, low interest loans, skills training and community capacity building. This approach is based on the premise that providing other sources of income will remove or minimise the incentive for illegal commercial exploitation of wildlife resources. This approach is currently being experimented in areas surrounding Bwindi Impenetrable National Park in Uganda.

The revenue-sharing approach is also widely employed in many national parks in Africa such as Maasai Mara and Amboseli National Park in Kenya (Talbot and Olindo, 1990). Revenue- sharing activities involve the distribution of cash and non-cash incomes (derived from tourist entrance fees, sport-hunting, game-cropping, etc.) to local authorities to undertake development activities which benefit the whole community (IIED, 1994).

Another commonly-used approach is the substitution of traditional resource management/land-use practices with modern appropriate technologies. This approach is based on the premise that where access to wildlife resources (meat, firewood, timber, water, land etc.) has been denied, provision of alternatives will remove the pressure on the protected area. Some of the modern technologies which have been introduced include agroforestry; new high-yielding crop varieties; zero-grazing; domestic water-harvesting; energy-saving devices and others.

Finally, conservation education has been widely used as an approach to raising dialogue and awareness about the need to conserve and sustainably utilise wildlife resources. It is based on the principle that local communities will be encouraged to practise conservation if they understand and appreciate the importance of doing so. (IIED, 1994)

All these conventional participation approaches have aimed at "compensating" local people for the loss of access to natural resources in the park by providing alternative sources of livelihood and by doing so it is assumed that the economic incentive to exploit wildlife resources will be removed. Furthermore, in all these approaches, local people are treated as passive beneficiaries and are rarely consulted during the planning and implementation of these schemes. This, in the short-term, has provided some positive response from the communities but in the long-term, however, there is little guarantee that such incentives will prevail if the political and economic circumstances change over time. Already, experience has shown that the benefits are rarely equitably distributed, compensation is seldom proportionate to the economic and social benefits forgone and the services provided do not adequately meet the real needs of the people. Therefore, such approaches seem to provide temporary remedies to the problem. The real solution lies in establishing mechanisms for ensuring active and functional community participation.

TOWARDS LEGITIMATE COMMUNITY CONSERVATION

Community participation in biodiversity conservation projects and programmes needs to go beyond the classical passive participation approaches which simply attempt to minimise local community opposition or simply encourage local people

to participate in implementing already designed conservation plans and projects. It should aim at achieving active participation of local communities, particularly women.

Active participation entails enabling local people to contribute to and influence decisions on conservation projects, policies and action plans. It attempts to establish equitable partnerships, so that all stakeholders have an equal opportunity to control and benefit from wildlife resources.

Active participation should have the following characteristics, among others:

- There should serious attempts to establish equal partnerships. Local people should be treated with respect as equal partners and not just "targets" of conservation activities.

- Stakeholders should be given chance to take part in joint appraisal and problem analysis, development and implementation of action plans as well as joint evaluation of performance.

- Decision-making should be shared.

- Local people should be empowered to influence plans and decisions affecting their well-being.

- Building of local institutional capacity should be emphasised.

- Ownership and access rights should be fully transferred to the local people.

- The participatory process should propagate a sense of ownership and strong internal motivation among the local people to contribute to sustainable use of wildlife resources.

- Needs of the less powerful members of the community should not be suppressed by the most powerful.

By and large, four broad principles should guide active community participation in park management and decision-making:

1. Recognition and respect of local community rights and cultures;

2. Local institutional capacity building to enhance the ability of local communities to plan and implement their own initiatives;

3. Equitable sharing of benefits from wildlife;

4. Local empowerment to enable local people to take a leading role in project design, implementation, evaluation and decision-making.

Furthermore, there is need to critically examine the validity of opposing views and interests of the different stakeholders and develop mutually agreed guidelines to existing conflicts. There is also need, on part of resource managers, to fully understand the needs of local communities and how they make resource-use decisions. Community involvement should begin at the project conceptualisation stage and not at the implementation stage.

Moreover, active participation requires joint partnerships rather than the usual quick public consultation ploys; it needs mutual respect for each other's views and interests as well as equality in the decision-making processes. The process of dialogue, collaboration and co-ordination with local communities should be an integral part of the planning and management activities (Barzetti, 1993).

Besides, achieving *bona fide* participation requires resource managers to know the social structure of the community to ensure that as many members of the community as possible are involved and not only the leaders, the rich and local élites (Midgley *et al*, 1986). Conventionally, decision-making and executive action has tended to be taken by small, self-perpetuating cliques of local élites who often act in their own interest and not those of the wider community. It is imperative, therefore, to identify the various stakeholders, including the disadvantaged people in society (the poor, women, children and the disabled) and evolve mechanisms to involve everybody equitably (Cernea, 1991). Strategies are needed to safeguard the participatory process from being dominated and manipulated by the rich, the local élites and the affluent politicians and bureaucrats.

CONCLUSION

The task of re-building the relationship between local communities and resource management authorities after a long history of exclusion, policing and repression, is not an easy task. However, with commitment, on part of resource managers and project planners, to develop and implement strategies that will create long-term incentives and mechanisms for authentic community participation in park management and decision-making, things can change for the better. While continuing to pursue the conventional passive participation approaches as the preliminary step, all effort should be made to realise legitimate community participation by building the local institutional capacity; devolving decision-making

power and responsibility to the local community; maintaining constructive dialogue; ensuring equitable sharing of benefits; and respecting local community's rights, cultures and indigenous knowledge.

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CHAPTER 10

Community Conservation and the Use of Incentive Measures: A Case Study of the Care/"Development through Conservation" Project in Communities around Bwindi National Park[3]

Erie S. Tamale,
World-Wide Fund

INTRODUCTION

Biological diversity, upon which human survival hinges, today faces an ever-increasing threat of total destruction due to several factors including: population pressure, over-exploitation and unsustainable consumption patterns. It is against this background that the world community negotiated and adopted the Convention on Biological Diversity (CBD), to promote the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the utilisation of genetic resources. While past conservation efforts have focused primarily on establishing protected areas and enacting legislation, these efforts alone have had limited success in addressing the complexities of biodiversity conservation. It is in view of this limitation that the CBD, in Article 11, urges each Contracting Party to "*... as far as possible and as appropriate, adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity*", as an essential part of designing effective biodiversity conservation strategies.

This paper describes incentive measures which are being implemented in communities around Bwindi Impenetrable National Park (BINP) in South Western Uganda, particularly the Development Through Conservation (DTC) Project, but also with some reference to the Revenue Sharing Program (RSP) and the Bwindi Impenetrable Forest Conservation Trust (MBIFCT).

Following the designation of Bwindi forest reserve as a National Park in August of 1991, resource users who had earlier been legally allowed to harvest small amounts of both wood and non-wood products from the forest for subsistence, lost access into the forest. Consequently, community hostility towards the Forest Reserve (now Park) reached its peak, adding to the earlier animosity which had developed

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3 This Case Study was carried out by Dr. Yakobo Moyini for the World Wide Fund for Nature (WWF), Eastern Africa Regional Programme Office, under the supervision of Mr. Erie Tamale, a Regional Biodiversity Policy Officer.

particularly between 1986–1987 when the surrounding communities got more upset about the increasing loss of access to the Reserve and the possibility of total exclusion. To compensate the local resource-users for this loss of access rights and to motivate them to enhance biodiversity conservation, the above incentive measures were initiated. These measures were aimed at sentisising the local communities around the park to and making them appreciate the economic benefits of biodiversity conservation through sharing with them benefits from the park, thereby relieving pressure, due to illegal and unsustainable resource use, from the park.

BACKGROUND TO THE STUDY AREA

Bwindi Impenetrable Forest National Park (BIFNP) is situated in South-Western Uganda just South of the Equator (0°53' to 1°8S). It stretches into three districts of Kabale, Kisoro and Rukungiri and lies on the edge of the Western Rift Valley along the Zaire border. It covers an area of 330.8km^2, approximately 5.43 per cent of Uganda's total gazetted natural forest estate. The climate in the forest is characterised by heavy mists and relatively low temperature ranges (7°C to 20°C). BINP is surrounded by a high human population density ranging from 151 to 301 persons per sq. km. The majority of the population is poor and experiences serious land shortage characterised by land fragmentation and absence of fallow periods.

The park comprises a continuous forest cover lying over rugged topography between an altitudinal range of 1160m – 2607m, representing a continuum of lowland to montane forest communities. The park, therefore, has a great diversity of plant and animal species with a number of regional endemics. It supports at least 120 species of mammal, making it one of the forests in Africa with the highest mammalian species richness, including the only few remaining species of Mountain Gorilla (*Gorilla gorilla berengei*) in the whole world. It also supports at least 346 bird species, several of which are regional endemic species, including seven which are listed in the Red Data Book of the International Council for Bird Preservation. It is also estimated that there are at least 14 snake species, 27 species of frogs and 20 species of other reptiles. Although botanical surveys are still incomplete, over 200 species of trees have been identified, ten of which occur nowhere else in Uganda and sixteen of which show a very limited distribution elsewhere.

Bwindi Impenetrable Forest National Park (BIFNP) was originally a gazetted forest reserve, managed by the Uganda Forest Department in the Ministry of Natural Resources. However, due to its importance as a biodiversity-rich area and being home to the rare Mountain Gorillas, it was decided to designate it as a national park in 1992 under Uganda National Parks (UNP) and now Uganda Wildlife Authority (UWA) in the Ministry of Tourism, Wildlife and Antiquities. The other major

actors in and around BIFNP include: district administration; local councils; parish park management committees (PMACs); and NGOs such as CARE International, World-Wide Fund for Nature (WWF) and African Wildlife Foundation (AWF).

THE DEVELOPMENT THROUGH CONSERVATION (DTC) PROJECT

Conservation efforts in Bwindi Forest have historically faced a variety of obstacles largely deriving from conflicts of land-use interests whereby local communities have wished to continue utilising the natural resources as they have done traditionally over many years. Between 1986 and 1987, that is prior to becoming a National Park, community hostility towards the Forest Reserve increased when local people got upset about the increasing loss of access to the reserve and the possibility of total exclusion. In 1988, WWF-US supported the Impenetrable Forest Conservation Project (IFCP) with the primary aim to halt encroachment into the Bwindi Impenetrable Forest so as to conserve the habitat of the Mountain Gorilla. WWF-US sub-contracted CARE/Uganda to assist with carrying out "out-of-forest" extension services and, through the DTC project, to win community support as a complement to the forest conservation efforts.

From 1991 onwards, CARE/Uganda in Phase II of the project introduced the integrated conservation-development approach to facilitate the conservation of the forest park as well as meeting the development needs of the local communities. This phase is aimed at promoting sustainable agriculture, soil conservation, and watershed management in the areas around BIFNP with the view to increase farmers' cash incomes, provide alternative occupations and replace products and services lost as a result of the creation of the national park. The project was implemented under the following components:

a. *Community Conservation Component* consisting of the following sub-components:

(i) Multiple Use Approach – allowing limited access by communities to harvest selected resources in BINP;

(ii) Vermin Control – to counter conflicts with neighbouring communities by supporting UNP erect a boundary wall;

(iii) Community Conservation Awareness devoted to changing people's attitudes and knowledge about forest conservation and sustainable agriculture;

(iv) Community Project Support – to develop community capacity to manage projects;

(v) Institutional Development – facilitating the organisation of Forest Societies and Park Parish Committees to be organised and supporting the Park Management Advisory Committees; and

(iv) Catchment Approach – a watershed conservation/management intervention still in its pilot stage.

b. *Park management* – involving institutional capacity building; re-organisation of law enforcement and preparation of park management plans.

c. *Development* – including establishment of development and conservation committees; on-farm planting of forest species; establishment of tree nurseries; establishment of woodlots; establishment of exotic trees on farm; establishment of vegetable nurseries; improved soil conservation; improved banana management; improved bean varieties; improved potato varieties; improved cooking stoves; development of village-level community action plans.

The DTC project was established after fairly good consultations with the different actors including; Government Departments (the Department of Environment, Forest Department, Uganda National Parks, Ministry of Finance and Economic Planning (MFEP), Ministry of Agriculture, Animal Industry and Fisheries-MAAIF), District Authorities, Local Councils, and NGOs/donors including; WWF, CARE and USAID. The local people were involved in the project formulation and have continued to participate in the implementation of the project, mainly through four local institutions namely: the Park Parish Committees (PPCs); Park Management Advisory Committees (PMACs) comprising the chairpersons of the PPCs; the Forest Societies; and the Beekeepers' Association. CARE, is providing technical assistance to the PPCs in the preparation of village-level development action plans. Those activities falling within the mandate of the DTC project are supported, while the remainder are referred to other support agencies/organisations in the project area.

The rights and responsibilities of the different stakeholders and collaborators are defined, at the national level, by the Project Coordinating Committee (PCC) comprising UNP, CARE, USAID, GMU, MFEP, MAAIF and MGCD and at the district level by the Project Technical Committee (PTC) comprising the Chief Administrative Officer; District Agricultural Officer; District Forest Officer; District Environment Officer; and the Chairman, Local Council V. At the community level, it is the Park Parish Committees; Park Management Advisory Committees; the Forest Societies; and the Beekeepers' Association.

Objectives and Effectiveness of the DTC project as an Incentive Measure

The ultimate long-term goal of the DTC Project is to promote the conservation of biodiversity and the sustainable use of its components in and around BINP in perpetuity for the health, welfare, enjoyment and inspiration of present and future generations. The intermediate objectives are to provide development/livelihood alternatives to the local communities so as to compensate for the benefits forgone by losing access to the park and by doing so to reduce the hostility towards the park and instead create better understanding of the benefits of biodiversity conservation.

The effectiveness of the DTC Project, in general, was assessed during an end-of-term evaluation which was carried out in January, 1996 and presented in the Evaluation Report (Metcalfe, 1966). Generally, it could be said that the project, as a non-monetary incentive measure for promoting the conservation and sustainable use of biodiversity in the areas around BIFNP, has, to a large extent, been effective. It has succeeded in making people around the park more aware of the need to conserve both the forests and the farmlands and has contributed to changing their attitude towards conservation. Secondly, the development component of the project has enabled farmers to increase the sustainable production and use of goods and services from the park and the farmland, thereby compensating for overall community hostility due to the gazetting of the forests into national parks and their subsequent loss of access to the forest resources. Finally, the project has helped to harmonise the relationship between UNP and the local people. UNP is now seen as a real partner to the local communities. From a hostile beginning a few years back, UNP now has a forum within which to meet and discuss with local communities.

IMPORTANT LESSONS LEARNED

- Before advising on an incentive measure for biodiversity conservation it is essential that a prior, detailed study is undertaken to identify the underlying conservation problems. Where it is felt that direct monetary benefits (e.g. through endowment funds or resource-revenue sharing) is the ideal incentive measure, the size of such funds should be sufficient so as not to undermine the credibility of the incentive measure.

- Depending on scale, successful incentive measures may require a concerted effort by several partners: the local community, government donor agencies and non-governmental organisations.

- Compensation is an expensive form of incentive measures and it may not be a sustainable measure in a number. A combination of modest direct

monetary benefits with an integrated conservation and development project is a more effective incentive measure for reducing human pressures on protected areas.

- For local communities to be equal partners in the implementation of positive incentive measures, considerable time has to be devoted to the development of community institutional structures.

- It is important to ensure that the definition of beneficiary communities or customers is all inclusive and equitable.

- The existing national sectoral and cross-sectoral policies and legislation need to be reviewed to assess their adequacy or appropriateness before introducing new incentive measures for biodiversity conservation. As indicated in this case study, for example, some of Uganda's current policies and legislation have some useful indirect incentive measures explicitly or implicitly aimed at biodiversity conservation. What may be required for purposes of Article 11, is to amend or improve upon them.

- NGOs are in a more strategic position than government to implement incentive measures aimed at the conservation of biodiversity because of their mode of operation, the trust often placed in them by the grassroots people, and their close proximity to rural communities. They can play a big role in building the capacities of local institutions in order to enable them to negotiate better the terms and conditions with government.

CONCLUSION

Until recently, the concept of using incentive measures to promote conservation and sustainable use of biological resources has not been widely pursued in Uganda. A few initiatives, however, have been introduced, for example, in the communities surrounding BIFNP including the DTC project, the UNP Revenue-Sharing Programme and the Mgahinga Bwindi Impenetrable Forest Conservation Trust (MBIFCT). This paper has described the DTC project, with some reference to the RSP and MBIFCT, indicating the various indirect non-monetary incentives that have been introduced to encourage and motivate the local communities to conserve and sustainably use biodiversity. This has been done through providing development/ livelihood alternatives to the local communities as a way of compensating them for the benefits they forewent by losing access to the park and, by doing so, reducing the hostility towards the park and instead creating better understanding of the economic benefits of biodiversity conservation. The DTC project is a unique and

innovative indirect incentive measure in the sense that, while ultimately aiming to achieve effective conservation and sustainable use of biodiversity, it has, at the same time, sought to meet the immediate development needs of the local communities.

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PART FIVE

INNOVATIONS IN BIODIVERSITY

CHAPTER 11

Biodiversity Research Innovations I: Biodiversity Identification and Monitoring

Dr. P .M. B. Kasoma
Acting Director, MUIENR

Inventories of species at particular sites are essential data sets for conservation and resource management. One needs to know what biodiversity there is in a given area before developing management plans for that resource.

However, it is important to recognise that undertaking thorough surveys is not an easy task. Usually, such surveys reveal large numbers of species, many of which may be undescribed, particularly invertebrates and lower plants. The formal determination of species names can take a long time and, in those groups where the formal taxonomy is poorly developed, may not be possible.

For well-known taxa such as vertebrates and flowering plants, it is relatively straightforward, using experienced biologists (taxonomists), to make an inventory of an area and establish what species occur there. Methods vary for different taxa but species lists are the ultimate results for the different methods. It is important to recognise, however, that vertebrates and flowering plants make up less than 20 per cent of all named species (Wilson 1989). The problem is that we do not quite know the relationships between vertebrate and flowering plant species richness to total biodiversity. It is therefore difficult to establish whether a high vertebrate and flowering plant species diversity corresponds to a high overall biodiversity. Despite this, however, various methodologies have been developed for biodiversity identification. The main ones include the following:

Use of Recognisable Taxonomic Units (RTUs)

RTUs are taxa that are readily separable by morphological differences that are obvious to individuals with less training than professional taxonomists. Such people are called biodiversity technicians in some countries and parataxonomists in others. They work with professional taxonomists to carry out biodiversity assessment.

Use of Indicator Species

Another method is to use several indicator species. A number of taxa may be selected and then specialists in those taxa are used to identify species within those taxa in a particular area. A ranking system can then be used to identify areas of high, medium or low biodiversity.

The methods above are field methods. Accurate identification of biodiversity requires a wide variety of specialist taxonomists who are often not easy to come by. They are usually based in institutions such as universities, research centres, museums of natural history and herbaria. Conventional biodiversity surveys are very demanding in terms of time and resources. It has been estimated, for example, that if the description of new species, using traditional methods, continues at the same rate with the same number of taxonomists as today, the cataloguing of global biodiversity would take several thousand years to complete! (McNeely *et al* 1990).

For practical purposes therefore, most researchers today are using the most convenient taxa as a basis for taxonomic surveys, e.g. birds, mammals, amphibians, butterflies, higher plants and a few others. It is important to note though, that flowering plant and vertebrate biodiversity is not an accurate indicator of the species richness of invertebrates (Oliver & Beattie, 1992).

Monitoring

In natural resources management, it is often necessary to take stock of what resources are available in order to establish the trends; whether the resources are increasing, decreasing or static. When managing biodiversity therefore, it is essential to monitor at regular intervals to enable correct decision-making. It is possible to monitor ecosystems, particular vegetation types, communities or species. Monitoring methods will depend on what is being monitored. The key issue is that there should be a specific purpose for which the monitoring is being done so that one knows exactly when the monitoring should end.

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CHAPTER 12

Biodiversity Research Innovations II: Ethnobotanical and Ethnopharmacological Research

Dr. Bukenya Ziraba
Botany Department, MUK

INTRODUCTION

Ethnobotany can be defined as the botanical study of local people's perception of the cultural and botanical knowledge including, for example, the local names given to plants and the various ways in which plants are classified and used by the people.

Ethnoecology is increasingly used to refer to all studies describing local people's interaction with the natural environment, including ethnobiology, ethnobotany, ethnoentomology, and ethnozoology. Hence, ethnoecology is a very broad discipline.

Most ethnobotanical studies are carried out in rural areas, especially forested areas, studying how the people in these areas use the plant resources. This is mainly because forests have an abundant species diversity and are major conservation targets. However, ethnobotanical studies can be done in non-forested areas or in non-rural areas like the study of plants sold in urban markets.

Ethnobotany began largely with direct observations about the ways in which people used plants and consisted mainly of compiling lists of plants used. Today a much more scientific and quantitative approach has been adopted, studying ways in which people manage their plant resources. Ethnobotany should ideally be a collaborative venture between people in the local communities, including various experts and scientists in the fields of plant taxonomy, phytochemistry, economic botany, ecology, anthropology, sociology and many other fields. However, normally ethnobotanists carry out studies individually but such studies should be as broad as possible.

THE PEOPLE AND PLANTS INITIATIVE

This is a joint project of the World-Wide Fund for Nature (WWF),UNESCO and Royal Botanic Gardens, Kew (U.K.). The main objective of this project is to build up the capacity for work with the local communities on botanical aspects of conservation especially in countries with tropical forests. Demonstration projects are

run in several tropical countries including Uganda, i.e. Bwindi Impenetrable Forest in S.W. Uganda and the Rwenzori Mt. Forest National Park.

The interest is in learning about the local community knowledge about plants and the uses of plants by the local people. This includes finding out which groups of people use which species, in which quantities and for what use. Such studies can lead to the identification of conservation problems, e.g. where utilisation is greater than the rate of regrowth this indicates an over-exploitation and the danger of depletion of the plant resources. In the poorer countries, many people depend on collection of plants for food, construction, firewood, medicine, handcraft, etc. (see attached sheet). As the human population grows, the pressure on resources increases and today the availability of wild plant resources is decreasing.

Ethnobotanical surveys or inventories can assist the local people to assess their requirements for plants and defend them for the continued access to given areas of land or to suggest alternatives to the wild plants.

Local communities have a lot of knowledge about the local plants and other natural resources, especially those on which they directly depend. Much of this knowledge is getting lost as traditional cultures disappear. Ethnobotanists can thus be very useful in assisting to preserve this knowledge and return it to the local people.

DISCIPLINES THAT CONTRIBUTE TO ETHNOBOTANICAL STUDIES

The fields of study that contribute to analysing how humans interact with the plant world are: botany, some linguistics, anthropology, ethnopharmacology, ecology and economics. Techniques borrowed from the above fields can be combined to carry out a systematic survey of the traditional botanical knowledge in a single community or region.

There are four main interrelated undertakings in ethnobotany, i.e.:

1. Basic documentation of traditional botanical knowledge, i.e. *Basic Ethnobotany.*

2. Quantitative evaluation of the use and management of botanical resources, i.e. *Quantitative Ethnobotany.*

3. Experimental assessment of the benefits derived from plants both for subsistence and for commercial ends, i.e. *Experimental Ethnobotany.*

4. Applied projects that seek to maximise the value that local people attain from their ecological knowledge and resources.

Rapid Ethnobotanical Appraisal

At times it is necessary to make a rapid ethnobotanical study (rather than a long-term project) to gather data for example on minor forest products for an environmental impact statement, make a preliminary list of biological resources at particular sites or conduct an initial ethnobotanical inventory in several communities in order to decide whether it would be most interesting to carry out long-term research.

Studies that last for a few days have disadvantages of:

1. Not allowing a deep working relationship to develop between the ethnobotanist and the community;

2. Not being possible to document carefully the cultural and biological aspects of local knowledge, for there is little time to make voucher collections, transcribe local names or talk with a range of informants;

3. Not allowing the local people (the visits being short) to learn rigorous ethnobotanical methods that would allow them to manage more effectively resources in their own community.

However, there is always the urgency of making quick assessments of ecological knowledge and resources while rapidly teaching local people some of the basic techniques we employ.

Various methods have been improvised for making a fast low-cost assessment of the use of forest resources and many other aspects of community development. Techniques have been adopted from various disciplines and combined to form a collaborative approach called "Participatory Rural Appraisal (PRA)".

Such a study using PRA would, for example, last for a few days in which a multi-disciplinary team can carry out a rapid appraisal of, say, forest regeneration and harvesting of non-wood forest products, with the members of the community.

First, the participants select several 100 m^2 plots showing various degrees of protection from deforestation. An inventory of the trees in each plot is made

determining the species and recording the size of each individual. In such a study, local and non-locals with strong ties to the forest can identify hundreds of productive species and how they are used as sources of foods, medicines, fibre, construction materials, gums, dyes, tannins, etc.

By use of secondary data and local resource persons, such information can be documented in the case study sites. Lists are made for all products used for home consumption or sale. Data is collected on harvesting seasons and volumes and determine the parts of the plants used, determine scientific names (Latin) and, where possible, get an idea of the market prices of the items. PRA borrows many of its tools from traditional disciplines, e.g. rural sociology, anthropology, ecology and economics. However, it is different from academic research in that:

1. Local people are full participants in the study but not objects of investigation;

2. Local people take part in the design of the study, data collection, analysis of the findings and discussions of how the results can be applied for the benefit of the community;

3. Outsiders in the research team have a variety of academic backgrounds, ensuring a multi-disciplinary perspective;

4. The relationship between all participants, local and outsiders, is egalitarian, avoiding the hierarchial or top-down approach common to much research;

5. Techniques can be carried out in a short time and do not require tools, for the participants are seeking a sketch of local conditions rather than an in-depth study;

6. A small group of local people is selected for preliminary interview in a semi-structured way, covering a wide range of topics, allowing a comprehensive view of how the community works as a whole;

7. Measurements are qualitative rather than quantitative and a few statistical tools are used in the interpretation of the results;

8. Emphasis is on highly visual techniques that the community members can carry out amongst themselves often in collaboration with outside researchers, e.g. sketching maps to show local classification of ecological

zones, making pie-charts that represent activities or drawing calenders which show seasonal variation in climate;

9. Analysis of the data is carried out in the community which allows participants to modify their methods on the spot and fill in any data which are missing after the initial field work;

10. It is a cost-effective approach enabling the accomplishment of a lot in a few days, including write-up of the final results and recommendations;

11. It allows flexibility, allowing the approach to be adapted to the very diverse cultural and ecological conditions under which ethnobotanists work.

When planning a rapid ethnobotanical assessment one needs to:

1. Prepare before field work: get secondary information – maps, floras, faunas, vegetation analysis, census statistics, reports on forest use. Whenever possible, the people should participate in the collection of the secondary sources of information;

2. Form a multi-disciplinary team – linguist familiar with the local language, botanist, anthropologist and other researchers who have worked in the area;

3. Ensure community participation – seek full co-operation and permission of local authorities who would recommend the local experts;

4. Be selective in choice of techniques – concentrate on methods that will yield the required information in the appraisal;

5. Do everything systematically – the appraisal should produce data which others who wish to conduct a thorough study can use and add to them. Maps of sites visited, names of the local people who participated, accurate identification of biological species encountered, sample questions used in the semi-structured interviews. Conclusions, drawings, charts or graphics created in the study should be presented in the final report written in an accessible style to a wide range of people, including the local participants.

LONG-TERM ETHNOBOTANICAL STUDIES

After carrying out a rapid appraisal one may continue research for a long period, i.e. a few weeks, season(s) or several years. In such a study, more rigorous research methods are applied. Staying in the field for a long period allows working with the local people to record ecological knowledge in a variety of social contexts, e.g. community festivals, ritual occasions and seasonal farming activities.

The minimum standards considered in a long-term ethnobotanical study are:

1. Collection of specimens of all species represented in the study, their identification and final deposition in an herbarium, museum, seed bank or similar facility. Detailed notes on specimens should be supplied on the labels (sample of label).

2. All local categories of plants should be identified and information collected on distribution, use and management of the corresponding botanical species. The cultural information should be confirmed in discussions with a cross-section of community members including: rich and poor, young and old, men and women, etc. of various ages, education, occupation, language and other personal data of the study participants.

3. All local plant names should be accurately transcribed and the names may be recorded on a tape so that other researchers can review their accuracy.

4. Each plant or animal population sampled for analysis in a lab or research centre should have a voucher specimen.

5. The local perception and classification of various aspects of nature should be recorded, e.g. concepts of vegetational communities, soil types, geographical landmarks, climatic zones and seasons.

6. The economic value of biological resources should be estimated. Prices and availability of plant and animal products sold in rural markets, time spent by people in harvesting the resources, estimated cost of transporting the products to the markets should be recorded.

7. The data should be analysed using standard data analysis methods, e.g standard computer packages, e.g. SPSS, Minitab, Flance, Excel etc. and presented appropriately.

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CHAPTER 13

Environmentally-Sound Technology Assessment and Transfer for Biodiversity

David L. N. Hafashimana,
MUIENR

Abstract

One of the largest problems facing humanity today is the balancing of population growth, biodiversity conservation and economic development. In the course of trying to overcome these problems, more problems may be created which may threaten the survival of the very species the programmes were meant to protect. Modern biotechnology which, according to its proponents, is a safe efficient way to produce higher agricultural yields from less land, in addition to pharmaceutical products, has proved to have serious ecological health and socio-economic hazards. There is a fear that, driven by the profit motive, some unscrupulous companies could use the developing countries as testing grounds for insufficiently researched biotechnologies that could pose a threat not only to biodiversity but to human health as well. There is need for an international regulatory mechanism to streamline (especially trans-boundary) transfer and handling of products of biotechnology, especially genetically-engineered organisms in order to save the future. Governments, especially in the Third World, need to build up capacity in biotechnology to assess and manage any potential risks if we are to benefit from technology transfer.

INTRODUCTION

The Convention on biological diversity, which was signed in Rio de Janeiro in 1992 and ratified by most of the world's governments ever since, has the main objective of saving the world's biodiversity. To preserve biodiversity, the growth of the world's population must be controlled and wild natural ecosystems must be conserved. Modern technological advances provide tools for producing more food and fibre from less land, thereby addressing the need for biodiversity conservation. One of the technological tools to boost agricultural production is genetic engineering. According to BIO (Biotechnology Industry Organisation), "more than 7,000 successful field tests around the world have demonstrated that genetic engineering is a safe, efficient way to produce higher yields from less land".

For today's developing countries to become economically viable, they need a strong agricultural base. However, as the poor struggle to survive, protecting the

environment becomes a secondary concern. But a viable agricultural economy can alleviate poverty and hunger which tear apart the environment in developing countries. From what has been done in the past decade, biotechnology will have a profound effect on the ability to provide organisms with many new properties. Hopefully, it will be possible to provide plants and animals with enhanced resistance to pests and diseases; have modified protein and oil content; and have improved nutritional properties; resistance to environmental stress such as drought, high salinity, or cold. Biotechnology also has a potential of providing new pharmaceuticals and other substances synthesised *in situ* within crop plants or animals in environmentally-acceptable ways.

However, the introduction of foreign genes derived from unrelated organisms into crop plants and even synthesise genes in the laboratory has raised concern among some people. For example, the insertion into plants of a *Bacillus thuringiensis* gene responsible for the production of an insecticidal protein may give rise to the evolution of insecticidal resistance in insect pests, triggered by continued exposure to insecticidal properties in transgenic crops.

The potential of biotechnology

In an attempt to reduce on the amount of chemicals applied in agricultural fields while at the same time increasing yields, research is being conducted to produce pest and disease resistant crops.

Examples of on-going work

1. **Paw paws**: In Brazil, which is one of the major producers of papaya in the tropical world, transgenic technology is being used to develop Ring-spot (the major disease affecting the crop) virus-resistant papayas. If successful, this could increase production in Brazil and later in other producing countries.

2. **Cotton**: Cotton growing in the Third World is affected by the multiplicity of pests, making it the highest user of insecticide compared to other crops of the world. In Brazil, selected personnel have been equipped with the training necessary to develop an insect-resistant cotton. They are using *Bacillus thuringiensis* (Bt), a naturally-occurring bacteria in the soil that produces proteins toxic only to certain insects. Growing of genetically-engineered, insect-resistant cotton could lead to a significant reduction in

insecticide application, hence a reduction in costs and the associated pollution.

3. **Tobacco**: In an attempt to provide for their high population, China has invested heavily in Biotechnology. Consequently, China has produced genetically-modified tobacco since 1992. Heavy metals like Cadmium pollute farmlands in China. Researchers from Peking University have developed a transgenic tobacco plant that absorbs Cadmium. It is hoped this technology will clean up their environment so that farmers can harvest crops without heavy metal contamination.

4. **Banana, Pineapple and Melon**: In Costa Rica, research is being done on these crops. It is aimed at producing banana and pineapple that will produce more fruit in less time. For the melons, the aim is to impart resistance to the Cucumber Mosaic Virus. This technology could later spread to other countries thereby boosting production.

5. **Potato, Corn, Cucurbits and Tomato:** Research is under way in Egypt to introduce, through genetic engineering, resistance to the potato tuber moth. The resistance gene is again from *Bacillus thuringiensis*. With corn, research is aimed at imparting resistance to the various species of stem borers that wreak havoc on Egypt's corn production. Work on cucurbits is aimed at imparting resistance to virus infection while research on the tomato is supposed to transfer resistance to the yellow leaf curl, a viral disease.

6. **Corn, Pineapple, Coffee, Bananas and Ornamental plants, Rice, Irish and Sweet Potato, and Peanut:** In Indonesia research is being done on various crops, in addition to training local scientists in genetic engineering. Research is being done on the following crops as outlined below:

   (a) ***Corn*** – Research is being done on corn borer-resistant maize.
   (b) ***Pineapple*** – Improvement of yield and quality to make them more economically feasible.
   (c) ***Coffee, Banana and Ornamental Plants*** – Improvement in propagation techniques.
   (d) ***Rice*** – Biotechnological research.
   (e) ***Irish and Sweet potato*** – Research is aimed at developing disease-free planting materials and imparting insect resistance respectively.

(f) ***Peanut*** – research is aimed at producing peanut cultivars resistant to peanut stripe virus.

7. **Sweet potato:** One of the greatest plagues affecting the sweet potato crop in Africa is the Sweet Potato Feathery Mottle Virus (SPFMV). In Kenya, research began in 1991 aimed at producing a potato resistant to the SPFMV. The task is to add virus resistance to locally-adapted sweet potato varieties grown by African subsistence farmers. If successful, this research could make a major contribution to food security for some of the poorest farmers of the world.

8. **Timber, Rattan and Bamboo, Rice, Papaya**

(a) ***Timber, Rattan and Bamboo*** – The development of the forestry sector is often hampered by lack of planting materials, due to the long periods taken to produce seed. Vegetative propagation techniques are being developed in Malaysia to overcome shortage of planting materials and to provide a rapid means of propagating superior genotypes. Rattan and Bamboo are being micro-propagated. This technique could be a viable technological option for the Third World, considering the ease to store large quantities of planting stock without interfering with utilisation of the mother stock, in addition to having fewer uncertainties since there is no genetic alteration.

(b) ***Rice*** – In the same country, research is being done on rice using genetic engineering to provide protection against the Rice Tungro disease which often devastates the crop.

(c) ***Papaya*** – Research is being carried out to impart resistance to papaya Ring Stop virus, through genetic engineering.

9. **Biotechnology development in South Africa**: In South Africa, the main thrust of the plant Biotechnology programme has been the isolation of novel genes for crop improvement, especially fungal, insect and drought resistance; plus development of transformation systems for specific crops. Work is under way on herbicide resistance in soya beans; modifying tomatoes; genetic manipulation of maize; and improvement of sunflowers.

Other work includes:

(i) Improved rooting for seedlings and development of somatic embryogenesis for propagation of commercial tree varieties;

(ii) Investigation of local germ plasm for valuable pharmaceuticals; viral resistance in local ornamental bulbs, cucurbits and potatoes;

(iii) Fungal resistance genes for cotton and tobacco; and

(iv) molecular markers for grasses, grapes, potatoes and alfalfa; *Bacillus thuringiensis* (Bt) genes for cotton boll worm and herbicide resistance in soya bean, and many others.

10. **Other initiatives**: Genetic engineering research is being done with funds from the World Bank, European Union, Zeneca Plant Sciences and the University of Belgium, using anti-fungal proteins to confer resistance to Black Sigatoka disease (a fungal disease) in both bananas and plantains. Though directed to all banana and plantain-producing countries worldwide, the largest research effort on plantains is in Nigeria and on bananas in Honduras. Fungi resistant bananas and plantains will decrease the use of chemical fungicides.

The need to regulate and control genetic engineering (biosafety)

In nature, whenever an organism evolves, it co-evolves with its natural enemy that is adapted to living with it and somewhat regulating its population growth. This naturally ensures that no species can become a noxious weed and pest, unless the natural control mechanisms have been tampered with. The creation of transgenic organisms through genetic engineering could therefore pose some ecological problems, since it is often not possible to duplicate field conditions in the laboratory.

The new biotechnology based on genetic engineering makes the assumption that "each specific feature of an organism is encoded in one or a few specific, stable genes so that the transfer of these genes results in the transfer of a discrete feature". However, this extreme form of genetic reductionism has been rejected by the majority of biologists, and many other members of the intellectual community because it fails to take into account the complex interactions between genes and their cellular, extracellular and external environments that are involved in the

development of all traits. It has thus been impossible to predict the consequences of transferring a gene from one type of organism to another in a significant number of cases.

Of particular concern is the difficulty or impossibility of recalling GEOs that have been either deliberately or accidentally released into the environment and later found to have adverse effects. The release of GEOs into the environment has a potential to disrupt radically the dynamic pattern of functional relationships which underpin both evolution and ecological stability.

Whereas it is known that some traits of organisms take decades to manifest themselves ecologically, observations of most GEOs cover only a few years. An organism declared safe in the short run could prove hazardous in the long run.

Ecological, health and social risks of genetic engineering

Several years of research and analysis have found that there are serious potentials for adverse effects of genetic engineering and Genetically Engineered Organisms (GEOs) on the environment and on human health. The ecological risks of applying genetic engineering to agriculture include the possibility that some transgenic crops could become noxious weeds and affect wild ecosystems. Plants engineered to express toxic substances such as insecticides and pharmaceutical products could poison non-target organisms, including beneficial ones.

The use of conventional pesticides involves intermittent exposure of the pests to the toxins, when an attack is eminent, as opposed to when the pesticide genes are engineered in the plant. In the latter case, the toxin is continually produced and the pests continually exposed to it. Under such conditions, an extremely strong selection pressure is created in the pests for the rapid evolution of resistance to the toxin. In the process of the pests reacting to the selection pressure towards survival, they would adapt new survival strategies adapting their behaviours as well as their genetics in highly unpredictable ways.

There is a possibility that plants engineered to contain viruses and/or fragments of viruses (in order to become virus-resistant) may facilitate the creation of new viruses or increase the host range of the existing viruses that can cause new plant diseases. The addition of novel adaptive traits to "wild type organisms" would give some of them a competitive advantage and cause them to overrun natural communities of fauna and flora thus reducing natural biodiversity. Transgenic crops pose a threat to wild plants and farmers' varieties which are major sources of crop

genetic diversity. This is possible through the competition that could result from pollen transfer from transgenic crops to their wild relatives. The loss of wild relatives and farmers' varieties would deprive the world of some of the most valuable resources needed for improving agriculture and for securing future food security. Genetic engineering may also favour monocultures and erode agricultural diversity, and especially threaten the global centres of crop diversity located in developing countries.

Transgenic crops and their non-genetically engineered and even wild relatives could exist together under field conditions, transfer of genes from GE crops to the weedy relatives could pose remarkable problems. The transfer of herbicide resistance to weeds could clearly cause enormous problems to weed control by reducing the effectiveness of specific herbicides which, in turn, could lead to farmers using stronger and perhaps more hazardous chemicals.

The effects of genetic engineering on human health can not be overlooked. The death of dozens of people and the crippling of dozens in North America around 1989 after consuming a batch of food containing L-tryptophan, produced using genetically-engineered bacteria, should be an eye-opener on the potential health problems posed by genetic engineering. The case could have been more pathetic in a Third World country, especially when food labelling requirements are not being enforced to enable epidemiologists establish a pattern between consumption and illness. The risk in the Third World is worsened by the low levels of expertise in biotechnology and the lack of an effective legal and regulatory capacity to monitor, assess, and manage risks related to GEO releases.

Some biotechnology agencies have claimed that genetic engineering "is safe" because there have been hundreds of "releases" of GEOs into "test plots" and that "nothing dangerous has happened". This, however, ignores the fact that these have not been true releases since the plots have been confined, not to mention the length of time over which the so-called safe tests have been observed. It is therefore scientifically imprecise and misleading to claim that there are no negative impacts since nothing unexpected has happened in the short run.

It should, however, be recognised that a significant number of individual projects can be done safely. This should not produce a false sense of security though. It would be extremely dangerous for developing countries to accept uncritically advice about safety and effectiveness from the biotechnology industry and governments of industrialised countries which are deeply committed to reaping profits from their enormous investments in biotechnology, and thus would tend not to give objective assessment or advice.

Proponents of modern biotechnology mobilise support from the public by making claims that biotechnology is the key to feeding the world and finding new cures for diseases. The technology, however, is imposed on a public which is largely excluded (or incapacitated) from decisions over its direction, desirable limits and value. This is particularly disadvantageous to the developing world.

Despite several claims by GEO advocates that it has a potential to bring significant benefits to the developing countries, by an increase in yields, drought tolerance and pest resistance, analysis of genetic engineering programmes currently under way shows that the majority of them are focused on potential GE applications for the North (developed countries). Not only do they ignore problems and circumstances in the South but many are developing programmes likely to reduce demand for primary products from developing countries (which are heavily dependent on agriculture). It goes without saying that such global shifts in the production of primary products will have major impacts on the conservation and sustainable use of biological diversity (WWF, 1995).

The way forward

There is clearly need for an appropriate international biosafety regulation that is legally binding, such as the biosafety protocol currently being negotiated under the auspices of the secretariat to the Convention on Biological Diversity (CBD), to regulate the transfer, handling and use of Living Modified Organisms (LMOs), in accordance with Article 8 (g), and 19.3 of the CBD. This should follow the precautionary principle proposed in the CBD.

Expanded and adequate resources should be made available (say in accordance with Article 20 of the CBD) for scientific and objective assessment and management of risks associated with effects of genetic engineering.

1. All trans-boundary movements of LMOs should be subjected to the Advance Informed Agreement (AIA) procedure which should be handled by the Competent Authority designated by the recipient country for that purpose.

2. Both governments and industrial concerns should urgently strive to adopt a culture of safety, according high priority to safety and health considerations.

3. Governments should set up national registers of past and present genetic-engineering experiments/projects in order to establish an effective monitoring system as part of standard safety measures.

4. There is need for an international register (say under the CBD secretariat) where information on worldwide activities regarding releases of GEOs can be accessed by parties as part of a safety and monitoring system. This should be characterised by high levels of transparency and honesty.

5. Genetic engineering should not be looked at as the panacea for all the world's problems but rather a more holistic approach should be adopted. Do not do things simply because they can be done, but because they must be done!

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PART SIX

POLICY ISSUES ON BIODIVERSITY

CHAPTER 14

Policy Issues in Biodiversity Conservation 1: The Convention on Biological Diversity

Erie S. Tamale
World-Wide Fund

INTRODUCTION

The Convention on Biological Diversity (CBD) is an international legal framework which was adopted by different countries in 1992 to promote the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources. It was one of the major outcomes of the United Nations Conference on Environment and Development (UNCED) which was held in Rio de Janeiro, Brazil in June 1992. Unique from other earlier conservation-related Conventions, the CBD emphasises an important principle that countries have sovereign rights over their own biological resources and they accordingly bear the responsibility for conserving and sustainably using such resources. It emphasises implementation at the national level and leaves the regulatory powers to the discretion of the national jurisdictional authorities. It comprises a preamble, 42 articles and two annexes namely: (i) Identification and Monitoring; and (ii) Arbitration and Conciliation.

Evolution of the CBD

The final text of the CBD evolved from a process that was started several years ago. Since the early 1970s, several international fora and conservation agencies, including IUCN, WWF and others expressed serious concern about the unprecedented rate of biodiversity loss. In 1972, the United Nations Conference on Human Environment initiated the political basis for linking the conservation of biodiversity, and other national resources, to development efforts. Similarly, the World Commission on Environment and Development (WCED) in 1987 highlighted the critical issues of biodiversity loss and their implications in the development process. Between 1984 and 1987, the Environmental Law Centre of the World Conservation Union (IUCN) together with experts from the WWF/IUCN Plant Advisory Group and IUCN's Commission on Environmental Law (CEL) explored possibilities for a global treaty on biodiversity and prepared successive drafts of articles for the treaty.

In 1987, the 14th Governing Council of UNEP took up the challenge to address the global concern about biodiversity loss and to streamline the international efforts to protect biodiversity. By decision 14/26 of June 1987, an *ad hoc* Working Group of Experts on Biological Diversity was established with the mandate to explore "the desirability and possible form of an umbrella convention to rationalise current activities in this field and to address other areas which might fall under such a convention"[1]. It had been envisioned that the umbrella convention would consolidate the then existing conventions, including the World Heritage Convention, CITES and the Ramsar Convention. However, after holding three sessions between 1988 and 1990, the Working Group reached a consensus that the idea was legally and technically impossible and therefore recommended that a new global convention on biodiversity was necessary.

On the basis of the Report of the Ad Hoc Working Group of Experts, the Governing Council, in July 1990, established the Ad Hoc Working Group of Legal and Technical Experts on Biodiversity, with the mandate to negotiate an international legal instrument for the conservation and rational use of biological diversity. This group held two negotiating sessions and utilised the earlier draft articles by IUCN in the negotiations. In May, 1991, the group was re-established and renamed the Inter-governmental Negotiating Committee for a Convention on Biological Diversity (INC). The INC held five formal working sessions of ten days each. This coincided with the UNCED preparatory process and therefore the CBD process was considered as part of the process for defining sustainable development and how to achieve it (Sanchez and Juma, 1994). The final text of the Convention was adopted on 22 May 1992 and was opened for signature at the UNCED on 5 June 1992. At the UNCED, 157 countries signed the Convention and by 29 December 1993, at least 30 countries had ratified it and it subsequently entered into force. To date, over 165 countries have ratified the Convention.

Administration of the Convention

The CBD is administered through five major organs, namely the Conference of Parties (CoP); the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA); the Secretariat; the Clearing House Mechanism; and the Financial Mechanism.

(a) ***The Conference of Parties*** is the supreme governing body of the Convention. It is the general meeting of all parties to the Convention, i.e.

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1 UNEP Governing Council Resolution 14/26 (1987)

those states which have ratified. Other agencies, including U.N. specialised agencies, the European Union, NGOs as well as non-contracting states, may attend the CoP as observers unless at least one third of the Parties present object. So far, two CoPs have been held. The COP.1 was held in Nassau, the Bahamas (28 November – 9 December 1994); COP.2 was held in Jarkarta, Indonesia (6 – 17 November 1995); COP.3 was held in Buenos Aires, Argentina (4 – 15 November 1996) and COP.4 will be held in Bratislava, Slovakia (4 – 15 May 1998).

(b) ***The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA)*** is the multi-disciplinary technical advisory body on the Convention. It provides the CoP with timely advice on scientific, technical and technological matters relating to the implementation of the CBD. It consists of government representatives with competence in the relevant fields expertise. The first SBSTTA meeting was held at UNESCO headquarters in Paris (4 – 8 September 1995), the 2nd was held in Montreal, Canada (2 – 6 September 1996) and the 3rd was held in Montreal, Canada (1 – 5 September 1997).

(c) The ***Secretariat*** is the administrative headquarters for the Convention. Its major functions are to arrange the necessary meetings, prepare the necessary reports, co-ordinate with the relevant agencies and perform any other duties assigned to it by the CoP. The Secretariat is located in Montreal, Canada and is headed by an Executive Secretary.

(d) The ***Clearing House Mechanism*** is the facility that was established to promote and facilitate technical and scientific co-operation. It is intended to enhance co-operation between the numerous information systems and activities relevant to the objectives of the Convention and to contribute to capacity-building. It fosters information dissemination and exchange and networking.

(e) The ***Financial Mechanism*** is the funding scheme/system for providing Contracting Parties, particularly developing countries, with financial resources, on grant or consessional basis, to implement the Convention. Contributions to the Trust Fund are sought from the Parties, mainly the developed countries, on a voluntary basis according to their capabilities. The mechanism functions under the authority and guidance of, and is accountable to, the CoP but its routine operation is currently carried out by the restructured Global Environmental Facility (GEF) on an interim basis. The GEF is governed by three major institutions: the World Bank, UNDP and UNEP. The World Bank acts as the trustee for the funds and

chairs the GEF. UNDP is responsible for technical assistance and capacity building and is the administrator of the Small Grants Scheme for NGOs. UNEP provides the environmental expertise and houses the Secretariat for the Scientific and Technical Advisory Panel (STAP) of GEF.

The North-South debate over biological diversity

The CBD process probably represented one of the bio-diplomatic negotiations that demonstrated the nature of power relations between the North and the South over biological resources. Although it is widely acknowledged that the majority of the world's biodiversity is found in the developing countries, these countries have not hitherto equitably shared the benefits accruing from the use of "their" genetic resources. Multi-national companies from the North, because of their advanced technology, have over many years "freely" accessed and transferred these genetic resources from the south to boost the agricultural, pharmaceutical and other biotechnological industries in the north and therefore boosted the northern economies to the detriment of the south.

During the negotiation process of the CBD, governments of the North wanted to advance the notion of biodiversity being a global "common heritage of mankind" and emphasised the need for conservation of biological diversity in the south. On the other hand, countries of the south reiterated that countries have sovereign rights over their biodiversity. While appreciating the need to conserve their biodiversity, they argued that such conservation should not thwart opportunities to exploit/utilise biological resources in order to develop their economies. Furthermore, in exchange for their co-operation in conservation efforts, developing countries demanded that:

- the North should transfer finances and technologies to the South as incentives to enable the latter to undertake biodiversity conservation efforts;

- the North should recognise and respect the national sovereignty of countries in the South over their genetic resources;

- allowing access to genetic resources in a country should be at the discretion of national authorities in such a country and should meet certain conditions and mutually-agreed terms, including prior informed consent.

Ultimately, the South was successful in achieving these demands which are included in different articles of the Convention particularly Art. 3, 15, 16 and 21.

Significance of the CBD to developing countries: benefits and responsibilities

After succeeding in entrenching their demands in the CBD, several opportunities exist developing countries to benefit greatly from the Convention. Prior to the Convention, developed countries had, more or less, free access to genetic resources in the South. Developing countries were unfairly rewarded for bearing the burden of conserving these resources. The Convention seeks to correct this inequity and empowers the developing countries to negotiate with prospective users of their genetic resources from the north and determine the equitable benefit sharing arrangements. By ratifying and becoming parties to the Convention, developing countries open avenues for:

- financial assistance from the global fund popularly known as the Global Environment Facility (GEF) and other donor assistance to conserve biodiversity;
- scientific/research co-operation and information-sharing through the Clearing House Mechanism;
- transfer of technology from the North;
- opportunities for capacity-building to conserve and sustainably use biodiversity.

Ratification of the CBD provides three important opportunities for the Contracting Party:

(i) It provides a stronger legal basis for the protection and sustainable use of biodiversity in the country.

(ii) It serves as a legal basis for a country to reject being made into a testing ground for the release of genetically-modified living organisms (GMOs).

- It prevents or minimises the unsafe transfer of biotechnology which may harm biodiversity.
- Ratification shows a country's commitment to international co-operation in biodiversity conservation measures.

BASIC ELEMENTS OF THE CONVENTION

Overall Objectives: The CBD has three broad objectives outlined in Article 1, namely the:

- conservation of biological diversity;
- sustainable use of its components; and
- the fair and equitable sharing of benefits arising out of the utilisation of genetic resources by allowing appropriate
  - access to genetic resources;
  - transfer of relevant technologies;
  - provision of funding.

Major Principles: In its preamble, the CBD outlines the following basic principles:

- Biodiversity has several intrinsic values – ecological, economic, socio-cultural and scientific values.

- Biodiversity conservation is a common concern of all humankind.

- States have sovereign rights over their own biological resources.

- States are free to use their own biological resources for development but in a sustainable manner and are responsible for conserving them.

- Information, research and assessments are requisites for sound planning, forecasting and mitigation of biodiversity loss and implementation of appropriate conservation measures.

- *In situ* conservation is a fundamental approach to biodiversity conservation, but it should be complemented by *ex situ* measures, preferably in the country of origin.

- Indigenous people and local communities who intimately depend on biodiversity should equitably benefit from the use of their traditional knowledge.

- Women who play a vital role in biodiversity conservation should fully participate in biodiversity policy-making and implementation at all levels.

- International co-operation and information exchange are essential in the implementation of the Convention.

- New and additional funding as well as access to relevant technologies from the north to the south are imperative for restraining further biodiversity loss, given that poverty eradication and socio-economic development are the overriding priorities of the south.

- International sharing of genetic resources and technologies is essential for meeting the food, health and other basic needs of the growing world population.

All the subsequent articles are cognisant of the above-outlined principles and provide the technical measures/approaches, legal framework and institutional mechanisms for achieving the stated objectives.

In general terms, articles in the CBD can be categorised into four major parts namely: (i) those on preliminary matters (Art. 1–5); (ii) those dealing with the substantive issues of biodiversity conservation (Art. 6–16); (iii) those dealing with the administrative and procedural issues (Art. 17–31); and; (iv) those on general matters/provisions (Art. 32–42). This guide concentrates on articles dealing with the substantive issues of biodiversity conservation and sustainable use.

Substantive Articles of CBD

- ***General measures*** or Framework of Action for biodiversity conservation, i.e. biodiversity strategies and action plans and cross-sectoral integration of biodiversity issues (Article 6).

- ***Identification and monitoring of biodiversity status and trends*** – including general inventories; ecosystem surveys; taxonomic studies; genetic research; studies on endangered species; assessments and forecasts; distribution patterns; and compilation of periodic status reports (Article 7).

- ***In situ conservation mechanisms*** including establishment and sustainable management of protected areas (PAs); protection of natural habitats; sustainable management of buffer zones; ecological restoration and control of alien species (Article 8).

- ***Ex situ conservation measures*** including off-site measures, e.g. gene banks, to provide "insurance" against extinction of certain germplasm, help to propagate useful genetic materials and assist in the recovery and eventual re-introduction of threatened species in their natural habitats (Article 9).

- ***Sustainable use of biodiversity*** including regulation of use by the different sectors to minimise impact on biodiversity; modest consumption; minimisation of waste; mitigation of negative impacts; adherence to customary uses and traditional lifestyles; and remedial actions/regeneration (Article 10).

- ***Incentive measures for biodiversity conservation and sustainable use*** – incentive measures are those that create behavioural change, inducement or motivation for conservation and sustainable use of biodiversity (Article 11). These may include; direct incentives (cash or in-kind); supportive economic policy instruments (e.g. subsidies/tax exemptions for conservation-based investments; soft conservation loans, etc.); and other socio-economic policies (e.g. secure land tenure; access to PAs for traditional uses; improved social services).

- ***Research and Training*** including gathering and application of new knowledge about biodiversity as well as human capacity-building to train skilled personnel that can carry out research and apply research results to conserve, bio-prospect (i.e. explore the untapped benefits) and devise sustainable use models and practices (Article 12).

- ***Public Education and Awareness*** to arouse people's general understanding and appreciation of the need to conserve biodiversity and to enlist their support/commitment to maintain/avoid impairment of the long-term potential use of biological diversity, through the media as well as formal and informal education (Article 13).

- ***Impact Assessment and Minimisation of Adverse Effects of Development Activities (policies and projects) on Biodiversity*** including mandatory EIAs for potentially adversive projects; trans-frontier notification and co-operative action to mitigate activities likely to significantly affect biodiversity; and the establishment of national/international emergency mitigation mechanisms or joint contingency plans (Article 14).

- ***Regulating Access to Genetic Resources*** involving the creation of conditions which facilitate access by other parties, for environmentally-sound uses, but based on mutually-agreed terms and prior-informed consent of the owner, subsequent to scientific research, including full participation of all the parties involved; and ensuring fair and equitable sharing of benefits arising from the use of the genetic resources (Article 15).

- ***Access to and Transfer of Technology*** including facilitation of access to and transfer of technology consistent with patents and other intellectual property rights (IPRs); private sector promotion of joint technology development and transfer together with governments; and ensuring that existing IPRs are supportive (Article 16).

- ***Information Exchange and Scientific Co-operation*** involving governments informing each other about their domestic situation/problems and counteractive measures being undertaken; sharing of research results; repatriation of information on training and surveying programmes; co-operation for the enhancement of indigenous and specialised knowledge; undertaking joint research and technology development ventures; and co-operation to strengthen human and institutional capacity (Articles 17 and 18).

- ***Handling of Biotechnology*** including requirement for each Party, particularly those supplying genetic resources, to engage in biotechnological research; provide access to the results and benefits from the technologies; participate in biosafety procedures and instruments; and provide regulatory and impact information related to living modified organisms (Article 19).

Building the foundation for implementation

In order to benefit fully from the new regime of national sovereignty over genetic resources put in place by CBD, developing countries must meet some fundamental conditions and establish adequate capacity to take maximum advantage of the opportunities provided by the CBD.

- Efforts to conserve and maintain vast genetic resources of transactional value, i.e resources that are of economic interest to actors in other countries.

- Establishment of national legal regimes that give a framework for administration and enforcement of national sovereignty over genetic resources.

- Establishment of institutional capacity for biodiversity prospecting and capacity to negotiate, design and administer the "sale" of genetic resources at competitive prices.

- Building technological and scientific capacity to carry out research, to assess, monitor and control, to mitigate negative impacts on biodiversity and to develop effective management strategies to enhance biodiversity.

- Enforcement capacity to curb corruption and criminal activities, including smuggling of germplasm out of the country, violation of IPRs of local communities.

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CHAPTER 15

Other Biodiversity-Related Conventions

Dr. P. M. B. Kasoma
Acting Director, MUIENR

INTRODUCTION

Apart from the Convention on Biological Diversity, there are numerous other conventions and treaties which have been in existence. They preceded the CBD but this should not mean that they should be ignored. Those that are of particular significance for Africa are:

- African Convention on Conservation of Nature and Natural Resources (the "African Convention");
- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the "Ramsar Convention");
- Convention concerning the Protection of the World Cultural and Natural Heritage (the "World Heritage Convention");
- Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES");
- Convention on Conservation of Migratory Species of Wild Animals (the "Bonn Convention");
- International Tropical Timber Agreement ("ITTA").

Two cases are elaborated upon below. For those with particular interest in the other conventions, please consult the book by Lyster (1985).

THE RAMSAR CONVENTION

Also known as the "Wetland Convention", the Convention on Wetlands of International Importance especially as Waterfowl Habitat was named after the Iranian City of Ramsar where the text was adopted in 1971. This was an early attempt by governments to conserve and make wise use of wetland biodiversity.

Wetlands are defined as:

> "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".

Countries which become Contracting Parties accept three principal obligations:

1. To designate at least one wetland in their territory for the Ramsar "List of Wetlands of International Importance" and to maintain its ecological character.

2. To make "wise use" of all wetlands in their territory, whether or not they are designated for the List.

3. To develop international co-operation over shared species, shared sites and development assistance related to wetlands.

In 1992, there were 17 African signatories to the convention.

The major benefits of Ramsar membership are:

- International solidarity. Membership of the major global conventions indicates solidarity with the international principles they represent.

- The possibility to influence world thinking on wetlands. Relatively few African countries have so far joined Ramsar; if Africa's point of view is to have its full weight in the world wetland outlook, more African countries need to join.

- Publicity and prestige for those wetlands included in the Ramsar List.

- Access to international information and advice on wetland matters, and in particular to the Ramsar "Monitoring Procedure', under which specialist missions visit sites where difficulties have arisen, and provide recommendations and advice.

- Access to the Ramsar Wetland Conservation Fund. The 1990 Montreux Conference established this fund, under which governments of developing countries may seek financial support for small projects (Ramsar 1990). The current ceiling is 40,000 Swiss francs, or about US$ 30,000.

THE WORLD HERITAGE CONVENTION

The Convention Concerning the Protection of the World Cultural and Natural Heritage was adopted at the General Conference of UNESCO in 1972 and came into force in 1975. It resulted from the realisation that some natural or man-made features are so spectacular or outstanding that they are more than the heritage of just one state; they constitute the heritage of humankind.

The World Heritage Convention provides a framework for efforts by various organisations to conserve important natural habitats. There is a World Heritage Committee which is responsible for selecting such cultural or natural sites of outstanding universal value so that they are included on the World Heritage List. Also, there is a World Heritage Fund that could be accessed to help protect sites which are on the list.

The World Heritage list provides a mechanism for giving international recognition to some of the most outstanding natural habitats in the World. It was one of the few treaties prior to the CBD to offer developing countries a material incentive to protect outstanding wildlife habitats.

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CHAPTER 16

Policy Issues III: National Biodiversity Strategies and Action Plans

Erie S. Tamale
World-Wide Fund

INTRODUCTION

Article 6 of the Convention calls on Contracting Parties to develop national strategies and action plans aimed at integrating biodiversity management into sectoral policies and programmes. The Parties are also required to review and adapt existing strategies which reflect the provisions of the Convention. This Article creates an obligation for governments to prepare specific plans which reflect the objectives of the Convention. Countries are required to integrate imperatives of biodiversity conservation and sustainable use of its components into existing conservation and development laws, policies and programmes. This implies that countries have to review their existing sectoral plans and policies to identify how and where to integrate the objectives of the Convention. The strategies, action plans and/or programmes should explicitly outline implementation measures.

The process of developing national strategies, action plans and/or programmes largely involves policy analysis. For countries to formulate realistic strategies, action plans and programmes they require specific policy analysis expertise and must organise their institutions in such a manner as to obtain institutional convergence and synergy. This is the challenge for African countries. Most of these countries lack expertise and appropriate institutional arrangements for developing such strategies, action plans and programmes. If these countries are to fulfil their obligations they will need to enhance the capacities of policy-makers in a number of government agencies and institutions to be able to deal with the requirements of Article 6 and other articles of the Convention.

The Convention sets out in Articles 7–19 a number of measures that the Contracting Parties need to implement. These measures include, among others: establishment and management of protected areas; formulating legislation for the protection of threatened species and populations; establishing measures to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts; measures to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities; providing incentives; ensuring equitable sharing of the benefits arising from use of genetic resources; and

establishing biosafety regulations. For African countries to effectively implement these provisions of the Convention they require expertise in policy research and analysis.

However, African countries lack the relevant policy analysis capacities to be able to formulate national policies and legal measures aimed at implementing the provisions. Policy-makers in these countries lack the relevant knowledge and information on issues of biodiversity, biosafety and protection of indigenous rights and practices. There is also a lack of biodiversity inventories and other vital information on the nature of habitats. Conservation and development policies are often designed and implemented using inadequate information, making it difficult to assess their impacts on biodiversity. In many cases, development projects are designed and implemented with heavy environmental costs, including degradation of biodiversity. The lack of information also constrains policy-making. In the absence of relevant information, countries are unable to formulate and implement realistic policy measures. They are not able to establish criteria for effective conservation and cannot target their limited resources to conserving highly-threatened species and/or ecosystems.

The need to formulate specific policy and institutional measures for implementing the Convention is crucial in African countries which have weak economies and where a significant percentage of the world's biodiversity is located. The countries face problems of scarce financial and human resources to invest in biodiversity management. Under frequent conditions of economic instability, it is difficult to invest their human resources and sustain institutions for biodiversity conservation. Furthermore, the countries are implementing structural adjustment policies promoted by the World Bank and the International Monetary Fund. These policies involve reduction of government expenditure, privatisation of certain public enterprises and cutting down the size of the civil service. Some of these measures are likely to have impacts on the abilities of the countries to engage in biodiversity management. It is therefore important that these reforms be sequenced and managed in a such manner that they do not erode the existing capabilities of national and local institutions. However, African countries have no option but to identify ways of directing their increasingly scarce resources to address biodiversity issues if they are to fulfil their obligations under the Convention.

NATIONAL BIODIVERSITY STRATEGIES (NBS)

An NBS is a statement of the mission/vision, guiding principles and the overall goals and targets as well as analysis of the issues, opportunities and impacts

different options and finally selection of priority actions and investment to achieve the desired goals.

Elements of the NBS

- Mission Statement (Vision) – strategic direction
- Overall Goals
- Specific Operational Objectives and Targets
- Guiding Principles: Principles are important tools which can be used to guide the selection of options and actions.
- Issues and Opportunities of Different Options – statement of factors likely to hinder realisation of the desired goals and objectives;
- Selection of Priority Actions or Investments (with clearly defined criteria for determining the priorities).

Approaches

- Identify and state clearly the conservation problems, issues, gaps etc.
- Articulate and debate the overall vision for conserving biodiversity.
- Determine goals and operational objectives to address the problems or gaps. The goals and objectives could be broken into component parts that give pragmatic direction for action. The objectives and articles of the CBD could provide the framework.

- State any principles that might be helpful in guiding the assigning of priorities and selection of options.

- Identify and analyse the opportunities and limitations of the different options to address the problem/gaps.

- Establish criteria and priorities to help in choosing from among the different options.

- Select the most feasible options (specific measures/actions) to close the gaps and address the most pressing problems, issues and un-utilised opportunities;

- Hold further consultations to reach acceptable targets and mechanisms/ approaches for action and investment strategies.

- Match the actions and the goals/objectives to determine whether the selected tasks strategically meet the conservation vision and goals.

- Identify where and how the necessary resources (funds, equipment, etc.) can be obtained.

NATIONAL BIODIVERSITY ACTION PLANS (NBAP)

The NBAP spells out the specific steps that need to be undertaken to implement the selected strategies. It addresses the following questions, among others:

(i) Who will undertake the selected actions?
(ii) Over what time-frame?
(iii) By what means and with what resources (human, financial, technical, facilities, etc.)?
(iv) What will be the implementation schedule?
(v) If any, what regional and international co-operation will be required and how will it be negotiated?

Approaches

- Outline the specific tasks to be undertaken (as determined in the Strategy);

- Describe and devise a worksheet indicating the roles and responsibilities of the different institutions/partners or stakeholders;

- Set a schedule for implementing each task;

- Develop a budget and resource requirements (personnel, equipment, physical facilities – buildings, transport, laboratories, etc; institutional requirements and operational funds).

Examples of action that could taken include: (i) formulation and implementation of specific field projects; (ii) policy reforms; (iii) enactment of new legislation; (iv) removal of perverse incentives; or (iv) capacity-building.

CONCLUSION

When developing NBSs and NBAPs, it is should be noted that it is not the content of these documents alone that is important but also the process by which they are

developed. In line with the commitment made by governments during the UNCED to involve local communities in developing strategies and plans for sustainable development, it important that local communities and other interested parties are fully involved in the process of developing the NBS and NBAP. This is imperative if local people are to identify with the formulated strategies and plans and implement them with long-term commitment. Failure to involve different stakeholders can result in a cursory "whitewash" of prevailing situations.

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CHAPTER 17

Integrating Biodiversity into Sectoral and Cross-Sectoral Policies, Plans and Programmes

Mr. Paul Mafabi,
National Wetlands Programme, Uganda

INTRODUCTION

Biodiversity is an old concept which has gained prominence in recent years due to its rapid loss and the need for urgent action to halt its loss. It recognised that biodiversity has been around and used by man to meet his various needs. However, in a bid to satisfy his basic need, coupled with population increase, inconsistent and inflexible policies and break down of law and order, biodiversity has been squandered, misused, overused and abused with varying consequences.

This paper reviews policies for the conservation of biodiversity, and outlines some of the guiding principles for and practices to achieve integration of biodiversity into sectoral and cross-sectoral policies, plans and programmes. It also examines some of the challenges likely to be faced in integrating biodiversity into other sectors.

***Key features of Biodiversity*:** Biodiversity is characterised by two main features: inter-dependence and multiplicity. First, inter-dependence is expressed in the various food webs and food chains. The existence of one organism depends on the existence of others. Secondly, it is charaterised by the multiplicity of habitats. Ecosystems are by nature varied through the differences in communities of plants and animals.

Why Integration? Many reasons are advanced for integrating biodiversity into sectoral policies. Chief among these is the fact that biodiversity is one resource with many interests and its conservation requires the concerted efforts of all interested "parties". As such, biodiversity is the concern of several institutions and its conservation and management is the responsibility of several sectors. Moreover, in most cases there are no specific policies for biodiversity conservation and attempts to develop such policies are usually branded as a "duplication of efforts". Integration is necessary because of the following:

The need to harmonise sectoral interests. Natural resources are managed by sectors quite similar to boxes and there are very few vertical or horizontal linkages. For example, until recently in Uganda, wildlife was managed by National Parks and the Game Department. Due to lack of integration, when an animal left the national park and entered a game reserve it was almost treated as vermin. This situation has

changed as the two have merged to form the Uganda Wildlife Authority. The other example is with Forest Department and National Parks which hustle over the management of forested areas where until recently, the forest department was more interested in harvesting of timber with very little attention to conservation of fauna, to the extent that some of the trees (especially mature ones) are the ones preferred for timber, yet they are also preferred by hornbills for breeding or chimpanzees for feeding.

The need to mobilise sectoral support. Different sectors managing biodiversity receive different levels of government support. For example, in Uganda's 1997/98 budget, emphasis has been placed on agriculture as a priority with very little attention or even mention of the environment sector with biodiversity conservation *per se* receiving the least.

Most conventional conservation efforts have advocated resource protection without human use, conversely, modern agricultural systems have emphasised production without conservation. Therefore there is need for integration so as to ensure that human needs are met in ways that are less destructive to the environment. There is need to broaden the focus on preserving endemism (genetic) and genetic resources to include increasing emphasis on conserving ecological systems as a whole.

GUIDING PRINCIPLES

(i) Biodiversity in a multi-sectoral resource and its management should consider the interest of all the stakeholders.

(ii) There is need to change the attitude towards biodiversity as not hindering development but as a resource which facilitates development.

(iii) All biological resources must be treated fairly and equitably be they algae or Mvule tree, or be they bacteria or the African elephant.

(iv) Appropriate incentives are needed to encourage participation of all stakeholders.

How to Integrate

Review sectoral policies to harmonise sectoral interests with biodiversity conservation and to ensure that biodiversity conservation is reflected in sectoral policies and plans. Ultimately, it is necessary to develop specific policies on

biodiversity, either separately or as part of wider environmental policies. This will help to focus attention on biodiversity as an important natural resource and not as a political gimmick. There is need to harmonise sectors that manage wildlife, be it plants or animals, with the best scenario being a protected areas system approach that combines forests and wildlife sectors.

Develop cross-sectoral linkages through delegation or management agreements where, for example, the Uganda Wildlife Authority enters into a management agreement with the Forest Department for the management of Mt. Elgon National Park which is largely a forest reserve. A matrix correlating policies at the microeconomic, macroeconomic, socio, legal and research/training levels is necessary.

Education and awareness is necessary to illustrate ways in which conservation of biodiversity is of direct interest to our society and stimulates the creation of appropriate interest groups and the development of channels of communication on biodiversity conservation for decision-makers.

Institutional reforms For biodiversity conservation to be integrated into sectoral policies requires some level of institutional reform to remove areas of overlap and inconsistency. Actions may range from inclusion of biodiversity into sectoral mandates to restructuring of institutions with responsibilities for biodiversity conservation.

Stakeholder consultation This is important because it provides an opportunity for sectoral institutions to provide inputs into the design of a biodiversity conservation strategy and ensures that the responsibility for their implementation is shared with the relevant stakeholders.

Training There is need to update training in sectors that deal with natural resource management so that they can reflect biodiversity conservation in their curricula. Already, efforts are being made towards including environmental issues into the curriculum at primary school level. It is necessary to produce materials relevant to biodiversity conservation to support the environment education curriculum.

Land-use planning One way to integrate biodiversity into sectoral policies and plans is through land-use planning. Unfortunately, several countries do not have comprehensive land-use policies.

CHALLENGES

There are several challenges which can make the integration mission difficult or even impossible. These include, but are not necessarily limited, to the following:

Sectoral interests/policies – breaking the barriers without harming biodiversity or its protectors. There is also the issue of sectoral mandates which are sometimes rigid and even influence the type of training that is offered at different levels.

Lack of alternatives Quite often, biodiversity is lost or degraded because there are no feasible alternatives. However, this is short-term view to provide long-term solutions and in most cases hastens the problem of trying to find long-term solutions as it closes off options. The case in point is the reclamation of wetlands in Kabale district to create more agricultural land. This happened as government policy in the 1950s and 1960s. However, thirty years on the problem of land shortage in Kabale has not been solved and even the wetlands which were drained cannot provide high yields any more.

Commercialisation The demands of modernisation and commercialisation of agriculture with the subsequent breakdown of traditional farming systems which makes it difficult to integrate with biodiversity conservation.

Inappropriate valuation of biodiversity Alternative methods for national income accounts fully reflecting the costs of resource depletion are not yet well developed. Therefore, while the cost of cleaning environmental damage is normally accounted for as a benefit economically, the cost of the damage itself never appears in national accounts.

Political will In general, domestic constituencies for biodiversity are lacking and sometimes conservation is seen as an intellectual or a *Mzungu* affair imposed on developing countries.

In addition, land pressures, the need to balance foreign exchange transaction (balance of trade and payments), and high levels of poverty are major barriers to the conservation of biodiversity and its integration into sectoral policies. Decision-makers may look favourably on natural resource exploitation even at the expense of biodiversity, if this reduces demand for jobs. Shifting cultivators who open up forested areas for agriculture or charcoal-burners can be seen as self-employed and their initiative welcomed by governments that are hard pressed to cope with economic crises.

Decision-makers' attitudes to conservation are sometimes ambiguous, encouraging development projects while restraints in natural resource exploitation may be viewed as "anti-development".

CONCLUSION

A lot of effort has been made in trying to conserve biodiversity but some of these efforts have been frustrated by sectoral inconsistencies and interests where biodiversity has always been treated as second. We should take advantage of the existing international goodwill to press ahead with biodiversity conservation, including integration into sectoral policies and plans. The task ahead is enormous but we must make a start.

CHAPTER 18

Environmental Impact Assessment of Biodiversity

Mr. George Sikoyo
MUIENR

INTRODUCTION

The biodiversity treaty of 1992 in Rio, Brazil is consistent with Agenda 21, chapters 15 and 16 (Holmberg, J. Thomson, K & Tomerlake, L, 1993), which covers biodiversity and biotechnology respectively. The overall objective of the treaty is the conservation of biodiversity, sustainable use of its components and fair and equitable sharing of benefits from the latter use of genetic resources. The treaty includes innovations such as the vital role that women play in the conservation of biological diversity and the desirability of sharing benefits arising from the use of traditional knowledge, innovations and practices of indigenous and local communities.

The burden upon member states like Uganda that ratified the biodiversity convention includes:

(a) developing national strategies, plans, or programmes for the conservation and sustainable use of biological diversity or adopt existing plans to this purpose;

(b) integrate conservation and sustainable use of biodiversity into relevant cross-sectoral plans and policies;

(c) identify important components of biodiversity and monitor them, particularly those parts requiring urgent conservation action, or which offer the greater potential for sustainable significant adverse impacts on the conservation and sustainable use of biological diversity;

(d) integrate conservation and sustainable use of biological resources into national decision-making; protect and encourage customary use of biological resources in accordance with traditional cultural practices; support local populations in this regard; and encourage co-operation.

(e) adopt economically- and socially-sound measures that act as incentives for the conservation and sustainable use of biological resources.

If individual countries are to fulfil the above requirements, then the reductionist approach and thinking to environmental problems, which characterised research in the past cannot sufficiently handle environment and environment-related issues like biodiversity. These require ballistic and integrated approaches in research to harmonise environment, social and economic development goals. This thought is reinforced further by the consensus reached by world governments at the Rio Conference in 1992. It recognised the need for re-shaping decision-making if environment and development were to be brought into balance for the benefit of both present and future generations. This sharply contrasts with the systems for decision-making in the past which tended to separate economic, social and environmental factors at the policy, planning and management levels. Environmental Impact Assessment (EIA) as a new innovation in research was one of the tools recommended in Agenda 21. The recommendation identifies the need to adopt "comprehensive analytical procedures for prior and simultaneous assessment of the impacts of decisions, including the impacts within and among the economic, social and environmental spheres; these procedures should extend beyond the project level to policies and programs".

Environmental Impact Assessment (EIA) is the information-gathering and analytical process that helps to ensure environmentally-sound development. EIA is a method of analysis which identified the environmental impacts of project activities and ensures that they are predicted and taken into account. It can be applied to all kinds of projects, policies, plans, programmes and budgets in any sector of the economy, including biodiversity conservation projects. The EIA process attempts to identify potential problems so that economic feasibility and environmental impacts of alternative approaches can be assessed while there is still need to make changes. Furthermore, it involves assessing environmental effects of a particular activity and identifying ways of minimising and mitigating its negative environmental effects. It (EIA) complements the conventional package of engineering, socio-economic, financial and economic analyses and provides practical advice to planners. EIA are designed to identify and measure the biophysical and social changes produced by a project or alternative project designs.

The primary objective of environmental assessment is to predict alternative future states of resources and environments, depending on the project design choices. EIA identities potential problems and opportunities and is thus an essential part of the project cycle. By itself however, it is insufficient for decision-making. It generates important information for decision-making, policy-makers, and planners. It provides the means for data about environmental changes to be translated into an assessment of the effects of these on human production and consumption systems. EIA also provides information that can be fed into other methods of project analysis like cost-benefit analysis and cost-effectiveness.

This presentation covers the legal requirement, different levels and stages of the EIA. The environmental impact assessment, review and analysis during the project cycle or development of biodiversity projects is also discussed.

LEGAL REQUIREMENTS OF THE EIA

Historically, EIA procedures were first developed in the 1970s following a recognition that it was necessary to assess the environmental impact of development activities before they were implemented, with a view to taking some kind of corrective measures if they would harm the environment. Since then EIA procedures have progressively been refined and developed. Today EIA is recognised as an integral part of any development activity. It is a legal requirement in many countries. A range of guidelines for EIA have been developed by different agencies and countries, and there is a strong role for EIA in the National Environment Action Programme (NEAPs). For example, Uganda's National Environment Statue, 1995 Part V, Section 20 (3) requires that an environment impact assessment is undertaken by the developer for projects that:

(a) may have an impact on the environment;
(b) are likely to have significant impact on the environment; and
(c) will have a significant impact on the environment.

The EIA study has either to conform to the guidelines of a given country as stipulated in the legal framework (like Uganda's environment statute) or must suit donor requirements. The donor agencies like the World Bank, Department For International Development (DFID); formerly the Overseas Development Agency (ODA), United States Agency for International Development (USAID) and the OECD have individual specific guidelines for conducting EIA.

The different levels of EIA

The three different levels of EIA include:

(i) ***Environmental Impact Review***: EIR is required for small-scale projects that may have significant impact on the environment and whose potential adverse impacts can easily be identifiable and for which mitigation measures can readily be prescribed. The objective is to ensure that the mitigative measures are identified and included in the design and implementation of the project.

(ii) ***Environmental Impact Evaluation (EIE)***: EIE requires a more detailed analysis than an EIR and is conducted for projects that are likely to have significant impacts on the environment. Its purpose is to determine if more in-depth environmental impact assessment is required and to assess various alternatives that the decision-maker can select one which does not have significant environmental impacts.

(iii) ***Environmental Impact Study (EIS)***: EIS is the major and detailed assessment conducted for any project which clearly will have significant impacts whose mitigation measures cannot readily be prescribed unless in-depth analysis of the project and its possible alternatives is conducted. The purpose of an EIS is to assess the environmental impacts of various alternative actions so that the decision-maker can determine if an alternative exists which has minimal or fewer adverse impacts. Conducting the EIS requires greater public participation than EIE.

THE STAGES OF ENVIRONMENTAL IMPACT ASSESSMENT

Different agencies have different ways of carrying out EIA, but all follow similar stages and ask similar questions. Although originally conceived as a one-off activity that takes place before a project begins, the role of EIA has expanded to cover all parts of the project cycle. There are two phases of EIA design and implementation. First of all, a preliminary screening of environment is carried out at the design stage of identifying and planning a project and this is then developed into concrete recommendations and actions through appraisal, implementation and monitoring right up to evaluation (see Figs 1 and 2).

Environmental aspects of the project cycle

The Project Cycle: All projects whether environmental or non-environmental are frequently identified and developed in a process known as the project cycle. The stages in the project cycle include:

- Identification: Finding a niche for a project
- Planning: Choosing the best project option
- Appraisal: Assessing whether the project is feasible
- Implementation: Carrying out the project
- Monitoring: Examining how the project is being carried out
- Evaluation: Judging whether the project has been successful
- Impact assessment: Looking at changes resulting from the project.

In the project cycle, there are many places where environmental, or biodiversity and resource concerns may be injected (see Figure 4). These concerns have to be taken into account early enough in the cycle and during the design stage. Only in this way, can alternatives be considered before too much time and effort can be invested in one project.

The following questions need to be asked in the process of analysis:

(a) Do laws or regulations require environmental impact assessment in the proposed development project ?
(b) Will a project harm or benefit the environment?
(c) Are we choosing project activities in such a way as to minimise negative environmental impacts and maximise environmental benefits?
(d) What changes in the environment have taken place as a result of the project?
(e) What environmental lessons can we learn from the project?

CONCLUSION

Environmental Impact Assessment considerations should be adequately incorporated in the planning, design, implementation and post-evaluation of biodiversity conservation projects. The overall purpose is to consider the full environmental implications of projects we carry out and to try and ensure that we make the best of most fully-informed choices in terms of their impact on the environment.

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CHAPTER 19

Regulation of Access to Genetic Resources and Sharing of Benefits from Biodiversity

Erie S. Tamale
World-Wide Fund

INTRODUCTION

The Convention on Biological Diversity (CBD) provides an international legal régime for the regulation of access to and exchange of genetic resources, i.e. genetic material of actual or potential value. While recognising the sovereign rights of States over their natural resources, the CBD in Article 15 urges Parties to facilitate access for environmentally-sound uses and not to impose restrictions that run counter to the objectives of the Convention.[2] However, paragraphs 4 and 5 emphasise that such access should be granted based on 'mutually agreed terms' and should be subject to 'prior informed consent' of the Party providing the resources. Article 15 also requires Parties to put in place legislative, administrative or policy measures aimed at ensuring fair and equitable sharing of the results of research and development, and benefits arising from the commercial and other utilisation of genetic resources. Benefits should not be limited to monetary benefits but should include other benefits such as technology transfer, capacity building, training of professionals (as the case of the National Biodiversity Institute in Ethiopia and INBI in Costa Rica), or training local people to identify indigenous plants and their values.

Before the Convention came into force, the world's genetic resources were treated as a common heritage of humankind and were open to access without restrictions. They were collected and utilised freely by interested persons and institutions, particularly those from the developed countries. Most developing countries were opposed to the principle of common heritage to genetic resources. They argued against a régime that allowed the developed countries to freely or cheaply obtain genetic resources, patent products arising from the genetic material and sell these patented products at high prices to the developing country where the materials was collected. The developing countries argued for sovereign rights over genetic resources. The debate, mainly between the developed and developing countries, on

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2 It should be noted that paragraphs 1 and 2 of article 15 mention "regulation of access" and not "control of access" as has been misinterpreted by some people.

ownership of genetic resources was partly resolved through the negotiations for the Convention on Biological Diversity.[3]

THE CONCEPT OF "MUTUALLY AGREED TERMS"

Article 15 of the Convention requires Contracting Parties to institute measures that strike a balance between national rights to determine access and obligations to facilitate access by other parties on mutually-agreed terms. The Convention elaborates on this basic point by explicitly providing that access shall be subject to prior informed consent. The mutual agreement by parties involved in the access arrangement is based on what we may term transparency which requires the party seeking access to obtain prior consent of the one that holds or owns the genetic material or resource.

Article 15 contains certain phrases that require mutually-agreed interpretation. For example, paragraph 2 of the article requires "each Contracting Party to create conditions to facilitate access to genetic resources for environmentally-sound uses by other Contracting Parties". This provision, it appears, applies to access to genetic material for environmentally-sound use(s). There are two points to note. First, it is the Party supplying the genetic material that determines what constitutes environmentally-sound use. Second, it is assumed that the Party seeking to have access to the genetic material will disclose the nature of the use(s) and both Parties have adequate capacities to determine that the use(s) will have no negative environmental impacts. To effectively enforce this requirement – that of ensuring environmentally-sound uses of the genetic material – both Parties must conduct their affairs in a very transparent manner. "Environmentally-sound uses" can be interpreted to refer to utilisation that gives high regard to conservation and the sustainability of the resource and furthermore, alludes to biosafety. But to date, no consensus has been reached on the concept of biosafety. The Party seeking to have access must disclose all the relevant information on the uses to the supplying Party. Second, access to the genetic material will only be facilitated after the supplying country has received all the information and has granted prior consent.

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3 Sanchez, V. and Juma, C. (1994), *Biodiplomacy: Genetic Resources and International Relations.* ACTS Press, Nairobi.

THE CONCEPT OF PRIOR INFORMED CONSENT

Prior Informed Consent (PIC) refers to the consent by the provider of the genetic resources based on the information (research proposal) provided by the applicant (prospector) including full disclosure of the intent and scope of the bioprospecting activity prior to granting permission to access the genetic resources. The applicant is required to specify the manner in which the resources are going to be used, by whom and the potential outcome of the bioprospecting exercise. Some of the main elements of the PIC model include the following:

- A designated national authority;
- Scope of the PIC;
- Complete information from the applicant:
  - the specific material wanted;
  - the quantities required;
  - the use to which the material will be put;
  - the potential implications for granting access;
- Requirement of licence and fees and financial returns such as loyalties;
- Conditions governing every licence, e.g. sharing of research results;
- Provisions for future uses and exchange of collected genetic resources.

Developing national access policies and legislation

Article 15 of the CBD provides the framework for Parties to assert their sovereign rights over their genetic resources. African countries need to move fast to take advantage of this opportunity provided by the CBD and establish national policies, legislation and institutional arrangements to regulate access to genetic resources under their jurisdictions and tap the benefits from them. In other words, for African countries to effectively enforce the provisions on sovereign rights and access to genetic resources countries they need to formulate policy, legal and institutional measures.

Specific areas that require attention in establishing national access regulation include the introduction of regulations governing the collection of biological resources. Contracts between the collectors, national authorities and the suppliers of biological resources can help ensure that they generate immediate as well as long-term benefits for the countries containing the resources.[4] Since the developing countries are not

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[4] Reid, E. *et al* (1993, *Biodiversity Prospecting*. World Resources Institute, Washington, DC.

in a position to correctly assess the potential value of genetic resources in the initial stages of exploitation (particularly due to a lack of information), it will be important to devise contracts carefully, negotiating the terms for actual commercial exploitation when greater information about the potential value of the resource is available.

A few countries, such as the Philippines and the Andean Pact countries, have initiated processes of formulating national régimes to enable them implement Article 15.[5] The Philippines has adopted a specific legal régime for regulating access to genetic resources, i.e. the Executive Order No. 247 and has developed a manual for implementing the Order. However, most countries do not have régimes to regulate access to genetic resources or have not initiated processes to establish such régimes. African countries will have to undertake major efforts to formulate national legal measures and establish suitable institutional arrangements for regulating access to genetic resources. These countries need to mobilise various forms of expertise and new capacities to be able to effectively implement the access provisions.

National legislation on access should, at the minimum:

- assert national sovereignty over genetic resources within the national boundaries;
- require bioprospectors to obtain PIC;
- require benefit-sharing as a condition for obtaining a collection permit;
- establish a national biodiversity board or its equivalent to administer access regulation;
- provide protection for indigenous people's knowledge and innovations;
- require that the rights of PIC and benefit-sharing extend to local communities;
- identify requirements for reporting and enforcement;
- encourage technology transfer;
- require use of contracts such as material transfer agreements, commercial research agreements or academic research agreements;
- require that any collection does not endanger biological diversity.

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5 Mugabe, J. *et al* (1995), *Regulating Access to Genetic Resource: National Policy, Legal and Administrative Regimes.* Background paper prepared for the Secretariat for the Convention on Biological Diversity, Geneva.

One of the main obstacles to formulating access policies is the lack of effective methods for valuing biodiversity.[6] Developing countries can enhance their ability to derive benefits from biological resources by seeking new ways to add value. The value of such raw materials is relatively low. Value can be added by establishing or encouraging institutions to undertake identification, collection and screening of biological resources. This will enable the developing countries to share the benefits of biotechnological research and strengthen their scientific, technological and institutional capacity. Such technological capacity could be applied in the development of other sectors of the economy.

BIOPROSPECTING AND ACCESS AGREEMENTS

Bioprospecting refers to the research, collection and utilisation of biological and genetic resources for purposes of applying the knowledge derived therefrom to scientific and/or commercial purposes resources.[7] Bioprospecting has to be done in line with the provisions of Article 15 of the CBD. Research agreements must be signed between the prospector and the Principal (i.e. the agency or regulatory body) granting access to the genetic resources.

There are different types of Research Agreements. The most common ones include:
(i) Academic Research Agreements (ARA);
(ii) Commercial Research Agreements (CRAs); and
(iii) Material Transfer Agreements (MTAs).

These agreements require the prospective candidates to satisfy certain requirements and undergo an application process, managed and enforced by an authorised agency.

Academic Research Agreements are intended purely for academic or scientific purposes. Commonly, developed country universities, botanic gardens or research institutions sign research agreements with collaborators from developing countries. These agreements sometimes include specific provisions for return of benefits to the developing country collaborators and biodiversity conservation programmes in biodiversity-rich areas. Some of the benefits include: publications; literature searches; equipment; lab supplies; access to international funding; building of

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6 See Brown, K. and D. Moran. 1994 in Sanchez, V. and Juma, C. *Biodiplomacy: Genetic Resources and International Relations.* ACTS Press, Nairobi.

7 Reid, E. *et al* 1993, *Biodiversity Prospecting.* World Resources Institute, Washington, DC.

infrastructure; fellowships or training of local scientists; deposit of research results, etc.

Commercial Research Agreements (CRA) are used if the bioprospecting is intended directly or indirectly for commercial purposes.[8] Many research institutions and botanical gardens, such as the Kew Gardens of UK, have developed collaborations with private companies (e.g. pharmaceutical companies) who help them to underwrite the costs of the research programmes, especially those with potential commercial outcomes. In some cases, agreements for commercial collections are signed with developing country collaborators. CRAs include other elements not included in ARAs such as loyalties; intellectual property rights or patenting issues; future supplies of raw materials; exclusivity for sole use samples; confidentiality; advance payments; and the disbursement of commercial revenues.

Material Transfer Agreements (MTAs) are a form of contractual agreements, ranging from letter statements to detailed negotiated contracts, often used for transfer of genetic materials between public sector laboratories to private sector laboratories or biotechnology industries. MTAs have the advantage of binding the parties involved and their successors to an agreement regardless of the status of a patent. The key elements included in MTAs include: what materials are being transferred; the nature of compensation (fees or loyalties); and the scope of the licence (non-exclusive, non-transferable or revocable).

ADMINISTRATIVE ARRANGEMENTS

National policies and legislation on access will be ineffective if they do not have clear provisions for institutional arrangements necessary for their enforcement. Key elements include: designation of the responsible agency (authority); outlining of clear procedures and mechanisms for handling the access applications; determination of PIC and for monitoring the implementation of the various research agreements and contracts. It is necessary to create National Biodiversity Boards, or their equivalents, to oversee the development and implementation of the access policies and to administer and monitor the various bioprospecting relationships. The participation of various stakeholders, including the affected local communities, is critical. They must be informed of all the discoveries and the development of any commercial products from the collections.

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8 The distinction between commercial and academic research agreements is difficult since the latter often leads to commercial application.

CONCLUSION

As a matter of priority, African countries should embark on implementing Article 15 of the CBD (on regulation of access to genetic resources and the equitable sharing of benefits from the use these resources). This will require putting in place regulatory framework (policies and laws); clear access guidelines; institutional mechanisms; and equitable benefit-sharing arrangements. Furthermore, it will require building national capacities in 'Biodiversity Prospecting' such that there are national experts who are capable of negotiating favourable terms and working very closely with the biodiversity prospectors to ensure that African countries reap maximum benefits from their biodiversity. The way forward to regulate access to genetic resources in African countries should take a gradual incremental approach. All existing human potential (experts) and the policy, legal and institutional régimes should be considered and utilised before seeking for new ones.

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CHAPTER 20

The Role of Valuation in Policy Formulation for Biodiversity Conservation

Sikoyo George Michael
MUIENR

INTRODUCTION

Environmental economics as a developing and growing discipline plays a role in the identification of efficient natural resource management options for sustainable development (Munasinghe, 1993). It is an essential bridge between the traditional techniques of decision-making such as cost-benefit analysis and the environmentally sensitive approach now emerging. The goals of environmental economics include the incorporation of ecological concerns into the conventional framework of human society. Specifically, environmental economics:

a. explains the causes of environmental degradation;

b. identifies policies in the cost-benefit analysis framework relevant for the sustainable management and resilience of ecosystems;

c. monitors environmental progress or changes through natural resource accounting (NRA), which is subjected to the genuine saving analysis (like GNP) and finally;

d. plays a role in the valuation of environmental assets, specifically those that are not priced.

Valuation is a tool for organising information in an efficient way. Most specifically, valuation is defined as the assignment of a monetary value to economic goods and services and in particular to environmental resources (Maler 1997, Dixon et al 1994). For most conventional goods and services, valuation is done by pricing boards (agricultural pricing) by trade unions and Central banks. However, there exist a substantial number of goods, services and factors of production that are not assessed an economic value at all.

The purpose of the valuation technique is to identify "the correct prices for these goods and services. The value attached to a good is measured from the people's preferences for these goods and services provided by the environment in question which can be expressed in monetary terms. Not all environmental services can be

economically valued at present. For example, environmental degradation like pollution which spans across borders: how much worth is it? Another example is the effect on community co-operation from environmental programmes like the Mgahinga Bwindi Impenetrable Trust Fund in south-western Uganda. The value from co-operation and participation as such cannot be valued and should not be valued because of arbitarity of the resulting value.

This paper looks at why valuation is important and goes further to discuss the valuation techniques that are relevant in policy formulation and analysis of projects and decisions made in biodiversity conservation.

Why is valuation important in policy formulation?

The reasons why valuation is important in policy formulation include:

a. The determination of a precise value on environmental and natural resources is an important step in incorporating the costs and benefits of using such resources into the conventional calculus of economic decision-making.

b. The outcome of valuation enables projects and policies to be re-defined to mitigate harmful environmental and social effects.

c. Valuation contributes to the analysis of impacts of macroeconomic policy changes as well as developing the evolving concept of natural resource accounting, so-called "green accounts" (Sinden and Worrel, 1979, Hufschmidt et al 1983; Dixon 1986; Winpenny 1991; Munasinghe 1993).

d. It demonstrates in economic terms the value of biological resources to a country's social and economic development (McNeely, 1993). This would provide a justification for more effective government action, often through the use of economic incentives for conserving resources (McNeely, 1988).

e. The values derived from the valuation process help in the identification or approximation of the optimum either at the *ex ante*, that is to say before deciding on a type of regulation, or *ex post* after a regulation has been imposed, to see if the regulation has achieved the desired optimum (Turner and Pearce, 1993). The optimum being defined as that level of welfare where society is as well off with a change in environmental quality as they were before the change, thus achieving economic conditions of pareto efficiency (Varian, 1993).

f. Valuation demonstrates the importance and effectiveness of environmental policy. For instance, how relevant is the introduction of the multiple-use policy or revenue-sharing in the conservation efforts of the Uganda Wildlife Authority (UWA)? The question is difficult to answer because many of the benefits of such policies do not show up in the form of immediate gain. The benefits may be found in the local community's quality of life rather than in any increment to a nations economic output. Alternatively, it may be found in the improved park relationship between the local community who were once denied access to the park and the park management authorities.

g. The notion that the environment is a "free good" is eliminated because of the absence of markets in them. Placing values on the goods and services produced by Bwindi Impenetrable Naional Park (BINP), Mt. Rwenzori, Semuliki and Kibale national parks helps societies learn that natural environments are not free goods; they have bounds to what they can provide (OECD, 1992). Not valuing them perpetuates the "free good" syndrome and anything that is free tends to be over-exploited. Valuation in this case corrects the economic distortion in the market-place.

h. Valuation serves the quasi-political end of demonstrating that natural environments matter. This is important in countries where development activities, including agriculture and the building of highways have sometimes been implemented to the detriment of the tropical rainforests and other natural environments (Grainger, 1993). What is even important is the need to demonstrate the value of these resources to the local governments living in and around these natural environments. "Importance " is often best demonstrated by putting the environment on the same economic footing as the benefits of economic development, that is to say by using money values.

VALUATION TECHNIQUES

From the economic standpoint, the total economic value of a resource (TEV), or when considering projects which involve considerable change in land-use (Irreversible), it may be useful to consider the total economic value of the area, both prior to the development and subsequently after the development. The determination of the total economic value of the environment should enable more rational decision-making as planners and politicians will be able to compare like with like (money with money) and they will be able to see the true value of biodiversity or environment. TEV includes both the marketed and non-marketed goods. The total economic value is categorised into the following values:

Use values

a. ***Direct-use values***: Direct-use values are the resources and services provided directly by the resource. These include the use of forests and wetland for timber and for recreation or fishing, respectively.

b. ***Indirect-use values***: These are the benefits derived from ecosystem functions such as a forest's function in protecting the watershed, nutrient cycling, air pollution reduction and carbon. These have monetary values which, if included by planners in their plans, will serve to protect the environment.

c. ***Option value***: This relates to the amount individuals would be willing to pay to conserve a resource or some part of it for future use (I don't use it now, but I may in the future). This is like an insurance premium, value or bond.

Non-use values

These values are difficult to describe but several authors have recognised the following divisions:

a. ***existence value***: The value associated with the knowledge that the resource exists. Existence value is unrelated to current use or option values. For example, the people from the western world who make monetary contributions for the conservation of certain ecosystems or species of animals and plants like the Mt. Gorilla in Bwindi Impenetrable National Park in Uganda and yet they will never see them. They will be satisfied to know that the Mt. Gorilla exists.

b. ***Vicarious use value***: This represents the enjoyment received by people from the picture, print and broadcast media.

c. ***Bequest value***: The satisfaction derived from protecting a resource for future generations.

d. ***Stewardship values***: The value derived from guarding or protecting a resource.

e. ***Cultural value***: The satisfaction derived from religions or cultural beliefs.

f. ***Intrinsic value***: This refers to the resources value "in and of itself" (some say this is equivalent to existence value).

In summary, we may write: TEV = UV + NUV or,
TEV = [DUV + IUV + OV] + [NUV]

Figure 1 shows the categories of economic values attributed to environmental assets. From the left-hand side, values are highly tangible and become progressively less towards the right-hand side. This determines the valuation technique that is most appropriate in each case.

Critique of total economic value

a. Not all values of any ecosystem can be captured; what is valued is merely economic values. What valuation does is to capture instrumental values.

b. Ecologists believe that TEV is not the whole economic story. Some underlying functions of ecological systems which are prior to the ecological functions that have not been discussed fully such as watershed protection, recycling of nutrients and biodiversity conservation are not captured. These are called primary values (Turner, 1992). These are systems characteristics upon whichall ecological functions are contingent. There cannot be a watershed protection function, but the underlying value of the system as a whole. There is a glue that holds everything together and it has an economic value. If this is plausible, then thee is a total value to an ecosystem/ ecological process which exceeds the sum of the values of the individual functions.

TECHNIQUES USED TO DETERMINE UNPRICED VALUES

Table 1 categorises valuation methods according to which type of market (conventional, implicit, or constructed) they rely on, and by considering how they make use of actual potential behaviour. Each of the techniques is briefly described under the conventional, implicit, and constructed markets.

1. Conventional market

Under this category we have the effect on production, effect on health and defensive or preventive cost. They are based on the actual market behaviour.

a. ***Effect on production***: Externalities associated with projects may affect the output, costs and profitability of producers through their effect on their environment and the welfare of consumers through changes in the supply and price of what they consume, thus altering the consumer surplus. The value of the change in output may be taken as a measure of the environmental impact

which caused that change. For example, denied access of forest resources to the local communities may cause a rise in price of the products due to a decline in the quantities harvested from the ecosystem. Another example is water pollution, which may effect the value of fish caught from a fishery. This is a widely-used and intelligible technique.

b. ***Effect on human health***: In this approach, humans are treated as units of economic capital and their earnings as returns on investments. The technique focuses on the impact of bad environmental conditions on human health, and values this as being equivalent to the reduction in earnings it causes the individuals and society. It determines the economic costs of environmental-induced illness. The assumption that output is related to labour will not be realistic in all situations.

c. ***Preventive or defensive costs***: The value that people place on their environment may be inferred from what they are prepared to spend to prevent its degradation (preventive expenditure).

d. ***Replacement cost***: This is the cost incurred to restore the environment to its original state after damage has already occurred. For example, the recent three (3) giraffes transported from Nakuru national park, Kenya to Kidepo valley national park in north-eastern Uganda is a good case in point.

e. ***Shadow projects***: Shadow projects are a special case of replacement costs in which the expected environmental damage is offset by the inclusion of a project that would replace the lost environmental service (e.g. planting new trees to make up for those chopped down during a development). This offsetting project can be real, in which case it is an actual cost to the original scheme or notion, where it serves as an appraisal device and establishes that there would be sufficient resources generated by the project to provide compensation if desired. The recent degazetting of 1,000 ha from Namanve by the Forest Department about 10 km to the east of Kampala is a very good example. The degazetting was for industrial development and an equivalent amount of land is supposed to be bought somewhere else and planted with trees.

2. Implicit market

The techniques in this category are all based on actual behaviour. These include travel cost, wage differential, property values and surrogate goods.

a. ***Travel cost method (TCM)***: The value people place on a good's environmental location is inferred from the time and cost they incur in travelling to it. This approach derives values by studying the recreationist's behaviour, particularly costs in relation to travel. Although this is a widely used technique, there are a number of shortcomings:
   (i) assumes a single purpose trip;
   (ii) assumes that the cost of travel is equivalent to entrance fees in its ability to limit use;
   (iii) assumes that the same amount of wealth in each travel zone;
   (iv) gives the value of particular recreation site, but does not allow alternatives to be analysed;
   (v) takes no account of option value or existence value;
   (vi) requires a lot of data collection expensive to collect and analyse;
   (vii) difficult to determine the shadow value of a recreational traveller's time;
   (viii) TCM tends to provide estimates near the upper limit of indications of willingness to pay;
   (ix) difficult to identify and model changes in environmental quality.

b. ***Hedonic pricing/surrogate market***: In the absence of a direct market for environmental quality, the value may be derived from the prices of surrogate goods the most common of which are property and labour.

(i) *Land value approaches*: This technique values an environmental good on the basis of an inferred market value for properties. The demand for property is affected by its characteristics from which consumers derive utility. Supply is affected by the opportunity cost of providing properties with such characteristics. A change in the price of a property may result from a change in any one of the property's characteristics or in the opportunity cost of providing the alternative.

(ii) *Wage differential approach*: This is applied to derive value placed on pollution or degree of risk of a job. The differences in wage levels for similar jobs can be expressed as a function of different levels in job attributes that relate to working and living conditions in the area where the job is. For example, a higher wage is necessary to induce workers to work in areas affected by air pollution or to work with radioactivity. However, the limitations of the surrogate market approach include:

(a) there are large data requirements and needs statistical competence in generating and interpreting results;

(b) the estimating equations are highly sensitive to decisions about specification and estimation;

(c) the environmental variable must be capable of being measured (both to the scientist and to the population as a whole).

3. Constructed markets

Contingent valuation method (CVM) falls into this category. It is also referred to as survey based methods. CW uses survey methods to measure benefits by estimating either the consumers willingness to pay (WTP) for a good or service or consumer willingness to accept compensation (WTA) for the prospective loss of a good or service. The CW has problems including:

A. Bias: There are four (4) types:

1. strategic – over or understate case deliberately to influence result;

2. information – WTP may be affected by amount of information available onto which to base valuation;

3. instrument – choice of bid payment (i.e. tax or entrance fee) or initial bid level;

4. hypothetical – the situation one is reacting to is completely hypothetical and unrealistic and therefore leads to bogus responses.

B. CVM does not use observations of actual market behaviour, and does not test consumer's effective demand by requiring them to back up their opinions with cash.

C. Grossing up from a survey to the relevant population (what is the relevant population).

D. As no cash changes hands, there is no constraint on what people can bid in successive WTP exercises.

CONCLUSION

Environmental economics and the valuation of environmental effects on biodiversity play a critical role in providing a common numeraire or basis for comparing a variety of different outcomes, from the viewpoints of many sectors. Furthermore,

they also play a key role in facilitating pragmatic and efficient trade-offs among alternatives and policies. The limitation of economic methods have to be understood and continually kept in mind if they are to be used successfully in valuation processes. Value judgements about distribution and irreversible effects are unavoidable, but quantification in monetary terms of as many variables as possible is important in crystallising those issues involving implicit value judgements, which may otherwise be ignored.

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CHAPTER 21

Incorporating Costs and Benefits of Biodiversity Conservation into Economic and Policy Decision-Making Processes

Sikoyo George Michael
MUIENR

INTRODUCTION

Biodiversity conservation is a resource allocation problem. That is to say, the preservation of biodiversity is part of the general problem of allocating the economy's resources between competing ends like the protection of genetic resources, habitats, species and ecosystems versus agriculture and industrial development. Biodiversity policies are a set of operational objectives and measures in conservation by which the overall efficiency objectives can be attained.The aim is to remove inefficiencies in the provision of biodiversity benefits to society sustainably.

Most public activities not directly concerned with biodiversity have considerable effects and important consequences, positive or negative on the resilience of different ecosystems. The examples include irrigation schemes, hydro-electric power stations, dams and many productive activities. On the other hand, where biodiversity is taken into consideration, like in the gazetting of protected areas in Africa, it has always involved the exclusion of indigenous people and the prohibition of resource use (Pimbert and Pretty, 1994). This has been on the presumption that as little influence as possible is desirable for conservation. This led to eviction and the imposition of state controls which is a significant burden on the affected communities because of their dependency on protected areas for their livelihood and welfare. In some cases, some communities were forced to undergo not only economic hardships, but also difficult social and cultural adjustment processes (Gihmire, 1994). For example, Turnbull (1972) states that the IK ethnic group, expelled from Kidepo National Park in north-eastern Uganda, experienced almost total social collapse.

Many designated protected areas are suffering from encroachment and conflict, (Wells, 1992). Where there are fewer economic alternatives, the local communities may have no choice, but continue to use resources illegally once those outside the protected areas have been depleted. Increased economic insecurity also generates extreme antipathy and conflict towards official conservation measures. Open protest and rallies against protected areas, attacks on park guards, poisoning of animals and deliberate destruction of forests have become a common experience in developing

countries (Pimbert and Pretty, 1994. Talbot and Olinso, 1990; Gadgil and Guha, 1992; Steinberg, 1993).

Pressure on any remaining resources outside the protected area is a direct result of exclusion. Parks therefore become "islands" in a sea of incompatible land usage (Bwindi Impenetrable Forest National Park (BINP), Mt. Rwenzori and Elgon National Parks are examples). This can be detrimental to biodiversity conservation in the long-term, since surrounding degraded habitats can limit gene flow, alter nutrient flow and water cycles and produce regional and global climate change that may ultimately lead to the disappearance of these "islands" parks, (McNeely, 1994).

Brandon, (1995) has stated that it is neither politically feasible nor ethically justifiable to exclude people with limited resources from protected areas without providing them with alternative means of livelihood. Otherwise, attempts to conserve biodiversity to the exclusion of the local community are expensive and unsuccessful and will continue to fail (Baranga, 1994; Wells and Brandon, 1992). Therefore the restoration of the balance between nature and people should be taken into account as the starting point of future conservation efforts. To achieve this, cost benefit analysis (CBA) as a tool for decision-making is essential in biodiversity conservation and policy formulation. The requirements for CBA are such that the costs and benefits of each action have to be evaluated, assessed, and accounted for, bearing in mind the various stakeholders, including women. Women in Africa are important in food production, natural resource management and economic systems, and are therefore a major stakeholder whose efforts and knowledge in biodiversity conservation are not appreciated. The reason is partly because, their contribution may not always be obvious and yet they do play a critical role in their respective communities.

This presentation gives the justification for CBA, the steps to follow in cost benefit analysis of programmes, policies and projects and the boundaries of economic appraisal. Fundamental issues that constrain cost benefit analysis and how they should be handled at policy level are discussed at length. These include discounting; irreversibility; future generations; sustainability; risk; and uncertainty.

Justification for CBA of Biodiversity

Cost benefit analysis has a utilitarian foundation. The 19th century British Philosopher, Jeremy Bentham, summarised the criterion for judging rightness of an action as "the greatest good of the greatest number". In the context of biodiversity, a fundamental objection to utilitarianism is its anthropocentrism that people, and only people count. Thus, the fate of every species, habitats and ecosystems depends

exclusively on its contribution to the well-being of people. In this case, the costs and benefits in economic terms are defined according to the satisfaction of wants or preferences. A benefit is supposed to increase human well-being and a cost reduces it. CBA functions on the basis that a "better" allocation of resources is one that meets people's preferences (wants). While some people object morally to this anthropocentrism, a conservation programme in which benefits to humans exceed the total cost to humans is more likely to succeed than one that does not pass a cost benefit test. A second fundamental objection is that the quantification and valuation required for cost benefit analysis cannot be done.

It is therefore, necessary that biodiversity conservation and planning goals are in harmony with society's economic objectives. CBA as a tool in decision-making can be useful in the following policy areas:

a. appraisal of projects or policies for biodiversity conservation;

b. appraisal of and design of projects whose primary objectives are not for biodiversity, but which nevertheless may have significant impacts;

c. it is necessary in framing biodiversity policies or legislation with the objective of directing limited resources into conservation;

d. provides a useful framework for consideration of the issues involved and therefore helps in resolving conflicts in decision-making. This reduces the dimension of the problem;

e. ensures that the rational design of development projects is the rule rather than the exception. In other words, incorporating the effects of a project on biodiversity into the CBA at the very beginning is likely to harmonise the economic and biodiversity goals in addition to maximising social benefits.

f. it creates an awareness of the causes of biodiversity loss and their inclusion into the CBA. This enables decision-makers to identify a socially superior project design which increases the well-being of society.

Steps in the application of CBA in decision-making

It is possible to identify numerous policy alternatives. The difficulty that arises thereafter is the need to keep the decision problems ??? manageable and yet at the same time be able to formulate them so that relevant options are chosen. In CBA, the formulation of decision alternatives are an important phase which may become

intertwined with the evaluation process itself. The CBA has to bring about an allocation of resources that will reflect and balance all of the different objectives of a project. The following have to be considered when CBA is used in decision-making and setting of policies:

a. Setting of clear CBA objectives

Once the use of CBA has been decided on, the objectives have to be clearly defined. This is important in the formulation of and choice between options.

b. Considerations of options

The purpose is to have clearly defined alternative options. A range of technically, managerially and politically feasible options is compared with the "with and without" scenarios rather than the "before and after" situation. This permits the choice of a socially optimal biodiversity conservation project.

c. Specification of effects of each option

The impacts arising from each option have to be identified and specified systematically. The specification of impacts on biodiversity from a project is a problem area in CBA. These impacts can be captured through Environmental Impact Assessment (EIA), which should not only capture the biodiversity indicators but also social and physical indicators. Quantitative estimate of the effects of these changes on receptors like humans, animals, wildlife, vegetation, etc., and the impact on human welfare should also be specified. Some impacts on biodiversity are easy to predict. For example, resource requirements for each option could be estimated from technical specifications in terms of land, labour, capital and equipment for each year of project duration.

d. Evaluation of effects of each option

The evaluation process involves quantification. Quantification forces policy-makers to be explicit about the nature and magnitude of benefits and costs associated with alternative polices. It also creates pressure towards and provides resources for systematic data collection. Even if it fails to improve decision-making in the short-run, it increases the knowledge base upon which future policy decisions depend.

For projects whose primary objectives are not impacting on biodiversity, valuation procedures of standard inputs and outputs of the project are straight forward because market prices are used. However, where inputs and outputs do not reflect

true scarcity of resources, shadow pricing or accounting prices are used in the valuation procedure. Shadow pricing is the process of deriving prices for a good or service when there is no monetised market or when the market fails to price goods based on their true value. The following three relationships between market and shadow prices are possible:

(i) the market price exists and reflects willingness to pay (WTP), in which case market prices and shadow prices are the same;

(ii) market prices exist, but due to market imperfections or distortions, they do not reflect willingness to pay and therefore shadow pricing is necessary;

(iii) no market prices exist, but market prices for similar goods and services might help in determining shadow prices.

The evaluation of use values of biodiversity such as ecotourism or new prescription of drugs may be inferred from spending patterns. For example, how much do people spend to travel to Uganda to see the Mt. Gorilla in its native habitat? How much does society spend on preventive health care? However, measuring potential use value is difficult because it requires predictions about which species will be useful and how highly that use will be valued. Whereas the determination of use values is difficult, measuring non-use values associated with biodiversity poses even greater challenges. These values include the satisfaction derived from the fact that the Mt. Gorilla is saved from extinction or the sense of knowing that Bwindi Impenetrable Forest exists. Non-use values are not manifested even indirectly in peoples lives.

e. Elimination of less desirable options

This phase in CBA depends on the nature of the project, the number of technically feasible options for each component of the project and how well the objectives of the project are defined.

First, if the objective of each option is well-defined and the available technology limits the options to one or two other than that of no option, then the analysis takes on a relatively sophisticated level and decisions may be reached quickly.

Second, when dealing with projects whose objectives are rather broader and perhaps less amendable to precise definition or contain a number of components that are independent of the rest of the project, then a detailed examination is impossible.

Finally, the number of options can gradually be reduced by increasing further analysis. The collection of more information through research may lead to the emergency of main options. CBA in such situations is regarded as a closed loop from which a final decision will eventually be made.

f. Decision made

Through consultation with the decision-makers, options or alternatives that closely attain the stated conservation objectives of biodiversity are chosen. However, some areas will remain that cannot be captured in the CBA for either ethical or technical reasons. One of the principal uses of the CBA tool is to weigh the benefits against costs of an action. For example, a close analysis of the costs and benefits of Uganda's protected area could be demonstrated by deriving the sum of all benefits less the sum of all costs (Howard, 1995), which can be summarised as:

NBPAs =GBDUM +GBDU/NM + GBM + GBO -CM -CLO

Where

NBpm = Net benefit to society of maintaining Uganda's protected areas
GBDU1/M = Gross benefits derived from direct use of marketed products
GBDUINM = Gross benefits derived from direct use of non-marketed products
G13ju= Gross benefits derived from indirect uses
G13Nu= Gross benefits derived from non-use (option and existence) values
CM = Costs of Management
CLO= Costs of protection, in terms of lost opportunities for alternative development

BOUNDARIES OF ECONOMIC APPRAISAL

The problem arises from the differences in the way costs and benefits are valued by individuals, private firms and society as a whole. For example, in the forest sector, benefits from the sale of timber, fuelwood or other marketable products accrue to private owners or individuals. These are the only incentives for private investment. Benefits such as watershed protection are critical for enhancing social welfare, but there are no incentives for including these considerations in private decision-making. Furthermore, whereas the private owners are concerned with costs that affect their profit, the public on the other hand considers costs of downstream siltation, loss of biodiversity, habitats, ecosystems and soil fertility. Society and individuals therefore view costs and benefits in completely opposite terms. This may explain why Wells (1992), basing his analysis from an economic perspective argued that the underlying causes of blodiversity loss are due to the imbalance in

costs and benefits of biodiversity conservation at the global, national and local levels. This argument is showed by McNeely (1994); Durbin (1994); Steinberg (1993); and Gihmire (1994) among others. How the imbalance arises is shown in Table 1 below.

Table 1

The Benefits and Costs of Protected Areas at Three Spatial Scales

	Significant costs	**Significant benefits**
Local	Opportunity costs e.g. loss of access	• Consumptive benefits e.g. resource collection
	Indirect costs e.g. crop damage	• Recreation/Tourism • Future values
National	Opportunity costs e.g. opportunity foregone to use land for other purposes	• Recreation/Tourism • Watershed values • Future values
Global	Minimal costs	• Biological diversity • Non-consumptive benefits e.g. existence of wildlife • Ecological processes e.g. the protection of international river basins, climate modification; • Education and Research • Future values

(Source: Wells (1992, p 241)

Table 1 above shows that, whereas most of the benefits from conserving biodiversity are global, most costs are borne nationally and locally. At the national level, the costs named are those related to the management operations, and the opportunity costs if there is a land shortage (referring to the foregone opportunities to develop the area for alternative purposes such as agriculture or hydro-power). At the local level, the costs include loss of access to forest resources, and opportunity costs associated with foregoing the opportunity to use the land for agriculture or timber harvesting. This is more felt in areas with high population density and land insecurity as is the case in Mt.Elgon and Rwenzori national parks, Kibale and

Bwindi Impenetrable National Parks in Uganda where consumptive benefits from grazing, hunting and collection of products are prohibited in all parks.

The relevancy of Wells, (1992) economic approach to the understanding of the imbalance of costs and benefits is that it helps at the time of appraisal of biodiversity conservation projects or new policies the identification and distribution of costs and benefits. This enhances improvement in decision-making by exposing real costs and benefits for certain courses of action previously carried out in a false belief that biodiversity is not important or the environment is "free". During the appraisal of projects, the following should be taken into account:

a. who are the gainers and losers from an action, policy or project?
b. are the various socio-economic groups clearly understood and defined?
c. what market distortions might bias the decision-making process? If any distortions occur at all they should be highlighted and where possible corrections are made accordingly;
d. what conditions encourage sustainable use of biodiversity that have to be promoted?

The growing concept of sustainability implies that the utilitarian cost-benefit analysis paradigm commonly used in conventional economic analysis has to be modified. The modification has to allow the integration of concepts like discounting, sustainability irreversibility effects, risk and uncertainty and future generations so that decision-makers make well-informed decisions.

Discounting

The project costs and benefits are normally spread over time. This is achieved by applying discounting to adjust all transactions to the present, so that they are comparable (Price, 1989). Economists use discounting to allocate resources to activities with the highest returns. Discounting:

a. is away of comparing projects with different time-scales;
b. is a way of taking into account time preferences of governments/ society and individuals, and;
c. discriminates projects according to their profitability.

In discounting, a discount rate is used to represent the implied time preference held by an individual or by society as a whole. The discount rate to use for a particular analysis is a very controversial issue. Private firms have a higher discount rate than society as a whole. The reason is attributed to the need to avoid the risk of waiting

to receive benefits. Society may be willing to spread out benefits over time, in spite of the assumption that doing so entails greater risks. Society in this case may be in a better position to pool risks from a large number of independent projects. To add to the complication, poor rural communities and mostly women have often a very high discount rate. The immediate pressures from hunger and poverty force people, particularly women to forgo possible benefits from a forest in order to provide goods they need for immediate survival such as food, fuelwood and fodder (Panayotou, and Aston, 1992). For policy purposes, these projects whose benefits will not be realised until the distant future, and which would be heavily discounted, can be dealt with by considering the following:

a. attempting to quantify and value biodiversity resources as much as possible;

b. highlighting important biodiversity values (not quantified) left out in the discounting process;

c. establishing a sustainability criterion to enhance the decision-making process. This overcomes the problem of choosing which discount rate to use because economists have had a long running debate over whether discount rates should be lowered and if so, how large should the reduction be (Grainger, 1993).

Sustainability criterion

The concept of sustaianability criterion applies to the use of critical and renewable natural capital. Biodiversity is a component of critical capital, which are resources essential to life and cannot be substituted, or replaced by manmade capital. Therefore it could be exploited to extinction. On the other hand, natural capital (renewable resources) which includes forests, soil fertility etc. are resources which can be partially replenished or substituted by manmade capital. Any decisions made should be for sustainable-use management like ecotourism and multiple use. Where communities, most especially women, have been the beneficiaries of the resources, shadow projects could be put in place. Shadow projects are a special case of replacement costs in which the expected damage from an activity is offset by inclusion of a project that would replace the lost benefits. For example, the establishment of ethno-botanic gardens in on-farms so that the desirable resources once accessed in the forests or wetlands is available to the affected communities. During project design, compensatory projects like village women co-operatives for arts and crafts promotion and ectourism are built in. Where certain projects displace local communities like the case of Kibale national park, actual compensation could be made to the losers by the gainers by resettling them somewhere else.

Irreversible effects

The outcome of undertaking an action without knowing for certain what will happen may create irreversible consequences (Pearce and Turner, 1994). For example, the elimination of species, habitats and ecosystems leads to biodiversity loss. Once extinct, we cannot recreate them and neither can we be certain of what happens if continued loss of biodiversity occurs. This is particularly felt if the loss sets in chain cumulative processes or permanently alters the state of nature. Under such circumstances, irreversible decisions carry a cost, which increases over time. A project with major irreversible processes requires serious thought as to whether or not to proceed at all. The way out is to measure the cost of not proceeding in terms of the benefits that would be foregone (opportunity cost), by abstaining from the proposed developments (MUIENR, 1994).

Risk and uncertainty

Risk and uncertainty are often used interchangeably. Risk is an event with a known probability, whereas uncertainty is an event with an unknown probability (Constanza, 1993; Affinadula and Sikoyo, 1996). The reality of life is that we do not know what the consequences of undertaking a particular project would have on biodiversity or other stakeholders like women, whose role in most African societies is not appreciated. The reasons for this include the lack of understanding of how ecological functions work and rnan-made substances interact with the environment. Individual behaviour often indicates an aversion to risk, while for governments or society, the cost of risk disappears because it is shared among many individuals. However, because of the public nature of the goods provided by the environment (biodiversity), the risks cannot be shared in the way that is possible in many projects. And government or society would prefer that private decisions made should display an aversion to risk. For policy reasons, it is necessary that the risk probability and severity of damage could be used to determine an expected value of potential costs, that would be used in CBA. The risk probability may be used to devise an insurance scheme to protect against the risk. The expected value of costs or insurance against an eventuality cannot be estimated because the increasing scale of human activity, complexity of environmental and ecological systems, and lack of knowledge of how these systems might be affected all emphasise the need to deal with uncertainty more explicitly. It requires a cautious approach. The way to incorporate uncertainty considerations in project level analysis would be to:

i. invest in collecting more information. This is not always possible or cost-effective in the course of the standard project life cycle;

ii. conduct sensitivity analysis (SA) to determine the variables that are most important to the success or failure of the project;

iii for variables that are likely to contribute to the success of a project, sensitivity analysis highlights the variables that require scrutiny, either in the course of seeking further information for the project or during project implementation.

The issue of risk and uncertainty play an important role in the valuation of biodiversity and policy formulation. Option value is the premium that consumers are willing to pay to avoid the risk of not having something available in the future. Quasi-option value on the other hand is the value of preserving options for future use in the expectation that knowledge will grow over time. For example, the indiscriminate destruction of forests leading to loss of biodiversity reduces the chances of gaining knowledge through the expansion of knowledge in the future.

Other important sources of uncertainty linked with environmental issues include uncertainty over land tenure, which leads to deforestation and unsustainable agricultural practices and uncertainty of resource rights. Policy-makers could institute land reforms that take into consideration the role of women in land ownership and resource management.

Future generations

The constant capital rule for sustainable economic development requires the adoption of an explicit equity (justice) and asset transfers across people and through time. The ethical argument is that future generations have a right to expect an inheritance (in the form of natural capital/human capital bequests) sufficient to allow them the capacity to generate for themselves a level of welfare no less than that enjoyed by the current generation (Pearce and Turner, 1994). This calls for an inter-generational social contract that guarantees the future the same "opportunities" that were open in the past (Page 1982).

The implication above is that today's generation has an obligation to future generation and that traditional forms of ethical reasoning and decision-making (cost-benefit analysis) must be broadened. The utilitarian cost-benefit paradigm therefore has first to be modified to allow for inter-generational equity, (Barbier, 1992). Therefore during appraisal, the impact a project will have on environmental assets, such as critical natural capital (biodiversity), which are substitutable and have to be conserved, may also be introduced as constraints on cost-benefit analysis. The functioning of the economic system before making a decision as to whether to invest in the project or not has to be looked into. There should be a moral

imperative to care for the next generation, even though it cannot readily be interpreted in terms of utilitarian gains and loses. The decision not to invest in certain projects that do not account for future generations due to environmental reasons might have to be borne by the current generation at a higher cost in order to maintain the environment.

CONCLUSION

Projects analysed using traditional cost-benefit analysis often seek to know the contribution that a particular project makes to a country's economy without considering the widespread long-term effects it may cause to biodiversity. Therefore, for the formulation and implementation of effective policies, it is necessary that biodiversity concerns are incorporated into the cost-benefit analysis framework. The objective would be to design incentives and measures that reduce or enhance negative or positive project impacts, respectively. The analysts and policy-makers have to ensure that fundamental issues such as discounting; sustainability; irreversability; risk and uncertainty; and future generations are introduced as constraints on cost-benefit analysis.

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PART SEVEN

CAPACITY-BUILDING FOR BIODIVERSITY CONSERVATION IN AFRICA

CHAPTER 22

Education and Training in Biodiversity

Ms Beatrice Adimola
National Environment Management Authority
(NEMA)

INTRODUCTION

"Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues.... Both formal and non-formal education are indispensable to changing people's attitude so that they have the capacity to assess and address their sustainable development concerns. It is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision making", Agenda 21, Chapter 36, UNCED 1992.

Education is a major tool for capacity building and developing human resources. Many times well-intentioned and planned projects are started but fail because there was an omission of education component, communication strategies, or gender perspective. The Convention on Biodiversity recognises the key role education can play, hence the inclusion of an article on education. Article 13 which focuses on Education and Awareness states that "contracting parties shall,

(a) Promote and encourage understanding of the importance of, and the measures required for the conservation of biological diversity as well as its propagation through media, and the inclusion of these topics in educational programmes and

(b) Co-operate, as appropriate, with other states and international organisations in development education and public awareness programmes, with respect to conservation and the sustainable uses of biological diversity".

Education is defined solely in terms of its intended outcome. Education or biodiversity seeks to change people's attitudes and behaviour towards the resources. While increased awareness and understanding may be important steps to conservation of biological diversity, it is important to go further and use education as tool to promote participation. Education for biodiversity conservation must be planned for and policy statement translated to reality on the ground.

This session seeks to discuss the role of education, women and environmental education, initiatives in environmental education, constraints and prospects for education in biodiversity.

THE ROLE OF EDUCATION AND TRAINING IN BIODIVERSITY

It is widely accepted that education and communication are essential tools in promoting conservation efforts. On the other hand, this conviction is not matched by practice in reality. In the past, in Africa, our ancestors lived in harmony with the environment. Before the introduction of formal education, knowledge was passed on by the older people at the fireplace in the evening. During the day, the young were shown the species in the field. Knowledge, values and skills were perpetuated continuously.

Education can:

- enhance perception and understanding of the importance of biodiversity;
- help bring about participation and therefore it is worth investing in. A multiplier effect is created at the grassroots level when people are educated about an issue;
- promote awareness, acquisition of knowledge and skills, change in attitudes, values and commitment;
- facilitate a two-way learning process leading to mutual benefit;
- empower individuals and communities to work out solutions to their problems;
- provide opportunities to develop and practice skills in problem-solving and decision-making, to assess and evaluate complex and often conflicting evidence concerning conservation issues and to make rational, informed decisions concerning their own attitudes and behaviour.

The guiding principles of environmental education

The philosophy and concept of environmental education was developed in the 1970s at the Tbilisi conference. They are internationally recognised and widely used. They are so fundamental that they have not changed in the last twenty years. The goals, objectives and guiding principles are set out below:

GOALS		
to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;	to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills, needed to protect and improve the environment;	to create new patterns of behaviour of individuals, groups and society as a whole towards the environment.

Objectives of environmental education

Awareness: To help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems.

Knowledge: To help social groups and individuals gain a variety of experience in, and acquire a basic set of values and an understanding of the environment and its associated problems.

Attitudes: To help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.

Skills: To help social groups and individuals acquire the skills to identify and solve environmental problems.

Participation: To provide social groups and individuals with an opportunity to be actively involved at all levels in working towards the resolution of environmental problems.

Some of the guiding principles

Environmental education:

- considers the environment in its totality: natural, technological, social and cultural, etc.;
- is inter-disciplinary in its approach;

- is a continuous, lifelong process;
- focuses on current and potential environment and development situations;
- examines major environment and development issues from local, national and international co-operation;
- stresses the value and necessity of local, national and international co-operation;
- explicitly considers environmental aspects in plans for sustainable development/growth;
- helps learners discover the real causes of environmental and development problems;
- enables learners to assume roles in planning their learning experiences and making decisions;
- emphasises the complexity of environmental and development problems and thus the need to develop critical thinking and problem-solving skills;
- relates environmental sensitivity; knowledge, problem-solving skills and clear values;
- employs diverse learning environments and educational approaches to teaching/learning in, from and about the environment and development.

Education Programmes must take into consideration people's attitudes to and perceptions of their environment and resources (see Box 1 below).

WOMEN AND BIODIVERSITY/ENVIRONMENTAL EDUCATION

Although women in Africa have knowledge and awareness of the environment, there is a need to develop their knowledge further so as to empower them to use the resources sustainably. Women can contribute a lot to the transmission of knowledge, social values and development of human resources. These are important attributes that need to be promoted and enhanced. The issue which was raised at the Global Assembly of Women and the Environment in Miami, USA (1991) is how to design and deliver environmental education which is geared towards addressing and meeting women's learning needs (Leo-Rhynie, 1993). Other issues which are to be considered are:

- the perception and participation of women in the promotion of environmental management;
- the lifestyle and nature of women's work;
- women's exposure to technology.

BOX 1: Some Zambian Perceptions of the Environment

Wild Animals

- There are still a lot of wild animals in Zambia. They cannot finish. Any animal which kills a person should be killed too.
- The government stops us from killing the animals, so we have to go to hunt when the government is not seeing us.
- Rich men with big guns come to hunt while we look on. They kill large numbers of animals while we starve for meat.
- They asked us to move from our original village so that they could create a national park. Who benefits from the national park?
- In our language no-one is called poacher. We are hunters and not poachers.

Fish

- Fish drop from the sky with rain so it cannot get finished from the rivers.
- We cannot observe the non-fishing season, we will starve.

Forest

- Trees cannot finish in Zambia.
- Which persons or people plant trees? They must be crazy.
- Nobody plants trees. They grow on their own.
- We still have a lot of trees in the Northern Province, therefore deforestation is not a problem.
- If you advise to plant trees, when shall we plant maize?
- The trouble with trees is that they take too long to give you the fruits.
- Forests should be burnt to remove all dangerous animals.

Juliana Chileshe

Examples from the Commonwealth

- Commonwealth country reports presented at the Global Assembly of Women and Environment: Using education as a strategy in the process of addressing local environmental problems.

- Malaysia Project MY0032 Rural Community Programme in Sarawak: Addressing barriers to women accessing education in a project.

Approaches

The majority of the women live in the rural areas and it is vital to target them in order to contribute to a wider distribution of sustainable development.

- The "bottom up" approach to education can be very effective in initiating change at the local level. The approach addresses specific problems, promotes problem-solving by the local people, and motivates them as they see the results. Initiatives can come from the top and be effective. This should not be exclusive of the top to bottom approach.

- Women should be involved right from the beginning in designing the educational programmes.

Constraints to education and training in biodiversity

Constraints can be external factors such as legislation or internal such as perception.

BOX 2

- Lack of capacity of education institutions to integrate new concepts into their programmes.
- Conceptual complexity. Environmental education is a new dimension and not well understood.
- Lack of materials on biodiversity.
- Logistical. Perceived lack of funds, time, materials etc.
- Information not readily available or disseminated.
- There are few available courses addressing the African context apart from Wildlife colleges etc.
- Lack of ownership.

Constraints should not be perceived as a deterrent to initiating educational programmes. Groups should not doubt their capacity to overcome such constraints. It is important to get people to value education, see the need for it and budget for its inclusion in their activities. Ensuring the integration of education component in every project is a cost-effective way of overcoming some of the constraints. Constraints should be looked on as challenges that should be addressed.

Prospects for education and training in biodiversity

There are many opportunities for education and training in biodiversity that have not been developed. Africa is know for being a continent of great potential. The onus is on us to take the initiative to tap the opportunities for our own benefit. The opportunities range from a wealth of knowledge; abundance of unique resources; and a vast population that can contribute to conservation activities. The population can be divided into target audiences as shown in the table below.

Need for research in biodiversity education

TARGET GROUP	AIMS
• School-going children • Initial training programme • Teacher-training programmes • General education • Agricultural colleges • Game Rangers • Forest Rangers • NGOs • Out-of-school youths • Women's organisations • Policy-makers • Local authorities • Community training programmes • Journalists • Public	• Incorporating biodiversity concerns into the study programmes • Plan and implement projects that promotes participation of target groups with communities • Incorporate biodiversity into sector activity • Integrate biodiversity into group's activities

Educational research should strive to improve the education process of policy-making, implementing, teaching and learning levels:

- Investigate activities designed to build up and document insight related to biodiversity issues.

- Developing education and training materials on biodiversity.

CHAPTER 23

Curriculum Development and Biodiversity

Ms Beatrice Adimola
National Environment Management Authority (NEMA)

INTRODUCTION

Curriculum is being taken to mean in the broadest sense here. Curriculum development is a complex process but can be made easier and the content updated regularly. There is need for a thorough review of existing curriculum to ensure that biodiversity/environmental issues are integrated. It is important to design the curriculum with the people, especially in the non-formal sector. These are simple guidelines that would need to be developed further. This section seeks to:

- Discuss valuing biodiversity within the formal and non-formal curriculum. What do we want to achieve in the curriculum?
- Discuss issues of the curriculum content, objective, resources and evaluation.
- Provide examples of activities on biodiversity.

CONTENT

In designing the curriculum, the content should be based on:

- building on existing courses or programmes in schools and institutions;
- continuing and emerging issues in biodiversity;
- specific contextual problem in the local area;
- gender and the environment;
- women and biodiversity;
- economic, social, political and cultural issues as well;
- traditional knowledge.

DEFINING THE OBJECTIVES

Right from the onset of developing the curriculum there needs to be a clear understanding of the terms biodiversity and education and other concepts being promoted. Activities can be designed based on the objectives such as the one used by a girl's boarding school in Uganda. The table below shows the criteria they use

for developing their objectives and implementing strategy for their school environmental education programme.

Awareness	Knowledge	Skills	Values	Participation

The aim is to have *breadth* and *depth* in the curriculum design and not only limit it to awareness, providing new knowledge, or teaching new skills or imparting a particular value or mobilising people to solve one particular problem.

Resource Materials: Resources should not be limited to written texts only. Crafts, and locally-developed materials are also effective. A common problem in developing countries is the lack of written materials and documented case studies. There is also an attitude of expecting materials from other countries. We should train people to develop good low-cost materials. People can be encouraged to produce modules, newsletters, articles and leaflets on biodiversity.

Approaches: Approaches to implementing the curriculum should be varied depending on the target group.

Examples

- Plant kit for pupils developed by St Lucia National Trust.
- Modules from Friends of the Earth, Ghana. A multi-audience module designed to be used by teachers, clubs and adult educators.
- Sample low-cost materials, e.g. leaflets, pamphlets, brochures etc.

EVALUATION

Evaluation is the process of making judgements about the effectiveness of a learning programme. It is important to develop an evaluation procedure for a programme that has been developed. There is a need to review the existing curricula in Africa to assess whether they are achieving the stated objectives of environmental education. In the environmental education status report of most countries they acknowledge the existence of environmental education in their curriculum but the teaching does not sensitise the learners to take action. How can we ensure that the curriculum design for biodiversity education will be effective?

The evaluation of the biodiversity curriculum may involve:

- determining the extent to which the aims and objectives have been achieved;
- determining the extent to which the overall goals have been achieved;
- detecting useful outcomes which were not originally specified;
- determining the effectiveness/ineffectiveness of the implementation of the programme.

CHAPTER 24

Network Development For Biodiversity Conservation

Ms Betty Gowa
National Environment Management Authority (NEMA)

INTRODUCTION

Networks have been in use for some time now. Every individual and all organisations have external relations they co-operate with which are of great importance to their effectiveness, efficiency and survival. Our societies have been existing with social relationships that contribute to our well-being from time immemorial. For example, during the difficult time of death, information is disseminated very fast and relatives, friends and in-laws gather to soothe and sympathise with the bereaved. This is a form of networking.

WHAT ARE NETWORKS?

Networks are made out of existing systems and institutions or individuals that have a common interest in a particular area, in this case biodiversity conservation. The networking may be simple in nature involving manual or non-electronic exchange of data. For example reports, results of inventories, or any other information. It could also be semi-electronic involving exchange of data through physical exchange of diskettes. At its highest level, it could involve exchange through electronic mail connectivity.

In summary, a network has the following characteristics:

(i) Consists of three or more organisations;

(ii) *Has clear objectives or addresses a specified mutually-agreed upon need*: This factor is highlighted as a key to network viability. In order to generate interaction among different institutions in different geographical settings, there needs to be a common network. Network activities cannot be random. They should be guided by systems and strategies which offer viable prospects of achieving set objectives. Networks benefit from clear objectives and clearly-defined systems and strategies.

(iii) *Capacity and willingness to learn and share experiences and ideas*: Members must have the capacity and/or willingness to contribute

resources, time or information if the network is to operate effectively. This is a logical necessity of any collaborative action. Members should use their individual comparative advantage in certain areas to complement those of others. For example, institutions with the basic communication infrastructure (telephones, fax, E-mail, computers) necessary to bring network partners together may be able to complement the efforts of smaller organisations who may have field personnel with access to a wide range of experiences. A "give and take" (symbiotic) relationships has to exist. Underlying the capacity to contribute to the network is the presupposition that everyone is actually actively engaged in some work in their various areas.

(iv) Mutual trust and respect among the partners;

(v) *Partners in the network are equal and maintain their independence*: A balance between the nodes (members) of the network is important in order to realise the full potential both of the network and of the individual participants. Dominant actors run the risk of marginalising the efforts of individual sources of information and experience.

STRUCTURE OF NETWORKS

It is not necessary to have a central repository in a network. This is because there is a lot of data and sometimes it is best handled by experts in a particular field of biodiversity conservation. The best approach is for members of the network to easily access information that they require and add value to it either through analysis or integration with their own data.

Even though a hub may not be necessary in a network, someone or a particular institution must take responsibility to ensure that the network functions. The most important role of this sacrificial lamb is to ensure that data exchange standards are set and complied with. Data exchange protocols, data release policies, methodology for data collection and analysis etc. have to be agreed on.

FUNDING

Very few networks are financially self-supporting. Many rely on donor funding which is well known to be prone to swings of fashion. Obviously, running a network costs money and somebody has to keep the purse. Everybody in the network should contribute to this purse and/or get involved in fundraising.

In order to get everyone actively involved, the secretariat of such a network could be rotated among the main actors. Most importantly, is the willingness to participate and to be honest enough to recognise the source of information when it is used by another member of the network.

ADVANTAGES OF NETWORKING

- Promoting the exchange of ideas and information amongst individuals and groups who would otherwise not regularly communicate to each other. By promoting interaction and exchange amongst members, networking provides an active forum for debate and this could be a potential tool for lobbying and advocacy at policy levels.

- *Focus*: A network helps to focus the efforts of an often dispersed and hard-pressed community of development workers. The can also provide a common direction for collaborative efforts since they enable groups to join together on a limited agenda while maintaining their autonomy.

- *Resource use*: They have the potential to prevent duplication of efforts, especially in such activities as research and publication.

- *Synergy*: Networks offer the opportunity to use synergy of a group to find solutions to common problems. The pooling together and sharing of experiences acts as a catalyst in encouraging new ideas and forms.

Constraints

The two major constraints to networking are heterogeneity of context and heterogeneity of membership.

CONCLUSION

For a network to be successful, it must provide valuable services to the members. A network that has no real or valuable data will just be a white elephant. Internal evaluations of various networks have identified some major areas that require strengthening to bridge the gap between information production and its use. These are:

- tendency for networks to develop independently of one another with very little integration or exchange of information, especially in the field of environment;

- lack of clear understanding of the perceived needs of the end users for environment information and inappropriate formats;

- lack of mechanisms for incorporating environment data and information into the national development planning processes.

Strategies designed to overcome these weaknesses should place more emphasis on integrating networking into the decision-making process. In other words, investment returns from networking should be measured in terms of provision of relevant information for use in the decision-making process, and consequently better management and judicious use of natural resources. Information compilation and transfer processes and mechanisms – how they can be enhanced to maximise the impact of environment information on the decision-making process.

Things that need to be taken into consideration with networks are:

- the type and extent of environmental data generated by national institutions, agencies and programmes (format, scale, completeness of data, etc.);

- importance of current data collection and compilation practices in meeting national and sub-national development goals;

- identify successes and shortcomings;

- determine the current levels of effective application of data by end users; and the extent to which environmental data is integrated into the overall national planning process;

- determine the output forms which would allow end users to best be able to understand and use the data;

- produce the necessary programme framework for the country to develop appropriate interventions for supporting resource management decisions, including detailed national assessments; infrastructure development; training; technical backstopping; etc.

Requirements

- "One-stop" centre to act as referral for locating data or information;

- Standardisation of data and/or information;

- "Quick-look" images to assist users to decide on whether or not the data is of use to them;

- Publicity to increase the number of requests because a network is of no use unless it is used. Publicity may be through media, brochures, newsletters, etc.;

- Assessment of performance of the network – you need to prove that the data or information provided has been used and a difference in resource management registered.

Issues

Some members of the EIN would like to sell their data. Policies within the organisations require that they sell their data. The trend is to sustainability and hence some members of the network are forced to sell their data and costs may be prohibitive, e.g. Biomass, Surveys and Mapping. Institutions like MUIENR and NEMA may be able to provide data free of charge because they are primarily research institutions or because their activities are already financed.

Two forms of data exist: analog and digital. Analog data can be distributed without due reference to the original source while with digital data one has to have express permission from the source. Exceptions to this are when this has been processed further.

The issue of data quality exists everywhere. The current position is that you should quote the source of data and let the source defend the quality. Adequate acknowledgements have to be given for each dataset.

Development of skills – specific arrangement to train members of the network should be made so that they can contribute and get more out of the networks themselves. These skills may include writing newsletter articles, organising workshops and exchange visits. Of course, some of these skills may develop as a by-product of the membership. Concrete network activities help to consolidate networks and raise the confidence level of individual members.

Need for a structure – It is important to consider what form your network will take. Will it be a loose collaboration amongst members? Will you have a co-ordinating centre or hub? Networks seeking to achieve particular objectives by sharing out work among members so that each contributes to the whole usually require structured management processes. In other cases, particularly with local grassroots-

based networks, the emphasis is likely to be on loosely-structured network management which allows for sufficient flexibility.

Protocols of exchange – (modern technology). Biomass are on the Worldwide Web and therefore you can access their data easily.

CHAPTER 25

National and Regional Biodiversity Databases

Herbert Tushabe
MUIENR

INTRODUCTION

Basic definitions

In simple language, A *Data Bank* could be defined as any repository for data (the term *'data'* is defined below). The repository can take any form ranging from simple filing systems to more complex electronic systems such as computer databases, sometimes interactively linked with other forms of electronic media.

Biodiversity has been broadly defined as the *'variability among living organisms from all sources including*, inter alia, *terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'*. (UNEP, 1992).

While this paper will not attempt to examine the deep meaning of the term, it is worth emphasising that the study and the conservation of biological diversity focus on three levels:

- *genetic* level – variability within species;
- *species* level – variety of species within a region;
- *ecosystem* level – variability among habitats.

Biodiversity Data Banks therefore, whether national, regional or international aim at storing knowledge about the world's biodiversity. Though usually limited in scope by the spatial and time-scales on which they focus, they are generally concerned with the *compilation, processing, retrieval* and *dissemination* of biodiversity data and information.

At this stage, a basic distinction between *data* and *information* should be made.

- *Data* refers to observations, measurements or facts referenced to some kind of accepted standard. Data are subsequently integrated, processed, interpreted or manipulated in any other way to produce information.

An example of this can be recordings of plant species in a given plot through a given time-scale, e.g. number of species, the abundance, heights of trees, etc.

- *Information* on the other hand, is the knowledge (product) derived from analysis and interpretation of data. It is highly specific and designed to support decision-making. It subsequently has a shorter 'shelf-life'.

From the example given above, one can analyse the data to find out the rate at which plant species have been decreasing or increasing in a given time, which would give an idea on species loss or on the habitat's re-colonisation. It should be understood that the information so produced should be of value towards the decision-making process (as to how the area in question should be managed so as to achieve the optimal resource use and conservation-oriented goals). Information is usually accompanied by option analyses.

Most biodiversity data banks therefore store the data necessary for incorporation into the planning process in the conservation of biological diversity. Worth noting is that a thorough analysis should be done prior to the establishment of the data bank, such that the data collected and subsequently stored will be useful in supporting decision-making. This avoids such unfortunate situations like finding out that the data one has been compiling are of no value after huge amounts of time and resources have been spent.

BIODIVERSITY DATA-BANKS

I will examine some of the main types of biodiversity data banks and how they relate to each other. The classification so presented here is in no way standard, but has been done for convenience. In some cases, a single data bank may cover scales ranging from local to global. The commonest types are:

(i) sub-national and national biodiversity data banks;
(ii) regional and international BDBs;
(iii) meta-databases.

Sub-national and national biodiversity data-banks

The term *'sub-national databases'* will be used here to denote those databases that focus on part of the country's biodiversity, either a *geo-political* part, e.g. a county; or that relate to a specific departmental sector of the country, e.g. the wildlife areas. In both cases, these may ultimately feed into a national data-set, or may stand on their own. In some cases, the databases can feed into a central 'clearing house'

which then helps to co-ordinate the activities at the feeder ends and also helps to disseminate the information (WCMC, 1994).

Figure 1 shows the concept:

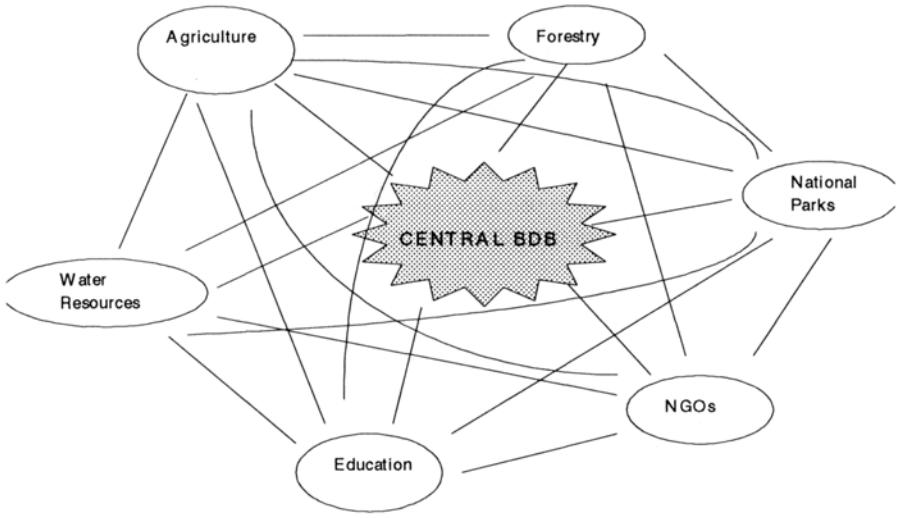

Figure 1: The biodiversity information network. Note that in some cases, the 'clearing house' may be missing all together, and sectoral data banks just share data amongst themselves. In other cases, the 'clearing house' may be responsible for disseminating the data and co-ordinating the activities. It is possible to have counties or districts in place of the departments.

Biological data banks with many recording centres spread over the countries include the Biological Records Centre (BRC) for the British Isles based in Monks Wood, Huntingdon; The Nature Conservancy (USA) with over 80 national and sub-national biodiversity information centres; among others.

Regional and International Biodiversity Data-banks

While there may be no clear-cut line distinguishing the regional and the international databases, I have preferred to consider them in different aspects. I will make the distinction clearer by considering what has been described as a *bioregion*, a land and water territory whose limits are defined not by political boundaries, but

by the geographical limits of human communities and ecological systems (WRI *et al*, 1992). It should be noted that concerted efforts in the conservation of cross-border ecosystems are essential for the maintenance of biodiversity integrity in these areas.

International biodiversity data-banks may involve more than one bioregion, e.g. a database of endemic bird areas (EBAs) or that of ethnobotanical plants of the world; or a database of groups of organisms found in protected areas of the world.

International biodiversity data-banks may range from holding a few species of special interest to many groups of organisms and ecosystems. In my view, it may not be practical to establish a global, or even a continental biodiversity data-bank involving all taxa. This, if it can be done, would be on a scale that may not be very meaningful for strategic planning of biodiversity. However, they are very useful in identifying areas where global conservation efforts can be intensified, e.g. a desire to protect all the endangered species of the world may call for a global database documenting where these species occur.

Organisations holding international databases include the World Monitoring Conservation Centre (WCMC) at Cambridge, UK, which holds data on trees of economic value, CITES-listed species, plant genetic resources, among others. WCMC also helps individual countries maintain and manage their own databases. Others are UNEP, IUCN and various secretariats of international conventions.

Meta-databases

Different in function from the fore-going, meta-databases contain references about the content and location of data and information holdings (McKenna, 1996). Meta-data are therefore high-level 'overview' or informational abstract that describe a particular dataset or institute that can provide access to the data. The meta-data can best be described as 'data about data'.

DATA/INFORMATION FLOW

Having examined the different types of biodiversity data-banks, it is important to consider how information should flow from one to the other. It should be stressed that data are not useful until they are transformed into information; and that information is not useful in it self unless it can be disseminated to the targeted audience at the appropriate time, and packaged in a way that the decision-maker will understand.

Figure 2 is a schematic representation of the relationships between the different data banks:

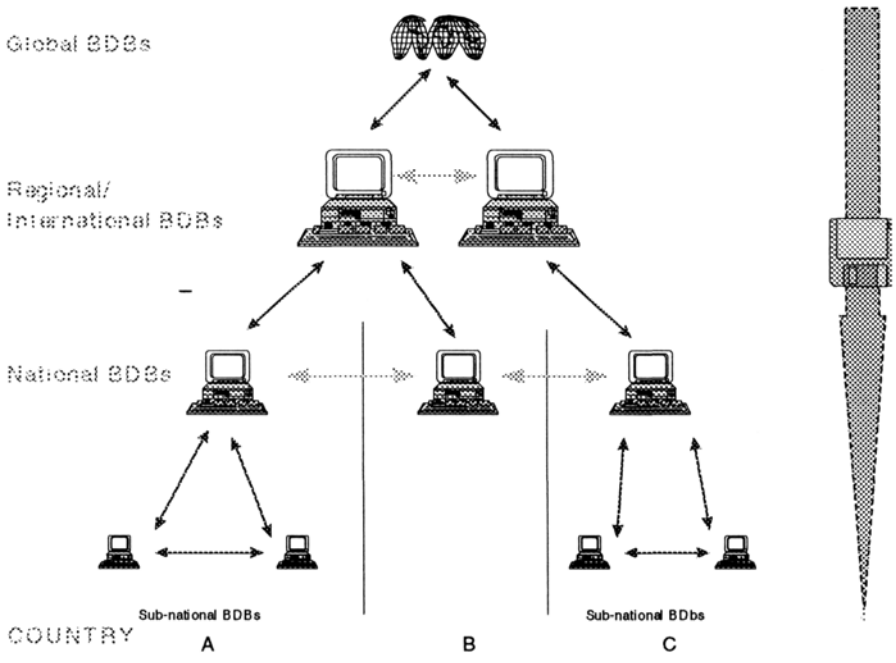

Figure 2. A schematic representation of the relationships within the various types of data-banks. Note that it is entirely possible for data to flow from any level to the other without necessarily passing through the intermediate systems. The arrows showing these relations have been left out for clarity.

FUNCTIONS OF A BIODIVERSITY DATABASE

Rational decisions regarding the use of resources, and indeed all other decisions, have to be made with the help of a sound information base. The information must be timely and easy to understand, and must be, to the best knowledge of the provider, appropriate to tackle the problem at hand.

Characteristics of a good information product are presented in Box 2.

Box 2
Characteristics of a well-designed information product

- Designed for a specific audience for a specific purpose.
- Relevant to decision-making needs.
- Available when the 'window of opportunity' for decision-making arises (i.e. timely).
- Easily and quickly understood.
- Delivered through recognised channels.
- Based on sound scientific principles.
- Areas of uncertainty and their significance are clearly identified.
- Accompanied by full acknowledgement of data sources and intellectual property.
- Available at minimal cost in terms of time, money and administrative overheads.

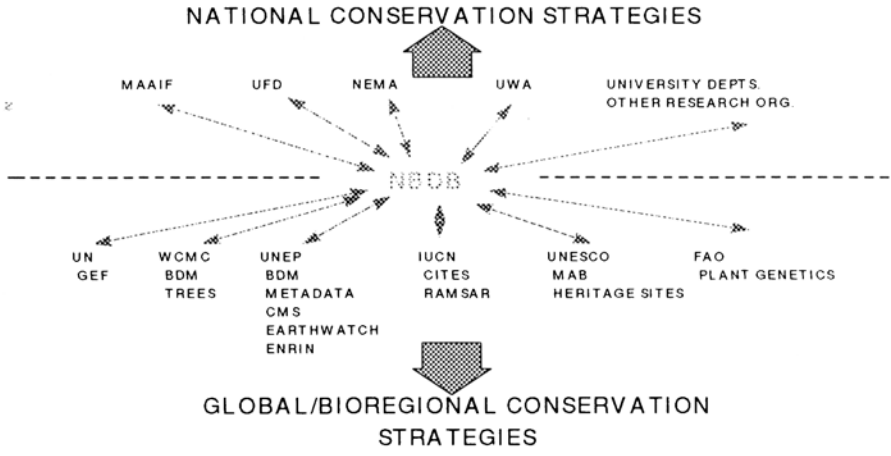

Figure 3. A schematic representation of the uses and the linkages between the NBDB and other databases/organisations.

ESTABLISHMENT OF A DATABASE

The establishment of a data-bank must first address the need for having one;the kind of product; the problem it will solve; and the targeted audience identified. It is important that a full needs analysis be carried out before the data-bank is produced.Ideally, representatives of all stakeholders involved in the problem for which the information system is intended to contribute towards the solution, should be involved in the initial planning of the information system, deciding on what kinds of data would be collected, how the product will be designed, and what problems the product will address.

The following basic questions should be thoroughly investigated:

- What is the problem?
- What kind of data is needed to provide the answers?
- Who will collect the data?
- When, where and how will the data be collected?
- What facilities should be used in the handling of the data and the dissemination of the information?
- Who is the target audience?
- How will the product be delivered?
- How sustainable will the system be to solve long-term needs (such as monitoring of biodiversity) or how suitable is it to provide short-term answers?

CONCLUSION

Biodiversity data-banks are quite useful in the conservation process of biodiversity, both for the present and the future generations. Today's data can provide information for the future on the state of the world's resources if kept in the appropriate way, in as much as earlier data are constantly finding their uses today.

National and international data-banks are both useful in their ways for the study and the conservation of biological diversity, albeit the fact that one type may be inappropriate to provide the necessary tools for strategic planning at different scales. National databases may be quite important in setting priorities for conservation in the country, but may be less effective in setting global priorities, most especially when data gaps exist in the neighbouring countries. On the other hand, global databases, such as those based on wide scales, may be inappropriate on setting national priorities for conservation. Nevertheless, data should not be disregarded at whatever scale or resolution, both in space and in time, for they may be quite useful in some other ways or in the future.

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CHAPTER 26

Application of Remote Sensing and GIS Technologies for Biodiversity Management

Samuel Mugisha
MUIENR

INTRODUCTION

According to FAO (1981), land is composed of several natural resources such as soils, climate, water, *vegetation*, people as well as *animals*. Remote-sensing and geographic information sytems (GIS) technologies are the most cost-effective techniques for providing information for land resource management, including biodiversity. *Remote-sensing* is commonly defined as a technique of collecting information (*using a sensor*) about an object without coming into physical contact with the object (Rees, 1990). To make the definition more focused so as to exclude sensors like animal eyes, a number of restrictions are imposed to the above definition: the object to be sensed is located on or near the earth's surface (vegetation or clouds), the sensor is vertically (ideal case) above the object, and at reasonable distance from it. Examples of sensors are photographic cameras, SPOT, Landsat TM, and MSS.

While remote-sensing is a data-collection technique, (GIS) is a computerised data-handling system. GIS has been defined as a computerised system that allows integration of hard- and software for both spatial and non-spatial data. A GIS must be capable of data input (digitising, scanning, keyboard entry and importing); manipulation; display and analysis. The only relationship between remote-sensing and GIS is that the former provides data or information for use in the latter. However, there are other data and information sources for GIS operations such as field observations with the help of compasses, topographic maps and global positioning systems (GPS).

Because biological diversity is dynamic in both *space* and *time,* remote-sensing, among other techniques, is used to measure and monitor several parameters of biodiversity. While there are several levels of biodiversity (*allele diversity; genetic diversity; polygenic genetic diversity; species diversity; patch diversity; habitat diversity; community diversity; landscape diversity, and regional diversity*), it should be noted that remote-sensing techniques may be limited in measuring or monitoring biodiversity parameters at a level of patch diversity or higher. This may be partly due to the low resolution of the remotely-sensed data and partly due to the

limitation of remote-sensing techniques. Research efforts are under way to try and identify plant species using various types of remotely-sensed data. However, it is possible to measure specific indices of biodiversity at higher levels, e.g. vegetation structure, and relate it to lower biodiversity levels such as animal species.

Remote-Sensing and GIS: Application for Biodiversity Measurement, Monitoring, and Modelling

Remotely-sensed data have been used to measure a number of quantitative and qualitative biodiversity parameters such as what is at point X, where is it, how much of it and its status. Repeated measurements of such biodiversity parameters over a period of time generates data for biodiversity monitoring. Remote-sensing and GIS technologies are ideal tools for measuring, analysing and monitoring of biodiversity resources either directly or indirectly. Ideally, one would like to use remote-sensing tools to measure biodiversity at three levels:

Ecosystem or ecological diversity: This is possible using remote-sensing and GIS techniques. Examples include identifying and mapping forest, woodland, savanna, grassland, water and cultivated ecosystems in any given geographic area.

Species divenrsity: It may be possible to discriminate between different plant species based on factors like amount of ligno-cellulose and arrangement of leaves. However, it is difficult to identify different plant species systematically when using remotely-sensed data. This is the reason why plant species mapping is carried out by use of remotely-sensed data to identify vegetation boundaries and then carry out intensive field work to know which plant species belong to any of the mapped vegetation polygons. However, GIS can be used to model the presence or absence of plant species if conditions suitable for any given species are known.

Genetic diversity: Genetic diversity is often measured by techniques of provenance, progeny, clonal test or genetic markers like DNA analysis. Remote-sensing is not yet directly used for such genetic diversity measurement.

Satellite imagery data

Satellite data are acquired by several types of sensors such as Landsat TM and MSS; SPOT, AVHRR, and Radar. The sensors are mounted on satellites and then placed in outer space. The data is then collected by ground receiving stations located in several regions around the globe.

The principle used to collect remotely-sensed data is that electromagnetic radiation react differently (*by reflection or absorption*) when it interacts with different objects

on the earth's surface or in the lower atmosphere. Thus, green vegetation will react differently than clouds to electromagnetic radiation and hence the two objects can be uniquely discriminated by use of remotely-sensed data. Satellite data are captured in form of images (smallest unit of the image being a square or grid). The size of the grid (raster) cells vary from sensor to sensor such as TM (30m by 30m); MSS (80m by 80m); SPOT (20m by 20m and 10m by 10m); and AVHRR (4.0km by 4.0km and 1.1km by 1.1km).

The resolution of a sensor relates to the smallest object that can be scanned by and captured as a unique raster cell in the resulting image. The presence or absence of reflected or absorbed electromagnetic radiation is recorded by the sensor and then expressed on a digital scale of 0 – 256. The recorded numbers are called digital values (DNs).

Most commonly-used remotely-sensed data are multi-spectral, i.e. the data are collected using more than one channel or band of electromagnetic radiation. TM data are collected in seven bands and SPOT uses three bands. To maximise the measurement of land resources from remotely-sensed satellite data, at least three bands of the raw data should be used.

The processing and analysis of satellite data for biodiversity measurement may be done by manual or automated techniques. Manual image classification is the oldest and simplest (but not necessarily the most cost-effective and accurate) technique for extracting information from remotely-sensed data. The only requirements needed to carry out manual image classification are a knowledge of terrain features as they express themselves on the remotely-sensed imagery data.

Digital camera data technique (recent advances in remote-sensing)

In the recent past, it was believed that the failure of remotely-sensed data to allow plant species mapping was due to low resolution of satellite data. This led to the development of powerful sensors to collect very high resolution data, as small as 0.01 μm. Such data have been collected for experimental research by the ***Airborne Visible/Infrared Imaging Spectrometer*** (AVIRIS) sensor. However, preliminary research has shown that high resolution imagery may not necessarily perform better than low resolution data in mapping different plant species, soil or rock types (Price, 1994).

Another new remote-sensing technique of great potential is the use of ***Kodak digital colour infra-red camera*** that captures images between 400 – 1000 nm. Optimal image resolution of 15cm can be achieved. The images are taken by mounting the camera on a low altitude flying aeroplane and the resolution of the images are pre-determined by height of the flight. The images can be used to measure individual

canopy cover of woody vegetation and hence it is a cost-effective technique of biomass assessment (using canopy area to predict woody biomass). It may be possible to use digital camera data for counting of big game in savanna national parks (provided such game is exposed). However, both AVIRIS and digital camera may not overcome the limitations of using remote-sensing for plant species identification.

The invention of a digital camera may reduce the demand of panchromatic aerial photography for natural resource management. Aerial photography is the oldest form of remote-sensing and is still widely used by urban planners and was widely used for natural resource inventories (vegetation, land use, soils, geology) before the advent of satellite remote-sensing techniques.

Application of Remote-Sensing and GIS for Biodiversity Management: Selected Case Studies

The only alternatives to remote-sensing and GIS techniques for land resource management would be field surveys and manual GIS. Field surveys to carry out inventories of natural resources such as boundaries of vegetation types, soils, geological material and land-use types is only cost-effective for small geographical areas. Manual analysis of geographical data is limited if different map layers have different scales. The following examples provide case studies for the application of remote-sensing and GIS techniques for biodiversity management.

Integration of Remote-Sensing and GIS for Biodiversity Conservation in Sango Bay area, Uganda

The project to integrate remote-sensing, GIS and field biodiversity surveys techniques was executed by MUIENR (*Makerere University Institute of Environment and Natural Resources, Uganda*) and ITE (*Institute of Terrestrial Ecology, UK*) between 1994 and 1996. The major objective of the study was to generate information that would be useful in formulating and designing an ***Integrated Conservation and Development Project*** for Sango Bay area, Uganda. Sango Bay was selected for the study because the area has high biological diversity (Howard, 1991; Taylor, 1991). However, it was realised that the assessment of biodiversity in Sango Bay area was based on limited access to just a small portion of the area due to extensive wetlands and tropical forests. It was also true that historical vegetation maps produced from aerial photographs of the 1950s were being integrated with limited field observations to interpret and assess the biodiversity of Sango Bay.

It was thus decided to update spatial information of Sango Bay habitats through the use of remote-sensing techniques. Landsat TM data were used for the mapping of the Sango Bay habitats. Field biological and socio-economic surveys were simultaneously undertaken in Sango Bay area. The data were integrated in a GIS environment to produce a biodiversity-rated map of Sango Bay. Finally, integration and analysis of biodiversity spatial and socio-economic data can be used to obtain a zoned map that will be used for conservation management.

Vegetation Mapping of Murchison Falls National Park

Murchison Falls National Park (about 5,000 km^2) is composed of woodland and savanna ecosystems. Like many parks in Uganda of the same ecosystem set-up, Murchison Falls National Park lacked an up-to-date vegetation map. Production of a vegetation map from panchromatic aerial photography would have been possible but more expensive and time consuming. The management of the park contracted MUIENR to produce a vegetation map using satellite data (Landsat TM) and field work.

Automated computer methods, using TNTmips, combined with GPS-field recorded data of dominant plant species yielded a vegetation map of the park. While traditional computer image classification techniques yielded a vegetation map that was characterised by a lot of misclassifications, using *fuzzy c means classifier* produced acceptable vegetation map. The resultant vegetation map of the park can be used for a variety of applications beneficial to park management and research activities. There is a proposal to use the newly-produced vegetation map of Murchison Falls National Park to set up an in-park monitoring system.

Some GIS techniques relevant to biodiversity management

GIS has several capabilities for data manipulation and to some extent data analysis. As mentioned earlier, GIS integrates data from different sources to ease analysis. The following are some of the commonly-used GIS applications.

Buffer zone creation

GIS can be used to calculate a constant distance from point, line or polygon data. The calculated region between the reference line or point and the new boundary is called a *buffer zone*. Buffer zones may be useful in locating areas suitable or unsuitable for a specified land-use type.

Home range analysis

This is a GIS tool used for creating "home range" polygons from point elements that represent observation events. Polygon fitting statistical methods are employed to create the home range polygons from point observations. Home range calculation is a polygon-fitting technique developed by ecologists to study animal movement behaviour in relation to environmental factors such as food, change in weather and many others.

Overlaying

Overlaying is one of the commonly-used GIS tools to derive information from map layers representing different data. Hence, overlaying is commonly used in GIS modelling procedures such as land-use allocation to meet specified conditions. For example, given several map layers of individual species as collected in the field, overlaying can be used to find out if there is any relationship between the occurrence of an animal and plant species by overlaying. Overlaying is only possible if the different map layers are georeferenced to the same map projection and co-ordinate system.

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BIODIVERSITY AND GENDER FOR SUSTAINABLE DEVELOPMENT

Biodiversity and Gender for Sustainable Development is a specialist publication, evolved out of many years of subregional, regional and pan-Commonwealth experience of education and training under the aegis of the Commonwealth Secretariat. The publication provides an unprecedented insight into the two subject areas of Biodiversity and Gender. It takes cognisance of the Convention on Biological Diversity which recognises "the vital importance that women play in the conservation and sustainable use of biological diversity and affirms the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation". This is not withstanding the fact that both women and men must exist in a mutually-beneficial partnership and strategic alliance that is poised to enable equal say in the decision-making process on the sustainable utilisation of biodiversity as well as facilitate equitable distribution of responsibilities for its conservation. The book is analytic and integrative in approach, clear in presentation and broad on the essential a concept of biodiversity, ranging from basic fundamentals to policy implications and biodiversity research innovation. The book is targeted at environmentalists, natural resource scientists, environmental practitioners, including planners and policy makers on national environmental issues.

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