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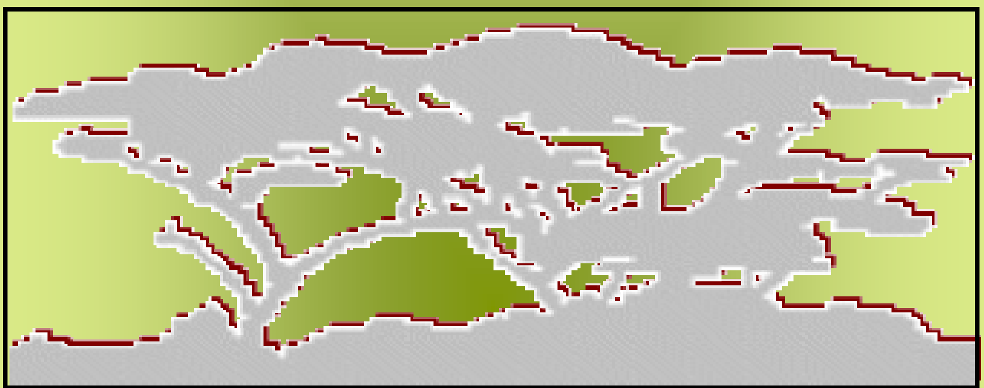
ECOSYSTEM BASED CONSERVATION STRATEGY FOR PROTECTED AREAS IN SAVANNAS



WITH SPECIAL REFERENCE TO EAST AFRICA

Diplomarbeit

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ABSTRACT

Radical integrative and pro-active ecosystem based approaches to conservation are needed to find realistic solutions for social and ecological sustainability in the protected areas and their bioregions in the African Savannas.

The Savanna regions of Africa are richly endowed with natural resources, which include widely divergent ecological and socio-cultural and economic systems. Sharp gradients in climate, biotopes and land-use patterns interact to produce a characteristic Savanna landscape mosaic, marked with ecological and economic contrasts ranging from highly productive agricultural and industrial economies to vast areas of desertification, soil and vegetation degradation, characterized by endemic rural poverty. Although in some areas the African Savanna provides the base for a successful "wildlife industry" (tourism and other wildlife products), in the protected areas, private ranches or within indigenous communities, the region's rich biodiversity is nevertheless undergoing a severe erosion, resulting mainly from such factors as the impacts of recurrent drought, extended civil wars, migrations, rapid urbanization, inappropriate agricultural exploitation, poverty, unemployment and related social problems. There have been several attempts, since colonial period, to design protected areas as workable models of sustainable conservation of biodiversity in the African Savannas. The success has however continued to be constrained by such factors as the sectoral approaches to resource management, species oriented research and management and the narrowly focused conservation policies or institutional barriers.

Sustainability of the African Savanna landscapes will depend on a management approach that mediates the society and its cultural / economic activities on one hand and the continuance of ecosystem functional processes on the other, both operating at a regional landscape scale. Such an approach integrates the affected community visions, values and actions in dealing with a complex web of environmental and social challenges through a similarly complex network of multiple land tenures, public-private partnerships and resources and interdisciplinary professional capacities.

By analysing the conflicts arising from the past management approaches, we propose a new Integrated Bioregional Planning (IBP) paradigm based on the principles of the Man and the Biosphere Programme (MAB) and views conservation areas from their border outwards into their broader landscape context, known as bioregions. A concept of Ecological Functional Units (EFU) is developed for use in determining vulnerability analysis, that should serve as the basis for the delineation of various management zones for the respective sustainable activities within innovative concepts of protected areas.

Keywords:

Savanna, Protectionist Model, Community based Conservation (CBC), Sustainability, Ecosystem Approach, Bioregion, Integrated Bioregional Planning (IBP), Functional Landscape Analysis, Ecological Functional Unit (EFU), Environmental Risk Assessment (ERA), Man and Biosphere Programme (MAB), GAP Analysis, Sequential Reserve Selection Method, Three-Phase-Area-Analysis, Hierarchical Planning Model for Protected Area Networks

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0 HINTERGRUND UND ZIELKONZEPT DER ARBEIT

0.1 Hintergrund

In den letzten zwei Jahrzehnten, und insbesondere nach der Weltkonferenz in Rio 1992, hat der Begriff „Nachhaltigkeit“ eine zentrale Bedeutung in den planerischen Überlegungen zur Lösung der globalen ökologischen, ökonomischen und soziokulturellen Probleme unseres Planeten erfahren. Im Mittelpunkt der Betrachtungen steht dabei die Manifestierung des Modells der „Nachhaltigen Entwicklung“ menschlicher Lebens- und Wirtschaftsweisen. Diese Bemühungen sind Resultat der Erkenntnis, dass sich menschliches Handeln an die Tragekapazitäten und Empfindlichkeiten der Ökosysteme anpassen muss, um sie als Lebensgrundlage des Menschen zu erhalten und sein eigenes Überleben zu sichern. In der Demonstration selbstregulativer Zyklen und Gleichgewichte und einer dynamischen Metastabilität sind die natürlichen Ökosysteme selbst die Vorbilder dieser Entwicklung. Grundlegend für die Konkretisierung nachhaltigen Lebens sind daher Erkenntnisse und Denkmuster der Ökologie als elementare Wissenschaft vor allen anderen Disziplinen.

Auch wenn in unserer Zeit die „Nachhaltigkeit“ immer wieder als oberstes globales Ziel menschlicher Planung beschrieben wird, steht die Realität der Welt dazu im krassen Widerspruch. Auf allen Kontinenten des Planeten hat man zwar begonnen Projekte zur Nachhaltigen Entwicklung ins Leben zu rufen, ohne aber wirkliche Erfolge verzeichnen zu können. Viele der Initiativen erschöpfen sich in allgemeinen politischen Forderungen, ohne klare und konkrete Konzepte präsentieren zu können. Das Internet als moderne weltumspannende Informationsressource ist in unüberschaubarem Maße überfüllt von theoretischen Arbeiten zu diesem Themenkomplex, ohne dass sich etwas daran geändert hätte, dass die meist ignorierte Tatsache unserer Zeit die totale Abhängigkeit des Menschen von den ökologischen Funktionskreisläufen der Erde ist. So unglaublich es auch erscheint, so ist es trotzdem ein tragisches Faktum, dass einige Initiativen, die mit gutem Willen begonnen wurden, letztendlich zu einer

Verschlechterung der Ausgangssituation vor Ort geführt haben. Der Grund hierfür liegt häufig im mangelnden Verständnis ökologischer Sensibilitäten und Funktionsprinzipien von Ökosystemen und daher unzureichender Interpretation des Ziels „Nachhaltigkeit“.

Dies zu ändern ist Aufgabe der ökologischen Planung, als elementarste Form einer strategischen Raumplanung. Sie soll konkrete Basismodelle für die verträgliche Nutzung in nachhaltig lebensfähigen Ökosystem entwickeln, und den Menschen als integralen Bestandteil auffassen.

Im Verständnis der Raumplanung ist es eine unbedingte Notwendigkeit nachhaltiger Entwicklung, dass bestimmte Gebiete als Kernzonen natürlicher Entwicklung und als Prioritätszonen des Naturschutzes gesichert werden. Diese Gebiete sollen im Zuge zunehmenden Nutzungsdrucks auf die Landschaft und steigender Bevölkerungsdichten, zur Bewahrung der Artenvielfalt und der Funktionalität essentieller ökologischer Prozesse in ultimativer Weise beitragen. Vielerorts dienen sie auch dem Schutz und der Entwicklung menschlicher Kulturen und Traditionen, die in einem direkten Miteinander zur natürlichen Umwelt stehen und initiale Alternativkonzepte der Nutzung von Landschaft darstellen.

Im Geiste dieser Herausforderung stellt der Kontinent Afrika einen Brennpunkt dar. Afrika ist der ärmste Kontinent der Erde und zugleich die Heimat einiger der bedeutendsten Beispiele des globalen Naturerbes, sowie nach heutigem Erkenntnisstand, die Wiege der menschlichen Kultur. Von weltweit unvergleichlichem Ruhm sind die Serengeti Ostafrikas und der Krüger Nationalpark im Süden des Kontinents. Die bekanntesten Wildtierarten der Welt leben hier in einer Landschaft, die zugleich direkte und täglich limitierende Ressource einer anwachsenden Zahl von Menschen ist.

In Afrika leben große Teile der Bevölkerung in unmittelbarer Abhängigkeit von den Funktionen der natürlichen Umwelt. Ökologische Katastrophen münden unmittelbar in den millionenfachen Hungertod von Menschen.

Die Afrikanischen Ökosysteme erfahren in dramatischem Ausmaße ökologische Degradation, die vor dem Hintergrund der Bedürfnisse der Menschen nach Ressourcen noch zunehmen wird.

0.2 Zielkonzept

Die Schutzgebiete Afrikas stellen insofern eine Ausnahme dar, weil sie sich außerhalb von landwirtschaftlich genutzten Räumen befinden und somit vermeintliche „Naturschutzinseln" darstellen. Insbesondere in den menschlich stark besiedelten Savannen ist eine zunehmende Isolation der Schutzgebiete infolge zunehmender landschaftlicher Fragmentierung feststellbar. Die Schutzgebiete sind umgeben von einer Matrix, in der Naturschutz im Kontrast zu den Schutzgebieten selbst keinerlei Bedeutung genießt. Zugleich führen vielerorts aber exzessive touristische Nutzungen der Schutzgebiete zur internen Entwertung der Areale.

Diese Polarisierung der Landschaft in Afrika hat der Naturschutz selbst mit erzeugt. Zwar sind in Afrika Schutzgebiete schon vor langer Zeit, viele während der Kolonialepoche, errichtet worden, aber sie führten nicht zugleich zum Schutz des kulturellen Erbes der Afrikaner, wie es den heutigen Postulaten des internationalen Naturschutzes entsprechen würde (vgl. WCPA / IUCN 2000). Traditionelle afrikanische Lebensweisen der Menschen, die seit Jahrtausenden mit den Ökosystemen erfolgreich und nachhaltig interagierten, wurden aus den Schutzgebieten ausgeschlossen. Somit hat der Naturschutz in Afrika seinen Beitrag zum Niedergang alter Kulturen geleistet. Die Konflikte, die hieraus erwachsen, stellen mittlerweile eine ernste Bedrohung für den ökologischen und politischen Fortbestand der Schutzgebiete dar. Lösungen sind vor Ort nicht in Sicht, und viele neuere Ansätze der Planung sind bereits gescheitert.

In der Konsequenz sind die Schutzgebiete auf dem afrikanischen Kontinent nicht nachhaltig. Zwei Hauptkonflikte unterfüttern dieses weitreichende Problem:

1. Keine Kompatibilität zwischen dem Naturschutz und den unmittelbaren Interessen der Bevölkerung

2. Insuffiziente Planung der Schutzgebiete wegen der Nichtberücksichtigung ökologischer Planungsprinzipien

Bisher haben auch neuartige Versuche der ökonomischen Partizipation der Bevölkerung an den Schutzgebieten kaum zu einer höheren Akzeptanz des Naturschutzes oder zu einer ökologischen Stabilisierung der Gebiete geführt.

Die Aufgabe dieser Arbeit ist es deshalb, neue Ansätze für eine Naturschutzplanung in Afrika zu liefern. Diese Ansätze müssen:

1. Unter Berücksichtigung der Rechte und Interessen der Bevölkerung den Menschen als einen integrativen Bestandteil betrachten, statt ihn auszuschließen.

2. Die Planung von Schutzgebieten in Afrika auf dem Fundament der Ökologie als elementare integrierte und problemorientierte Naturwissenschaft diskutieren.

Die Arbeit unternimmt dies unter besonderer Berücksichtigung der Savannenökosysteme und der Region Ostafrika (im engeren Sinne vor allem Kenya und Tansania, sowie eingeschränkter Uganda). Gründe hierfür sind:

- Die Savannen haben nicht nur anthropologisch für die Evolution des Menschen eine Schlüsselbedeutung, sondern bis heute lebt der Großteil der Bevölkerung Schwarzafrikas im Biom der Savanne und in direkter Abhängigkeit von ihren ökologischen Ressourcen und Produkten.

- Die Savannen Ostafrikas beinhalten die bekanntesten und bedeutendsten Schutzgebiete des Kontinents und sind damit Beispiele des sektoralen Naturschutzes von globaler Signifikanz.

- Die Länder Kenya und Tansania besitzen eine intensive und ausgedehnte Naturschutzaktivität, die in hohem Maße mit internationalen Geldern gefördert wird, und bietet andererseits gute Beispiele für die Notwendigkeit und das tatsächliche Bestreben der Bevölkerung nach Verbesserung der Lebensumstände.

Lösungsansätze für das beschriebene Problem sind daher vordringlich und eine Erarbeitung am Beispiel Ostafrikanischer Savannen hat Modellcharakter.

Im einzelnen ist für die Entwicklung neuer integrativer und ökosystemorientierter Ansätze ein bestimmtes geordnetes Vorgehen notwendig, dass die Grundgliederung der Arbeit wiederspiegelt:

1. Eine Darstellung der Ökologie der Savannen und Herausarbeitung von elementaren Steuerungsprozessen natürlicher Gleichgewichte

2. Eine Darstellung der anthropogenen Nutzungsformen der Savanne, sowie ihrer ökologischen Folgen vor dem Hintergrund der Empfindlichkeit der Ökosysteme

3. Eine Darstellung und Prüfung der bisher praktizierten Ansätze zum Naturschutz in den Savannen vor dem Hintergrund ihrer Effizienz

4. Eine Formulierung der Zielebene eines Alternativkonzeptes und eine inhaltliche Deutung von Unterzielen und damit verbundenen Forderungen

5. Eine Entwicklung und Darstellung des inhaltlichen Beitrages der Ökologischen Planung zum Problemlösung

6. Eine Entwicklung und Darstellung innovativer Konzepte und Instrumente zur Umsetzung und Konkretisierung des ökologischen Planungsansatzes

7. Eine Entwicklung eines integrativen Modells, dass die gemachten Überlegungen vereint und sie im Sinne strategischer Raumplanung anwendet

1 INTRODUCTION

An international awareness of the principles of sustainable development, initiated in 1972 at Stockholm United Nations conference on the Human Environment, and ratified in 1992 at the Rio United Nations Conference on Environment and Development, (UNCED), has continued to grow by earning acceptance among the many local development communities as well as the foreign technical development agencies. The new paradigm is in most cases playing a key role in the decision making on the ecological, economical and socio-cultural issues in conservation and development activities both at the local and the international levels.

Different cultures and places have different definitions for the term sustainability. For the purpose of this discussion we will adopt a broad consensus definition given by BRUNDTLAND (1987), which states that:

"humanity has the ability to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits, not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activity."

For a development or conservation activity to be sustainable it must therefore initiate a positive change which does not undermine the environmental or social systems within and around the project or conservation area on which it is based. Such a positive change would require a coordinated approach to planning and policy making that involves all the stakeholders and the general public participation. The success of any activity ultimately depends on a widespread understanding of the critical relationship between people and their environment and the willingness from those affected to adjust to the necessary changes.

The growing importance of “sustainability” in nature conservation and other related fields comes from the realization that both social and economic activities must conform to the carrying capacities and ecological vulnerabilities of the systems on which they are operated, if those systems have to maintain their stability, dynamism and balance while serving their purposes of supporting a diversity of biological organisms and at the same time maintaining a sustained provision of the basic necessities to man.

However despite the fact that sustainability has occupied the center stage in development and/or conservation agenda since the Rio conference, the reality on the ground in many parts of the world does show an amazing contradiction. Many projects based on this principle are resulting not only in ecological degradation but also trigger a chain of conflicts: ecological and social economical, in the ecosystems as competition for the diminishing resources intensifies. Practical solutions to the sustainable conservation and/or development are constrained by institutional impediments, narrowly focused scientific research and compartmentalized or sectoralized government policies and other constraints such as the market and trade policies, property rights, land tenure and land use policies. Thus many conservation initiatives began with good intentions finally become an end to themselves or a trigger to environmental degradation as a result of these and many other impediments. The general lack or insufficient knowledge of ecological sensitivities, character and dynamism of the ecosystems where such projects are begun, contributes to the escalation.

To be effective in achieving sustainable conservation or sustainable development, management systems have to be compatible with the structure and function of the ecosystems involved. They have also to be compatible with the social, cultural and institutional norms of the society to which the resource belongs. This requires that before the project implementation, a detailed mapping and a careful analysis of the multi-scale and cross-scale temporal and spatial elements of both the landscape ecology and the social-cultural and economic structures together with the influence they have on both the conservation area and its associated bioregion be carried out. It is only through such ecosystem based analysis that ecological functioning of the area can be integrate with human activities in the same region. Such an analysis should also recognize those habitats and ecosystems in the bioregion or areas associated with the conservation area, that are of conservation value and earmark them for preservation as core conservation zones with limited human interferences. The principles of the Man and the Biosphere (MAB) concept of the UNESCO (1979) are fundamentally concerned with the whole of bioregional landscape processes, whether inside or outside of the protected areas, across a variety of land tenures and uses. MAB aims to sustain the biodiversity and productive capacity on a regional scale that is appropriate to the ecological processes, human use and cultural identity with that landscape.

It is from this background that we present and discuss the conceptual and theoretical framework for an integrated bioregional planning (IBP) as a means of attaining sustainable conservation of the biodiversity in the protected areas of the African Savanna.

Though designed to be centres of biodiversity conservation, protected areas in the African Savannas have often been described as ‘islands of biodiversity’ surrounded by seas of human altered landscapes (IUCN 1998).

With the increasingly changing demographic configuration and social trends in these regions, the Savanna landscape has continued to undergo fragmentations with more and more people converting the former wild nature into agricultural and other human managed activities. Fragmentation results into breaking up of the large natural places into smaller fragments or islands of habitat seriously interfering with the natural energy flows within and between biotopes and the “greater ecosystems” or the bioregions. National parks and nature reserves created in such a matrix of human changed landscapes are thus coming under increasingly severe stress from human and animal population pressures. Many animals confined in those national parks require a range of resources which are naturally patchy and could be located outside the man made barriers. Such animals therefore need to move around between resource sites in response to climatic and other natural cycles. Habitat fragmentation may make this either extremely difficult or impossible.

Nature conservation practices in the African Savannas are themselves responsible for this landscape polarisation. In the early 20th century, concern over the increasing poaching of wild animals and other resources led the colonial administrators to introduce the present configuration of protected areas based on European or American knowledge and values for nature conservation. National parks, game reserves, wildlife sanctuaries and strict nature reserves are some of the categories of protected areas introduced then. Control of those areas was and is in many cases vested in central administration or governments and enforced with externally enforced policies of exclusionism with no serious attempts to involve the local communities, who have sustainably bear the brunt of the exercise. Such conservation approaches have not only generated antagonism, which often results into conflicts between the local communities and the protected wildlife and their managing authorities, but are also systematically destroying the local people's culture and social economic norms and interdependencies with their environment.

Two main underlying causes of these conservation problems are the failure by the planning and management authorities to provide for:

1. Compatibility of the structure and functional dynamics of the ecosystems involved with the social cultural and institutional norms of the human populations sustained by the resources of those ecosystems

2. Sufficient ecological assessment, planning management of the areas designated for protection so as to base delineation and the management of the area on sound scientific knowledge of their functioning and processes

The goal of this paper is to present a new concept for nature conservation in the protected areas of the African Savannas that emphasises the following two points:

1. Integration of the rights and interests of the human communities in the planning and management of the protected areas and their bioregional resources.

2. Basing the planning and management of the Savanna protected areas on the principles of ecosystem structure and functions based on a wider landscape connectivity (bioregion), social cultural and economic integration and bases on the local, regional and trans-regional frame plans.

We have laid greater emphasis on the East African Savanna ecosystems (Tanzania, Kenya and for some instances Uganda), making a special reference to the famous Greater Serengeti Ecosystem (GSE), which strides the Kenya/Tanzania boundary. The choice of this region and the Greater Serengeti in particular is based on the fact that:

- The East African Savanna contains a high number of protected areas in the region
- The region contains the remnant of the worlds most popular and most diverse and dynamic migratory herbivores and birds

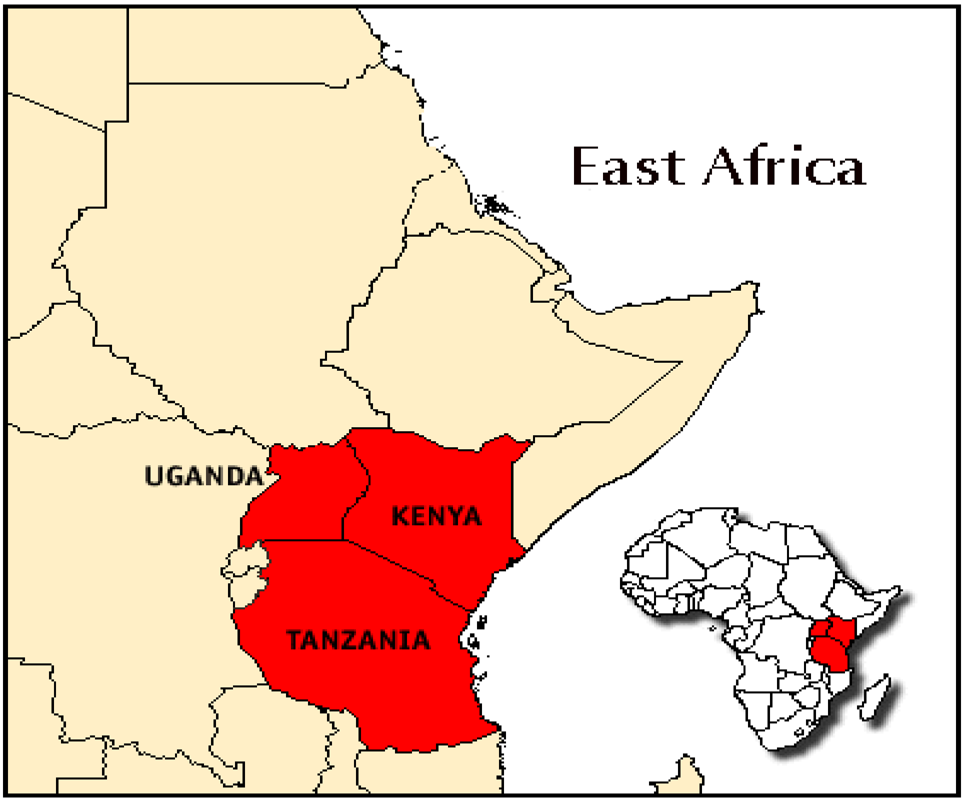


Figure 1: East African countries: the focus of the study. (graphic by frameweb.org)

The study begins by presenting a general ecology of the Savanna ecosystem with a brief mention of human uses of the Savanna ecosystems and the impacts of such uses on the natural ecosystem. A detailed discussion of the biodiversity conservation as a main human use of the African Savanna is presented. A detailed analysis of the

Greater Serengeti Ecosystem is then used to demonstrate the different conservation approaches, their successes, failures and the associated conflicts in the protected areas and their bioregions.

Goals and objectives for an alternative broad based conservation approach are defined followed by a discussion and presentation of a conceptual and theoretical framework for conservation approach that we think would minimize or eradicate altogether the identified conservation failures and their associated conflicts. A framework for an integrated bioregional planning approach that is based on the principles of the ecosystem approach to conservation and the Man and Biosphere (MAB) model, are discussed in detail as a necessary input towards sustainable conservation. Finally we present an integrated hierarchical planning model that should serve as the basis for the formulation of the goals and objectives for delineation and management of conservation projects on a site, regional or trans-national scales.

2 BACKGROUND

2.1 The Savanna Ecosystem

2.1.1 Definition

Although generally not considered to be climatically determined climax ecosystems, the Tropical Savannas are usually associated with the tropical wet and dry climatic zones. Savannas are also found in regions expected to have some form of seasonal forest or woodland vegetation community but are altered by either edaphic conditions or some form of artificial or natural disturbances (BOURLIERE 1992).

Many botanists and naturalists have attempted to define the Savanna. Most of those definitions have however sparked controversies, criticisms and led to new definitions. The first definition close to that commonly used today was given by DRUDE in the year 1890 (BOURLIERE 1992). DRUDE described Savanna as not only being characterized by high grass, but also by the presence of tropical woody plants which come into leaf during rainy season. Since this time authors and scientists have designated Savanna as a community having a continuous grass layer and scattered with shrubs and trees. Similar definitions have also been adopted in Africa by most botanists.

A scientific council of Africa recognized Savanna as “ formations of grasses at least 80 cm high, forming a continuous layer that dominates the lower stratum, usually with woody plants present and burnt annually” (BOURLIERE 1992). The council recognized the following four sub-categories of Savanna:

- Savanna woodland with trees and shrubs forming a canopy which is generally light
- Tree Savanna with scattered trees and shrubs
- Shrub Savanna with scattered shrubs

- Grass Savanna, where trees and shrubs are generally absent

A comprehensive definition of Savanna should therefore include those tropical and sub-tropical formations where the grass stratum is continuous occasionally interrupted by trees and shrubs, where bush fires occur from time to time, and where the main growth pattern is associated with wet and dry seasons. The factors that mainly contribute to the category of the Savanna in any one location include: biotic factors, climate, soil, drainage and geomorphology.

Figure 2: Typical Savanna landscape in the Serengeti National Park, Tanzania. (by www.planetware.com)

2.1.2 Distribution and Extent of the Savanna Areas

Due to their tolerance to climatic variations, the Savannas are have become the most dominant biome in the tropical world. They occupy no less than 45 per cent of South America, 65 per cent of Africa and 60 per cent of Australia. They range from the 'Big Thicket' in Louisiana and Texas, north of the tropic of Cancer in North America, to well south of the tropic of Capricorn at Port Elizabeth in South Africa. Savannas are also widespread in the Caribbean, the Indian sub-continent, and in both mainland (Burma, Thailand, Laos, Cambodia and Vietnam) and maritime (Indonesia) South-East Asia. The majority of people living in the tropics, comprising no less than one-fifth of the world's population, therefore inhabit the Savanna areas, which form the core of the world's monsoon lands comprising 50 per cent of the global population, thus making them the most important terrestrial environment (BOURLIERE 1992).

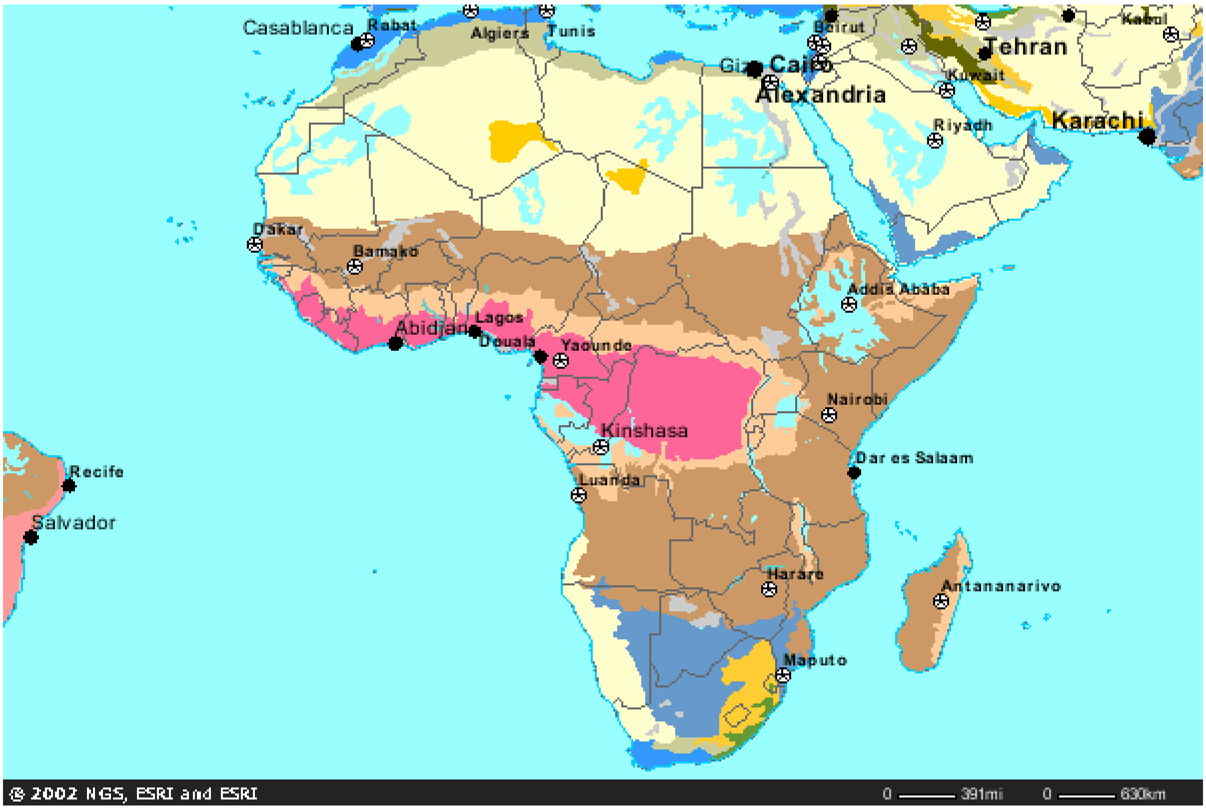


Figure 3: Distribution of the African Savannas. (World GIS by ESRI: Natural Landscape Zones)

Key:
Savanna and open woodland Evergreen semi evergreen deciduous forest
Hylaea and evergreen-deciduous forest Open woodland shrubland and Savanna
Desert Semi desert

2.1.3 Origins of the Savanna Biomes

On the basis of their causative factors, the Savannas could be classified into the following three classes:

- Climatic Savannas, caused most entirely by climatic conditions
- Edaphic Savannas, mainly a result of poor soil conditions such as low nutrient, droughty or waterlogged conditions
- Derived Savannas, which are manmade due to forest clearance, overgrazing, etc.

Fires and Grazing in the Savanna regions, are two major factors that are responsible in maintaining the Savanna grasslands. Fire mostly occurs naturally and prevents the woody habitants from reaching climax stages. Grasses are capable of coping with it because their roots are deeply anchored in the soil, enabling them to re-generate and grow after the exposed parts have been burnt up. Although grazing also serves to maintain grass as dominant vegetation, overgrazing by domestic stock may encourage shrub plants to dominate as the spread of fire through the fields is curtailed by the bare overgrazed patches left bare on the ground. This means that plants other than grasses can take over and dominate in those areas. According to ADJANOHOUN (1963) the present day Savannas at the northern edge of Guinea forest block, which are still enclosed within the rain forest, are an example of those Savanna types which originated naturally, during the Pleistocene epoch, when the northern edge of the rain forest retreated south giving way to the Savannas in many areas to reach the Gulf of Guinea shore.

The anthropogenic or also called “derived” Savannas, in which man plays the causal role are so intensely used by man, that a shift to the original vegetation, despite the favourable climatic conditions, is impossible. Such Savannas are frequently found in tropical Africa, where human activities have been carried out for a long time. In such Savannas, fire has always been the main conditioning factor.

STOTT (2001) argues that until the mid-1980s, studies on Savanna ecosystems were based on the concepts of ecology first developed in Europe and North America between 1910 and 1940. Plant communities were seen as 'organisms' or ecosystems, the equilibrium state of which would be determined by one prime external ecological or abiotic factor, such as climate, geology, soil or fire. Unfortunately, there was strong disagreement over which factor controlled Savannas. British foresters working in West Africa thought Savannas were anthropogenic (human-created) communities, forged out of the forest by cutting and burning. In contrast German scientists working in South West Africa (Namibia) and South America tended to view Savannas as a climatically determined vegetation type, while still the French in Indochina (Laos, Cambodia and Vietnam) saw Savannas as essentially fire climaxes.

It is currently thought that Savannas are determined by the complex interplay of at least six main ecological determinants, namely:

- PAM (plant available moisture)
- PAN (plant available nutrients)
- fire
- herbivory
- major historical anthropogenic events
- special regional factors, such as frost and wind

The following environmental aspects would help to explain the importance of the above factors:

Waterlogged conditions of the soil:

Occurs when the A-horizon of lateritic soils is exposed to the atmosphere. Alternating wet and dry seasons and heating by the sun create a brick-hard layer impermeable to water. This is usually a red hardpan known as a laterite (from the Latin word for brick). During the rainy season there is standing water above the hardpan for long periods of time, preventing the establishment of most tree species. During the dry season, the laterite prevents penetration of roots, also inhibiting the growth of most trees. Several species of palms do tolerate these conditions and, along with grasses, occur above laterites.

Droughty substrates:

Droughty substrates such as quartz or volcanic sands, also inhibit the growth of most trees. The pine Savannas of Central America are examples of Savanna vegetation developed on droughty, low-nutrient conditions of quartz sands. The grass Savanna of the famous Serengeti plains in Tanzania are developed on droughty but nutrient rich volcanic sands and is virtually treeless.

Low-nutrient soils:

The Cerrado of Brazil occupies a broad expanse of the Brazilian highlands that, were it not for the low-nutrient level of the heavily-leached soils, would be occupied by a seasonal forest.

Fire sub-climaxes:

Two groups of plants, palms and perennial grasses, that are pre-adapted to survive fire, become dominant in areas where burning is frequent and periodic. Such fires have both natural and human origins. The palms have the advantage of being monocots: their vascular bundles are scattered throughout the stem so that scorching of the outermost layer of the trunk will not kill the plant. Dicotyledonous trees, on the other hand, have their vascular bundles arranged around the outer, living part of their stems where they may easily be destroyed by fire. Perennial grasses have underground stems or rhizomes and so their growth nodes are protected by the soil during a ground fire. Trees and shrubs, with renewal buds above the surface, are selected against by fire and the balance tips toward the grasses.

Effects of grazing:

Large mammals such as the elephant open woodlands by debarking the trees and by knocking them over. This opens the woodland to grass invasion and attracts a variety of grazing animals, including zebras, wildebeest and the diverse herbivores. Grazers will both eat and trample tree seedlings, inhibiting the re-growth of the woodland. Only well-armed species of shrubs and trees can establish themselves in the clearings, leading to thickets of thorny acacias. Protected in the thicket, some acacias and other thorny trees will grow to mature specimens.

Overgrazing:

If a Grass Savanna is overgrazed, patches of bare ground will be created. The grassland will no longer carry a ground fire and invasion by trees becomes possible. The bare ground will suffer from increased evaporation and a dry microhabitat quickly develops. Well-armed, drought-resistant species like the acacias tolerate both grazing and drought, so again an Acacia Savanna can become established.

Altogether PAM and PAN are seen as the prime determinants of the type of Savanna which is then modified by other factors such as fire, herbivory and local factors. Historical events, such as the abandonment of human settlement or enhanced of global warming, may trigger Savannas into a totally new ecological state. The relationships between this complex of variables can now be analysed multivariately, using models or hierarchy theory and the PAM/(P)AN Plane (a two-dimensional plane in which the axes are defined by measurements of PAM and PAN). This can be used to make basic comparisons of Savanna at international, national and regional levels. Savannas should therefore not be seen as being simple equilibrium systems, but rather as dynamic ecosystem types constantly undergoing changes, with their biology driven by both gradual and catastrophic variation of the six ecological determinants mentioned above (STOTT 1994; BOURLIERE 1992; SOLBRIG *et al.* 1996; MISTRY 2000).

The functions of trees and woods in the Savanna grasslands matrix has been shown to compare with the gaps in a forest (BELSKY & CANHAM 1994). In the grassland matrix, trees and shrubs can be regarded as the 'gaps' in the matrix comparable to the gaps in the forest environment. The “gap” is seen as a break in the ecological factors and conditions dominating the rest of the open Savanna grass matrix. For example, during the wet seasons the soil under trees is relatively drier than their immediate surroundings. During the drier season the gaps remain wet and more humid because of cooler temperatures and a reduced evapotranspiration under the shade.

2.1.4 Structural and Functional Characteristics of the Savanna

Whatever category or origin, the tropical Savannas share a number of structural and functional characteristics which also distinguish them from other terrestrial ecosystems of the tropics. These characteristics are largely interlinked. The major ones are:

1. The tropical Savanna ecosystems form a transitional zone between the closed tropical forest and the open desert zones. Here the physiognomic gradients tend to follow the climatic gradients, showing an increasing density of trees with increasing precipitation and a complex relationship between the trees and grasses.

2. Production patterns are markedly seasonal. The seeds have long dormancy periods and have an accelerated growth as soon as conditions are favourable. Most plants have also demographic strategies, with most of the invertebrates and smaller vertebrates being r-strategists. As a result of this seasonality, migrations to take advantage of temporally food surpluses are also a common characteristic of these environments.

3. Savannas have an outstanding dynamic nature in which they display marked fluctuation in dominant species and whereby perturbations may lead to chain reactions in the system in which the perturbations of one dominant species may have far reaching repercussions on other system components.

4. They have a relatively high net production, characterized by high production, high biomass ratio and rapid population turnover.

As discussed earlier, the availability of water has a decisive role for the development of the vegetation blanket. In more humid places Savannas can develop as a mosaic interspersed with gallery woods which develop mostly at temporal creeks and in river valleys.

The natural Savanna is strongly connected to the dry-woodland environments. Their position between the two major African environments rainforest and arid low-latitude ecosystems once again attests to the importance of moisture as the dominant variable in their relative location. However, in many regions the area extent of contemporary Savanna and dry-forest environments largely reflects the major modifications that human activities have induced on the "natural" Savannas. As already explained above climatic criteria alone cannot accurately explain the current extent of these environments in Africa today. Clearly, besides the moisture balance as a critical determinant, contemporary Savannas and dry forests in many places in Africa reflect generations of human activity, which include forest clearing and grass burning. We can sum up, Savanna suggests a mixture of grassland and trees, and this combination of vegetation types occurs over a range of climates and other environmental conditions. In areas of lower rainfall the trees are very scattered, being located mainly near seasonal water courses. Short seasonal (annual) grasses predominate there. In the wetter part of the zone grasses are tall (1-2 m) and woodland occupies a larger portion of the land surface. Terms such as "Woodland Savanna", "Grassland Savanna", "Parkland" and “Shrub” are used to subdivide this category ecologically. These various vegetation descriptors give an indication of the range of varying moisture conditions that exist in Savanna areas. Natural grassland and semi-deciduous forests are primarily a response to seasonal moisture deficiencies when they occur at low and moderate elevations in the tropics. Generally the Savannas are characterized by a continuous cover of perennial grasses, which may or may not have an open canopy of drought-resistant, fire-tolerant, or browse-resistant trees, or which may have an open shrub layer. Distinction can thus be made between Tree or Woodland Savanna, Park Savanna, Shrub Savanna and Grass Savanna. Furthermore, Savannas may be distinguished according to the dominant taxon in the tree layer: for example Palm Savannas, Pine Savannas and Acacia Savannas. In a number of areas where stable equilibrium has been reached between Savanna trees and grasses, it has been shown that these two life forms, which are usually antagonistic in other biomes, generally exist harmoniously in Savanna ecosystems even eventually benefiting each other. This co-existence has been proved by comparing the amount of mineralised nitrogen in open Savanna grassland and under trees in the same Savanna conditions. It has been found that mineralisation of nitrogen is higher under trees such as *Acacia senegal* than under pure grass cover (BELSKY 1992). Other examples that help to explain the harmonious mutual co-existence between Savanna grasses and Savanna trees or woodlands are: Instead of competing for the top soil water, the Savanna trees make exclusive use of the sub-soil water while the grasses make use of the top soil water. Open grassland however tend to inhibit the recovery and re-establishment of the of herbaceous vegetation after drought. It is shown that such re-establishments are much faster in areas where trees and shrubs have not been cut down than in open grassland environments.

Savannas occupy a very wide area of the tropics and the sub-tropics where there is a combination of a low total annual rainfall of between 400 mm and 1500 mm (extremes at 200 mm and 2000 mm) and a marked seasonality in the rainfall distribution, with a normal dry season of between 4 to 8 months (extremes at 2 to 10 months) of the year (LEWIS & BERRY 1988) . This very long dry season is a second reason why fire is an annual or biennial event in the Savannas. As mentioned fire is both a natural and an anthropogenic phenomenon in Savannas. The ecosystem is adapted to fire regimes that are characterized by their frequency, spatial patterning and intensity of events (BRAITHWAITE 1996). Significant changes in fire regime, such as very frequent and / or spatially extensive fires, or fires of greater than usual intensity, can have negative impacts on ecosystem structure and function.

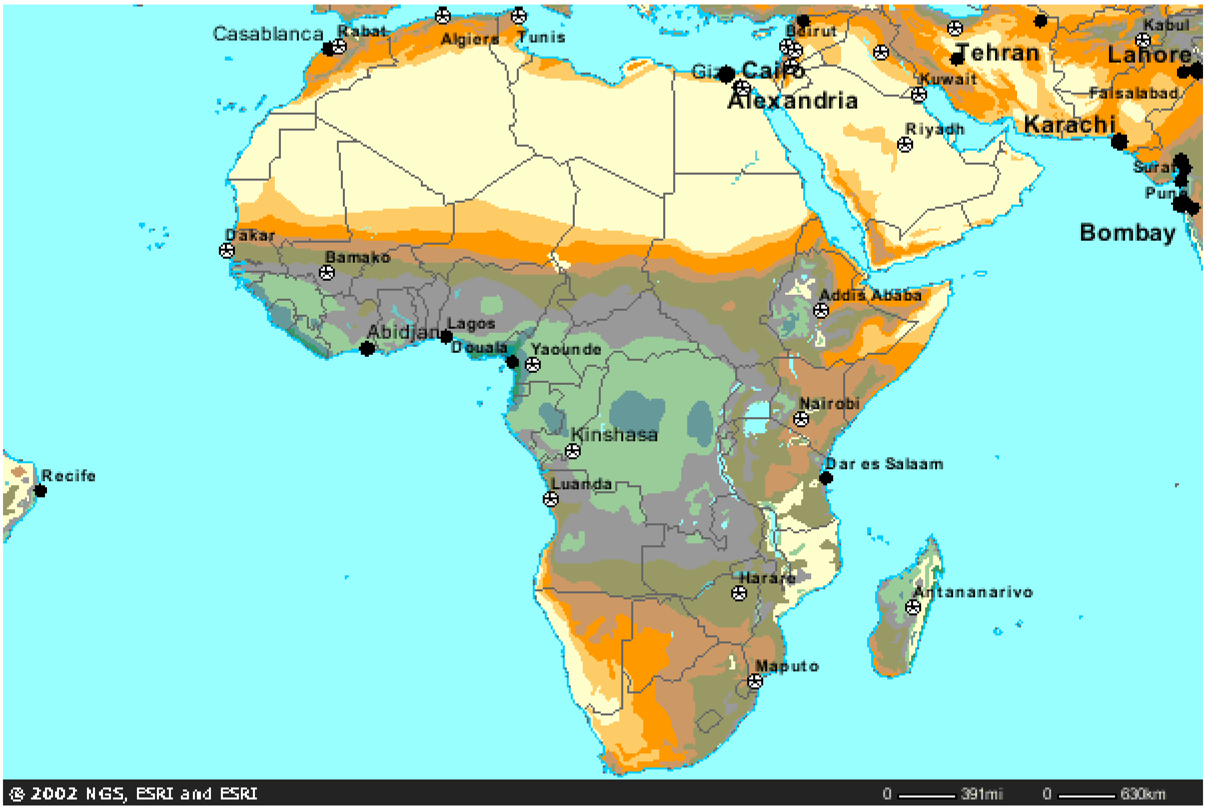


Figure 4: Annual Precipitation in Africa (mm/y). Precipitation is one of the determining factors of Savanna development. (see also Figure 3). (World GIS by ESRI)
Key:
2000 1400 1000 500 400 200 100 0

2.1.5 The East African Savanna Ecosystems

Although much of the East African Savanna ecosystems are found at altitudes around 1000 - 1500 m, they are nevertheless characteristic of any other African Savanna, characterized by seasonal fires among others. Usually the fires start just before the rainy season begins. Most of the remaining woody species have through time become fire resistant. As elsewhere in Africa, Savanna grasses dominate the landscape at the expense of woods and forest. However, unlike most other regions, especially West Africa, there are many different vegetation associations as a sign that former large expanses of Savanna are being taken over by woods and thickets.

In East Africa the most common Savanna type is the woodland type dominated by the *Combretum* species. In drier areas *Albizia amara, Acacia* and *Commiphora* species become more important. The tall grasses are dominated by *Hyparrhenia* species.

Acacia Savannas are common in East Africa, but many areas appear to have special soil or drainage conditions. In Southern Kenya *Acacia senegal, A. seyal, A. gerrarii* and *A. nilotica* are the main Acacia species types, among *Themeda* grasses. The *Acacia tortilis* Savanna occurs most frequently in drier marginal Savanna areas. *Acacia xanthophloea* and *Acacia kirkii* are often found in connection with the riparian vegetation in seasonal dry valleys (MORGAN 1972).

The climatic variation in the Kenyan Savanna areas are to a large extent a reflection of the different altitudes. The rainfall pattern in the tropical Savanna in general depends on the movements of the air masses. The sun is over the equator on 21 March, the tropic of Cancer on 21 June, the equator again on 21 September, and the tropic of Capricorn on 21 December (MORGAN 1972). The sun's heat causes a low-pressure zone that encircles the earth roughly parallel to the equator, and that moves north and south following the suns movement, usually with a lag of 4–6 weeks. This zone is called the Inter-Tropical Convergence Zone (ITCZ).

The East African Savanna soils are quite varied. This pattern is diversified locally by volcanic rocks, some of geologically recent origin. There is a general tendency towards low levels of nutrients in most Savanna-area-soils on gently sloping land. The soils with the highest nutrient supply are usually in isolated alluvial areas or of local volcanic origins, like the Serengeti grass plains in Tanzania. Sloping lands, where drainage is better and production of newly weathered material somewhat faster, tend to be preferred for cultivation, though high levels of soil loss are also experienced from such lands. Thus a delicate balance between erosion and soil production must be maintained when these lands are used. The soils in the Savanna areas suggest a catena-type variation. This variation is a factor of the detailed pattern of vegetation distribution and land use pattern in many areas. The term "catena" was coined in East Africa for a repetitive sequence of soils, correlated mostly with topography (MILNE 1935). Such a catenary sequence is shown in figure 5. In parts of the East African Savanna areas, gently rolling country includes scattered small hills or ridges, gently sloping slopes and flat base slopes and valley floors. The steepest hill slopes are often covered with shrubs and bushes, the lower hill slopes are naturally Savanna, and the valley bottoms most often grassland.

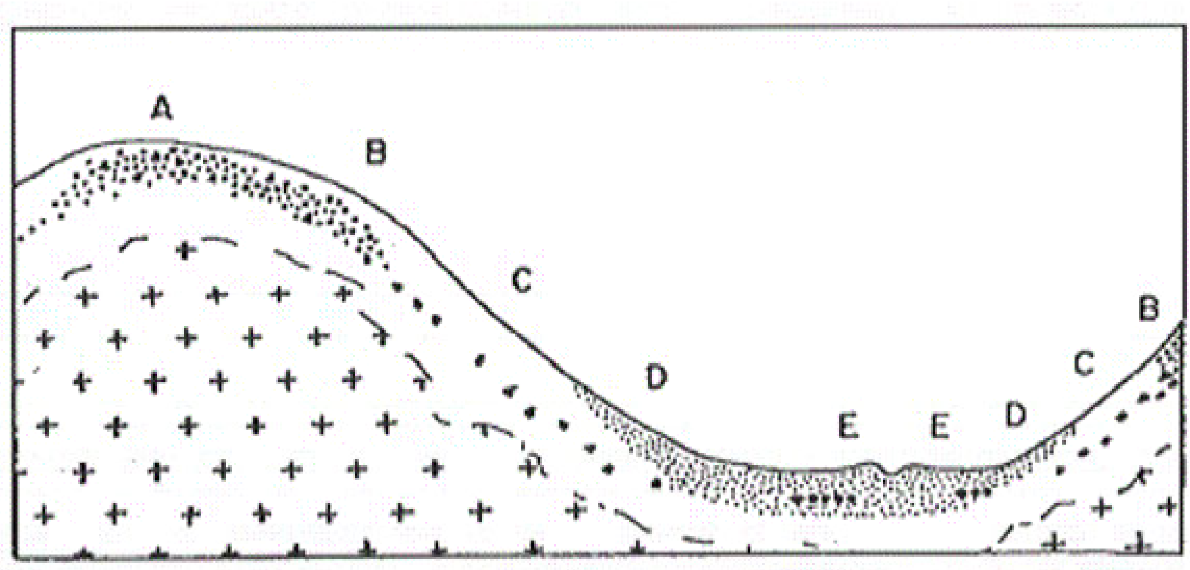


Figure 5: Soil Catena. Soils properties are influenced by the height of water table the slope gradient. Gravely red and brown upland sedentary soils are found at *A* and *B* on summits and upper slopes. These grade down slope into yellow-brown, sandy, light, clay soils developed in middle-slope colluvium at *C* and into yellow-brown, sandy loam and loamy sand colluvium at *D*. The soils developed in local granite-derived alluvium at *E* are mostly grey to white sands with subordinate areas of gritty or sandy grey clays. (Fig. by AHN (1970))

The open grassy character of some Savannas is also associated with a distinctive and often very visible mammal fauna which form the world's greatest diversity (over 40 different species) of ungulates (hoofed mammals) on the Savannas of Africa.

The great antelopes (*Antilopinae*) commonly found in the Savanna include among others the eland (*Tragelaphus oryx*), kudu (*Tragelaphus imberbis* and *T. strecsiceros*), impala (*Aepyceros melampus*), oryx (*Oryx gazella beisa*) and gerenuk (*Lithocranius walleri*).

Buffalos (*Syncerus caffer*), wildebeest (*Connochaetes taurinus*), zebras (*Equus grevyi* and *E. burchelli*), rhinos (*Diceros bicornis* and *Ceratotherium simum*), giraffes (*Giraffa camelopardalis*), gazelles (*Gazella sp.*), elephants (*Loxodonta africana*) and warthogs (*Phacocoerus aethiopicus*) are among other herbivores of the African Savanna. Up to sixteen grazing and browsing species may coexist in the same area. They divide the resources spatially and temporally, each having its own food preferences, grazing or browsing height, time of day or year to use a given area, and different dry season refugia. This species-rich environment supports a diverse set of predators which include the cats (lion (*Panthera leo*), leopard (*Panthera pardus*), cheetah (*Acinonyx* *jubatus*), serval (*Leptailurus serval*)), jackals (*Canis sp.*), wild dogs (*Lycaon pictus*), and hyenas (*Crocuta sp*.). Noteworthy among these predators are the lion and the cheetah, which prey on large herds of grazers and browsers, such as wild cattle, antelope and deer, as well as a range of Savanna specialists, like the giraffe and the zebras. Temporal and spatial patterns of herbivory play a significant role in shaping Savanna habitats. The variety of wild grazers and browsers, from dikdik (*Madoqua kirki*), through impala, gerenuk and oryx to elephant, influence the dynamics of different aspects of the ecosystem in different ways and to different extents. Termites are an important soil forming factor in many areas, helping in soil turnover and creating small zones of better aerated and more fertile soils by bringing soil material up from underneath to the surface.

Figure 6: Termitarias. Termitarias are conspicuous and ecologically important elements of the Savanna (by www.planetware.com)

Besides being useful soil forming agents, termites can also be regarded as good Savanna “landscape engineers”. Termites are thus capable of modifying, maintaining and/or creating micro habitats and landforms that greatly influence ecological functioning and alter the landscape scenery through the formations and distribution of the different shapes and sizes of the termitarias that exert a strong influence on the spatial pattern and temporal dynamics of the Savanna ecosystem.

By creating macro pores through tunnel and nest building activities, the termite creates conduits in the soil which accelerate the transportation of nutrients and provide shelter for shade and protection of many other organisms like reptiles and small mammals. Deserted termitaria are often turned into home for snakes, mongoose, mouse and other smaller creatures.

Figure 7: Termitaria on a sandy loam soil. Termites are ecosystem engineers that alter the ecological function and landscape scenery of the Savannas (Photo by Isabel Schad, Essen University)

2.1.6 The Greater Serengeti as a typical Example of an African Savanna Ecosystem

The Greater Serengeti Ecosystem (GSE) strides the Kenyan/Tanzanian border and occupies more than 60,000 km² of two East African countries. The GSE represents not only the remnant of a large mammal dominated ecosystem which has existed in African at least since the Pleistocene (WCMC 2001), it is also the home of the early man, where LEAKEY found the 1.75 million-year-old remains of *Australopithecus boisei* ('Zinjanthropus') and *Homo habilis* suggesting the presence of mans early relatives in Oldupai. Oldupai is the Maasai word for Olduvai Gorge. A 3.6 million years old footprints of hominids were also discovered here (at Laitole site) in 1978.

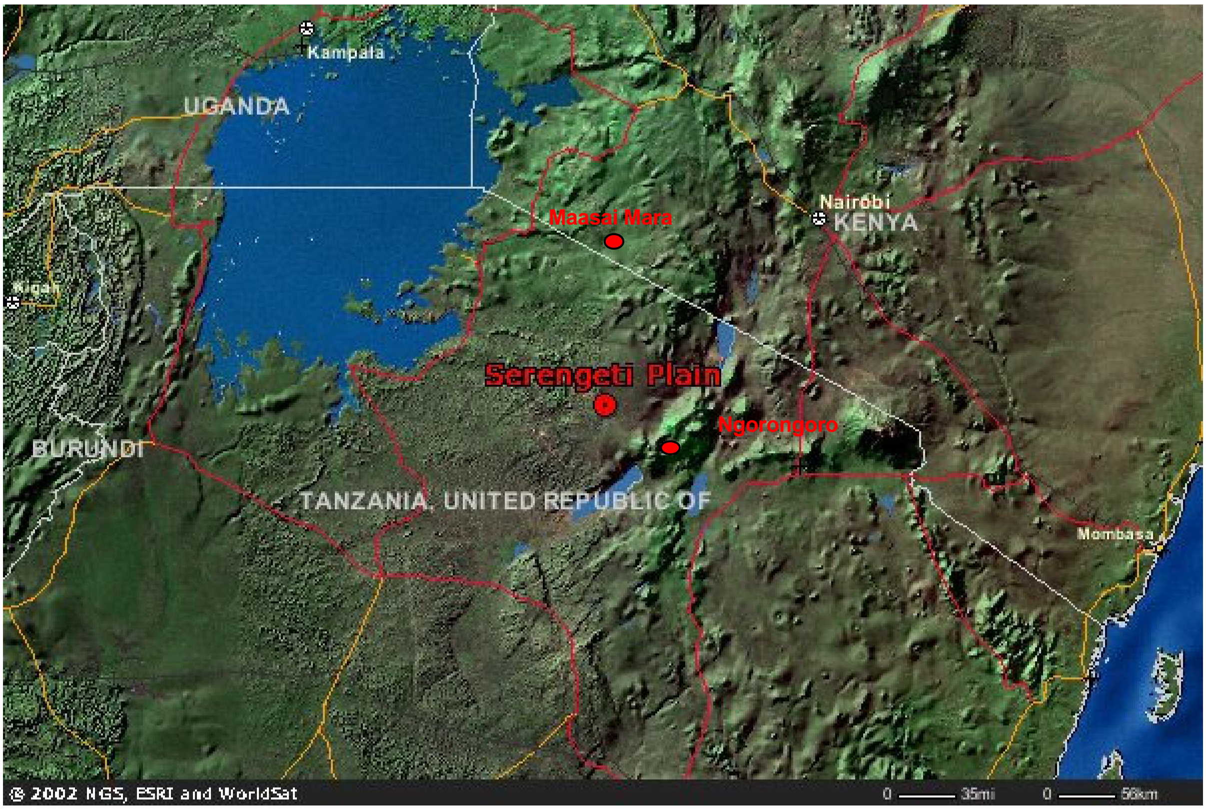


Figure 8: Geographical position of the Serengeti. The Serengeti-Mara Plains are the heart of the GSE (ESRI World GIS)

The name Serengeti comes from the Maasai word "String" referring to an "endless plain". From the southern end one experiences a vast endless grass plain, covered with the greatest concentrations of plains animals left on earth. These plains were formed 3-4 million years ago when ash blown from volcanoes in the Ngorongoro highlands covered the rolling landscape. The rich soil which supports the southern grass plains establishment are also supported by these mineral rich volcanic ash. It is in these volcanic ash (at the Oldvai Gorge) that the oldest remains of human have been found preserved. This is an indication that from the ancient humans here who were hunter-gatherers and more recent pastoralists, have co-existed together with the diverse wildlife and shared this ecosystem in an ecologically harmonious manner, until the first European, an Austrian explorer and naturalist, Oskar BAUMANN, on his way to Burundi 1891 “found a land virtually undisturbed” (BAUMANN 1894) after which the exploitation of the ecosystem for its exceptional hunting opportunities started.

The Greater Serengeti Ecosystem is made up of several smaller systems, both aquatic and terrestrial, connected by natural corridors and defined into one larger ecosystem by natural barriers which both determine the movements of the organisms within the ecosystem and prevent the emigrations and immigrations. On the Tanzanian side the ecosystem is composed of Serengeti National Park, the Ngorongoro Conservation Area, The Lake Eyasi Basin, Maswa Game Reserve, the Ngurumeti, Ikorongo, Loriando and Lake Natron Game Controlled Areas. On the Kenyan side the Greater Serengeti Ecosystem comprises of the Maasai Mara National Reserve, the Loita Plains, the Isiria Plateau and the Loita Islands. The extents of the ecosystem are defined by the annual movements of the migratory wildebeest within the ecosystem’s natural barriers formed by the rangelands of the dry Loita and Mara plains of Kenya on the north, the Loita Hills of Kenya and Gol Mountains of Tanzania on the east, the Eyasi escarpment of Tanzania on the south and the strips of cultivated lands adjoining the Lake Victoria on the western end. Small rivers, lakes and swamps are scattered throughout the ecosystem. In the south-east rise the great volcanic massifs and craters of the Ngorongoro Highlands.

Being part of the high interior plateau of East Africa, the Serengeti Ecosystem forms a gentle slope from its highest part (1,850 m) near the Gol Mountains toward Speke Gulf (920 m) of the Lake Victoria. Late precambrian sedimentary rocks overlie the shield and form the central and southern hills. A late precambrian orogenic event produced outcrops of granitic gneisses and quartzite east of Seronera, forming the eastern hills and the kopjes (Inselbergs). The crater highlands are volcanoes of Pleistocene age. The Serengeti on the western side were formed by the aerial debris blown out of these eruptions. Oloinyo Lengai hill is still active.

Soils on the eastern plains are highly saline and alkaline, and are also shallow as a result of their recent volcanic origin. The soils become progressively deeper and less alkaline toward the north western plains and into the woodlands. The soil catena is characterized by shallow, sandy, well drained soil at the top changing to deep, silty, poorly drained soil at the bottom. Nutrient flow through the grazing food web determines the distribution of resident ungulates, the movement of migrant animals and the biomass of herbivores (SINCLAIR & ARCESE 1995).

The main vegetation types of the GSE are the vast open plains covered by short and long grasses in the south and south eastern parts, the Acacia Savanna in the central area, the wetter, hilly and more densely wooded northern section and the extensive woodland and black clay plains, dominated by the central ranges of mountains in the western corridor. The south east plains are virtually treeless except along the Oldvai Gorge. The main grass species found in the open plains and continuing into the woodlands are *Themada triandra* and *Pennicetum mezianum*. The woodlands start at a sharp boundary around Seronera area. The dominant species of the woodlands are the *Acacia* species (EMERTON & MFUNDA 1999). The vegetation is supported by volcanic ash derived vertisols. The soils have characteristic plant communities which distinguish the ecosystem from its neighbours and give it a topographical outlook of a flat to slightly undulating grassy plain, interrupted by scattered bushy vegetation around the Kopjes, which are part of the Precambrian basement rocks protruding through the ash layers. Humid forested mountains, volcanic craters, fresh water lakes and the extensive Savannas make the outstanding landscape diversity.

Average annual rainfall varies from 500 mm in the dryer, southern grasslands, to almost 1.200 mm on the shores of lake Victoria. Almost all the rain falls in two seasons, a short season (November-December) and a longer one (March-May). The altitudes range from 920m to 1,850m and the mean temperatures vary from 15 degrees to 25 degrees Celsius (SINCLAIR & ARCESE 1995).

The ecosystem supports not only the largest herds of the migrating ungulates but also one of the highest concentrations of large predators in the world (SINCLAIR & ARCESE 1995). Among the ungulates, it is estimated to harbour about 1.3 million wildebeest (*Connochaetes taurinus*, 200.000 zebras (*Equus burchelli*), and 400.000 Thomson's gazelle (*Gazella thomsoni*) (CAMPBELL & BORNER 1995, WCMC 2001). The carnivores are also numerous with the hyenas (7.500), being the most numerous, and the lions being about 2,800 (SINCLAIR & ARCESE 1995). In total there are about 30 species of large herbivores and nearly 500 species of birds. Migration within the GSE is therefore dictated and totally dependent on patterns of rainfall and grass growth and difficult to predict. The migrating wildebeest followed by zebra and gazelle migrate to the west and north in search of better grazing from May through to July, moving from Seronera through the Western Corridor, then outside the park to the Grumeti, close to the shores of lake Victoria and arriving in the Maasai Mara in Kenya by late July through to early September. By October/November they are drifting back to Seronera and spend the long rainy season in the Serengeti grasslands national park in Tanzania. The western Grumeti corridor of the GSE derives its name from the Grumeti river and stretches to the shores of Lake Victoria. The corridor supports a lush Grumeti riverhine forest vegetation that provides a sharp contrast to the surrounding plains. It is used by the migrating herds and serves as the first annual stop-off point by the migrating herds which arrive between June and July, having left the dry plains in the south in May/June. Its colourful topography of hills, rivers and flood plains thus provides year-round habitat for both the migrating species and the resident species such the black and white Columbus monkey, the Grumeti's river population of giant Nile crocodiles at Kirawira, the topi, giraffe and buffalo as well as some resident wildebeests. Between June and December the migrating wildebeest move through northern woodlands across the Kenya/Tanzania boundary to the Maasai Mara region in Kenya. Here they feed on the longer grasses on the rocky hills, along the rivers and woodlands that typify this scenic area. Here they mix with a large diversity of the resident wildlife which include the elephants, giraffes, zebras, buffalos and many more. In November, the beginning of the wet season, these animals complete the cycle and return to the plains (SCHALLER 1972). Here they exploit the young growing grass rich in the minerals and at the same time give birth to young ones. In February/March one of wildlife's most amazing spectacles occurs. For 3-4 weeks 90% of the female wildebeest give birth, flooding the plains with thousands of newborn calves, estimated to be about 8,000 births a day (EMERTON & MFUNDA 1999). This synchronised birthing is a strategy for increased survival of the calves. Since the young are at their most vulnerable in the first month of their lives, the chances of being killed are much lower for each calf if they are all born within a short period (ESTES 1966, 1976). Calves born outside of this synchronized birth period seldom survive (KINGDON

1997). The wildebeest may remain on the plains for several months, where they share these productive grasslands with migratory zebra, Thomson's gazelle and eland, as well as the many residents including the Grant's gazelle, topi and hartebeest.

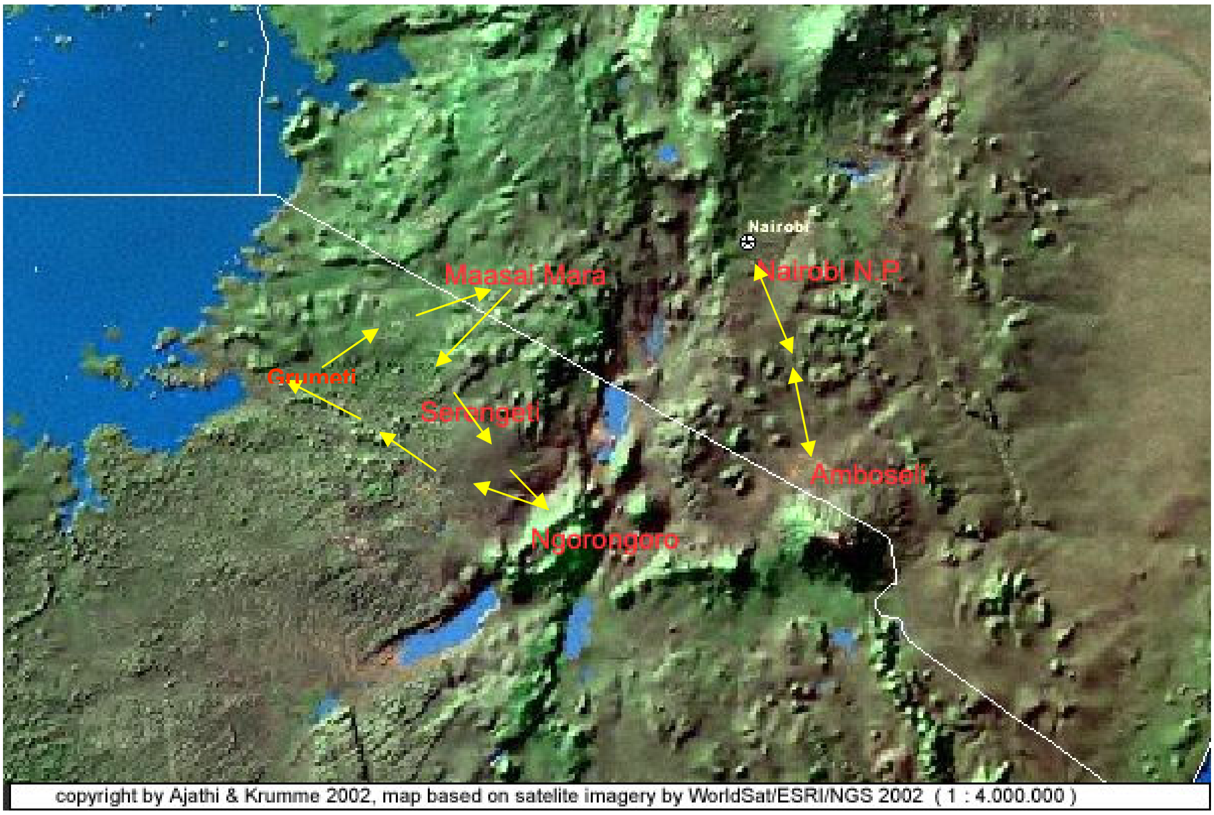


Figure 9: Herbivore Migrations. The arrows show the main migratory routes within the GSE and between Amboseli and Nairobi National Park.

Although populations fluctuate, there are an estimated 1.3 million wildebeest (*Connochaetes taurinus*), 200,000 plains zebra (*Equus burchelli*), and 400,000 Thomson's gazelle (*Gazella thomsoni*) migrating each year (CAMPBELL & BORNER 1995, WCMC 2001). A large number of associated mammalian predators are also involved in these movements. By the onset of the dry season (late May), the grasses on these plains have either dried out or been eaten down to stubble, and water is scarce (SCHALLER 1972). This triggers the massive migration of wildebeest and zebra, later followed by Thomson's gazelle and eland (*Tragelaphus oryx*), from the plains to the *Acacia-Commiphora* woodlands.

Figure 10: Wildebeest herd. Wildebeest migrations are one of the most characteristic spectacles in the GSE (by A.S. TANENBAUM)

2.2 Vulnerability of Savanna Ecosystems

From the above sections, it can be concluded that Savanna ecosystems are by their nature complex and dynamic ecosystems. Savannas display numerous mosaics ranging from human uses to natural elements. The stability of an ecosystem arises from its ability to maintain structure and function during disturbance (termed resistance) and to recover following disturbance (termed resilience). Spatially heterogeneous and very dynamic ecosystems, such as Savannas, tend to have several alternative stable states adding to their resilience.

When the Savanna ecosystem is functioning normally, unusual perturbations (such as unusual high rainfall or fire or intense mega herbivore activity) may move its state away from one stable state to another. When the ecosystem is degraded in some way and so not functioning normally, these kinds of perturbations may push the state of an ecosystem away from all possible equilibria towards an ecological limit, risking destabilisation of the entire ecosystem. The risks of this happening are greater if the ecosystem is already experiencing other disturbance, such as excessive anthropogenic exploitation and pollution, which is the case in many Savanna areas, especially due to excessive tourism or agricultural exploitation. For example the erodibility of Savanna soils is naturally high because many of the soils are sandy, low in organic material and of unstable crumb structure (KOWAL & KASSAM 1978). Under natural vegetation undisturbed by humans or domestic animals, the soil surface is normally protected by leaf litter and a canopy of leaves and negligible amount of soil erosion takes place. The danger comes as population pressure causes an increasing proportion of the land area to be cultivated and exploited for extended periods, so that soil fertility and the vegetative cover are reduced and accelerated erosion can take place if careful precautions are not taken. BROWN & WOLF (1985) have argued that about 1 billion tons of top soil is being lost by erosion each year in the East African countries Eritrea and Ethiopia alone. There is no doubt that due to inappropriate land use systems uncontrolled erosion is causing enormous damage to the African Savanna ecosystems. It appears that the Savanna types of fine sandy loam or loamy sand soils, that are low in organic material (OM) through over-cultivation, and therefore have unstable structures, are particularly liable to erosion because of their tendency to crust.

The temporal patterning and intensity of rainfall is critically important to the dynamics of a Savanna ecosystem. Variably periodic extreme rainfall events, like that experienced by East African Savanna during the 1996–98 ENSO event, when a prolonged period of unusually intense drought was followed by exceptionally heavy rainfall for many months, undoubtedly shape ecosystem dynamics. Such superordinated events may have much more impact if they interplay with human disturbance on the area condition on which they take place, such as the degradation of sites through damage of vegetation cover or surface texture of the top soils. When a high intensity rainstorm hits bare soil, the fine soil particles are loosened by rain splash and are washed down into the pore spaces, which quickly become blocked. Once the pore spaces are blocked and the soil surface is saturated, runoff starts (CHASE & BOUDOURESQUE 1989).

Further key parameters in driving Savanna ecosystems and potentially manageable disturbance factors and processes are for instance fire and herbivory. As we have mentioned fire is both a natural and an anthropogenic phenomenon in Savanna. The ecosystem is adapted to fire regimes that are characterized by their frequency, spatial patterning and intensity of events (BRAITHWAITE 1996). Significant changes in fire regime, such as very frequent and/or spatially extensive fires, or fires of greater than usual intensity, can have in the long run negative impacts on ecosystem stability. The main issue in managing fire is to ensure that 'hot' burns, which are largely dependent on the amount of readily-combustible biomass (itself related to the interval between fires) do not occur. Avoiding accumulated biomass in the grassland and bush land areas probably requires periodical fire events and equivalent grazing and herbivory intensities, which require stabile and healthy populations of the requested animal species in the habitat.

Temporal and spatial patterns of herbivory also play a significant role in shaping Savanna habitats. The variety of wild grazers and browsers, from Dikdik, through Impala, Gerenuk and Oryx to Elephant, influence the dynamics of different aspects of the ecosystem in different ways and to different extents (VAN DE KOPPEL & PRINS 1998). Tourism as one of various stressors in Savannas, can have a remarkable influence on these phenomena, if the expanding human activities lead to dispersive movements of populations and seasonal migrations, which can change the spatial pattern, density and intensity of grazing.

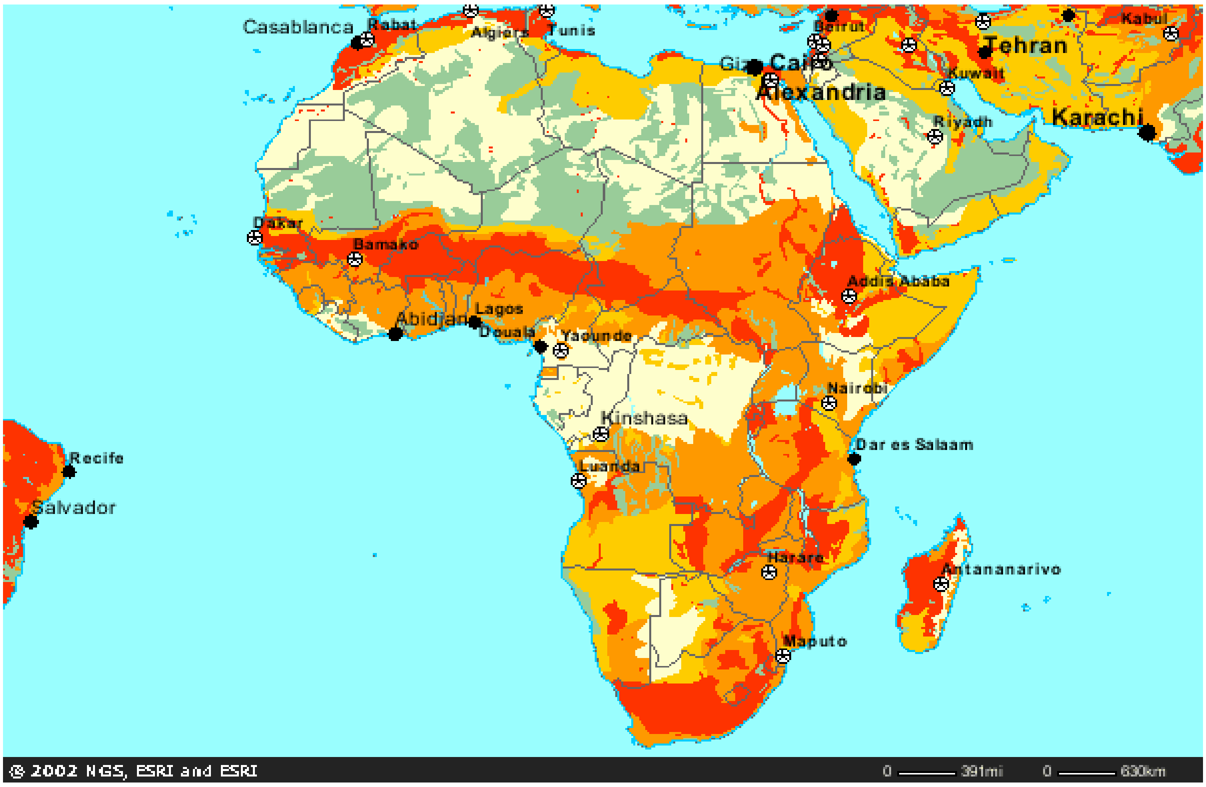
Because of its cumulative effect to natural conditions or natural disturbances, human use in ecosystems cannot be regarded in isolation. This context is difficult to simulate because it does not mean that a naturally highly disturbed Savanna ecosystem is more fragile than a relatively undisturbed other ecosystem. A system with a high disturbance frequency could also have a higher level of adaptation against specific kinds of intervention, so that ecosystem change certainly depends on the type and quality of the disturbance. Unfortunately many of the anthropogenic disturbances in natural ecosystems are of a foreign character with vast ecological consequences in degradation. Savannas are, as already mentioned, often co-evolutionary landscapes driven by a diverse mix of both natural and anthropogenic parameters. Most of the current intensive forms of land use in their ecosystems have nothing in common with the old traditional cultural lifestyles of man which contributed to the original landscape scenery.

Although recent works suggest a remarkable comparative resilience to perturbation, in which the capacity for 'regeneration' is maintained for relatively long periods in Savannas (DUBLIN 1995; LEUTHOLD 1996), it is well observed that recent human use of low productivity areas like semi-arid Savannas leads to important changes in biodiversity. These changes might in some cases be reversible over time, but this will depend on the state of the ecosystem and the kind, extent, frequency and density of anthropogenic disturbance. If local anthropogenic disturbance does not mimic natural disturbances, in terms of nature, intensity, frequency, spatial patterning and variability, it is likely to degrade ecosystems in ways that may not be apparent for long periods of time.

An example of a complex vulnerability of Savanna landscapes can be presented in the functional role of *Acacia kirkii*, usually occurring along river valleys. This plant supplies both browse to animals and nesting material for the birds as cattle egrets, which in turn can suppress the severity of pest attacks on cultivated and conservation areas. The presence of many nesting water birds fertilizes the water with guano, which in turn triggers algal bloom and is leading to a chain of other aquatic processes like increase in fish production. If human interventions do change the site and the growth conditions of *Acacia kirkii,* or if the propagation of the nesting birds are endangered by continual tourist disturbances, the diverse effect is here already predictable.

Because of the traditional role of the African people in driving and maintaining Savannas one sharply has to distinguish human influences which could lead to the total destruction of the ecosystems, from those which are an integral component of the landscape maintenance. From the ecological point of view the impacts of modern human uses in Savannas are more multi-factorial and often cause a multiple of primary, secondary and further negative effects. Although the links between genetics, species, ecosystem diversity and ecological functioning are in most cases not well documented scientifically, it is nevertheless clear that species or community losses at one level do induce serious consequences elsewhere in the ecological system.

Habitats that have low species diversity can (but must not) especially be vulnerable to ecological disturbances. For example, the loss of a carnivore species in a region could result in a population explosion of herbivores and omnivores, with subsequent devastating effect on local crop production or the ecosystem primary productivity. This shows that there can be a strong negative correlation between such human activities as tourism, hunting or poaching on the one hand and other human activities like farming on the other hand in the same region. Like the herbivore density in an area, tourism, if not well managed, can also have a remarkable influence on ecosystem functioning, especially where the expanding human activities lead to diversion of natural movements of populations and seasonal migrations of wildlife, thus changing the spatial pattern, density and intensity of grazing. This could trigger a chain reaction, when the local predator pressure is increasing, because, for instance, lions or cheetahs concentrate on a habitat with an artificially high mega herbivore density. Such an anthropogenic caused process does not only trigger the over-exploitation of the grazing ground but may also lead to a drastic unnatural decrease of the prey. populations.



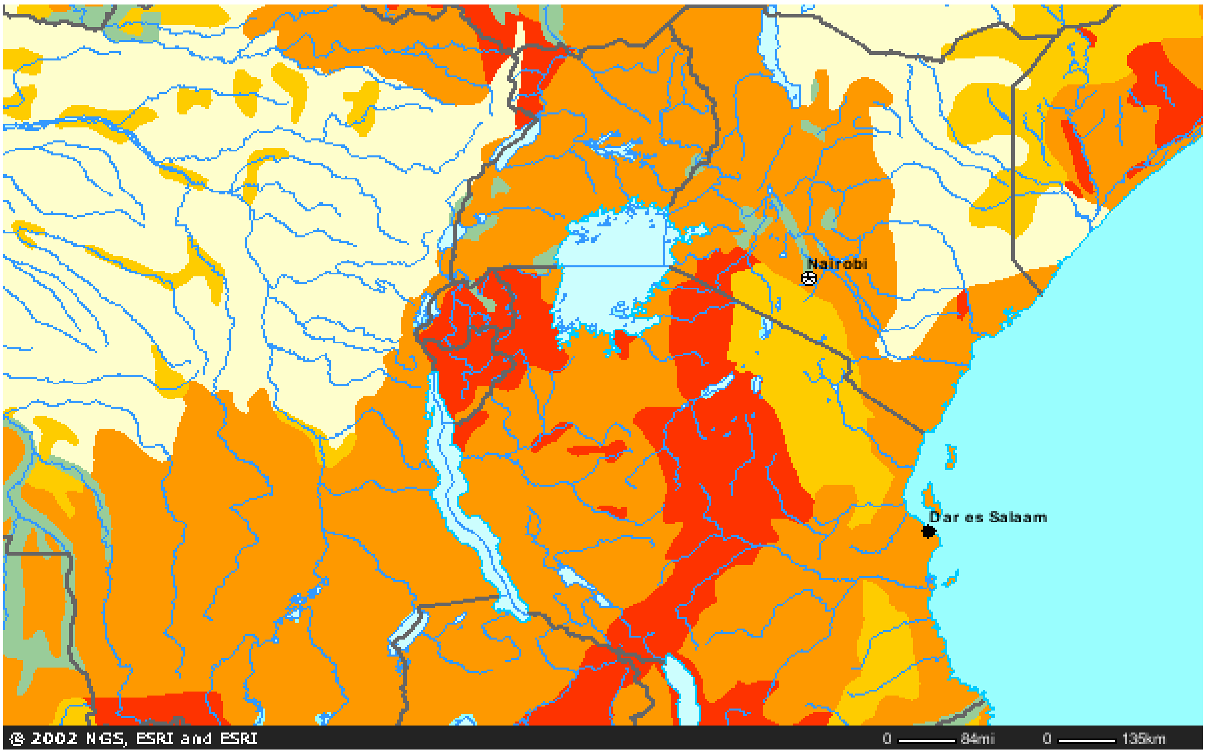


Figure 11: Maps of Africa / East Africa showing varying levels of vulnerability to agricultural activities. (ESRI World GIS: Agricultural Threat to Ecosystems)
Key:
very high high moderate low no threat

2.3 Types of Land Use and their Impacts

The African Savanna has for the most part undergone major changes in the last 100 years and probably many other changes in the years before. KJEKSHUS (1977) shows that until the 1880s much of the Savanna zone of East Africa was a grazing area with very large herds of domestic stock. Then, in the last part of the 19th century, the combination of the colonial invasion and the devastating widespread of rinderpest epidemic resulted in the death of large proportions of both the livestock and the humans. Consequently the intensity of land use in the area greatly declined and the focus of population and livestock retreated to the valleys. More woody vegetation gained hold, fire became less frequent and bush land and thickets replaced what had been Savanna grassland. This fact shows impressively the influence that man has on the ecology of Savannas. Tsetse fly became established in wide areas as bush land grew in extent. This pest helped to prevent the livestock and Savanna grasses from becoming re-established.

The major land uses in the Savannas today include:

- livestock keeping
- tourism
- conservation reserves
- small scale traditional agricultural activities
- human settlements

Water is the main determinant of the different types of land use and occurrence of various types of landscape types. Water is however a scarce resource not only for natural systems but also human in the Savanna, though floods may be a periodic problem for agricultural activities where intermittent short high rain comes in heavy storms. In addition the short and intense rainfall, combined with the generally low porosity of the underlying soil strata, means that in most areas there are only localized and limited supplies of groundwater for irrigation and other water supply demands.

According to MACKINNON & MACKINNON (1986), roughly 65 per cent of the original wildlife habitats of sub-Saharan Africa has been lost to various human interventions. Although some habitat change is inevitable due to the human population growth and the need for economic development, much of the present pattern of biodiversity loss and ecological degradation of landscape, however results from unnecessary exploitation of the resources without understanding the long-term ecological consequences. The large-scale monocultures which have significantly displaced the highly diversified traditional production systems of Africa, which in many cases were better ecologically adapted to local conditions, are an outstanding example to prove the above point.

Today the exploitation of the Savannas is carried out through a set of diverse land uses ranging from commercial, traditional and wildlife utilization (including traditional forms).

Traditional forms of Savanna land uses which include traditional farming or livestock rearing and the exploitation of ‘natural’ ecosystems for wildlife management, have also had an impact on the species mix and the physical and structural conditions of the environment. However, the dominant Savanna components are here likely to remain. In these types of land use, the ‘natural’ ecosystems are used for the supply of traditional Savanna and woodland products. Today these products include medicinal plants, the harvesting of insects and activities that exploit the potential of wildlife and nature reserves, primarily as a result of the income from tourism that can be derived.

In general, Savanna ecological systems are continuously coming under threat from a number of sources. A report by the World Conservation Union (IUCN) identifies eight major threats to Africa's ecosystems (STUART, ADAMS & JENKINS 1990):

- inappropriate agricultural methods
- over-harvesting of natural resources

- population and migration pressure
- fragmented populations of species
- commercial land-use practices
- climatic changes
- introduction of alien species
- foreign debt servicing

The above problems are often compounded by the following factors:

- poorly developed market system that does not price exploited natural resources at their real economic value and providing easy, open access to the already dwindling and cheap natural resource; a phenomenon leading to a vicious cycle of further resource exploitation, poverty and hunger
- inefficient public regulating agencies with overlapping responsibilities
- inadequate involvement of key stakeholders including local communities in natural resource management
- weak institutional capacity especially in the wildlife resource sector and little involvement of communities in the management and sustainable use of such a resource
- weak inter-agency co-ordination in planning / monitoring natural resource use, especially at the district and community levels
- unavailability of any effective national or local level policies, regulations or guidelines on issues related to land tenure and ownership, right of access to and use of resources by rightful owners, protection of indigenous knowledge, and intellectual property rights

Commercial management activities, generally large-scale agro-industrial systems (hundreds to thousands of ha in extent), can completely modify the vegetation species mix, often by introducing alien species (WOODS et al. 2001). These commercial land use systems for example, are altering the structure of the vegetation, completely removing woody species and thus a higher level canopy for sugarcane production or conversely dramatically reducing grass cover in forest plantations. Commercial agricultural systems significantly alter the physical environment, modifying the soils and possibly even raising the water table through excessive irrigation in otherwise arid areas. Commercial cattle ranching may also change the species mix through management to encourage grass (fodder) production by burning and the introduction of exotic grass species. All these types of modified environments may in their current state, not qualify to be known as 'Savannas' under the definitions adopted before. But because they are in a predominantly Savanna area and would probably revert to Savanna type of vegetation if interventions ceased, they are here also regarded as Savannas environments despite the current type of vegetation cover and landscape scenery.

The diverse impacts of Savanna land uses therefore pose a dramatic threat to the integrity of Savanna ecological sub-systems. These impacts, together with the degree of threat they pose, can only be understood and evaluated against a background of the vulnerability of Savanna ecosystems. We have described conservation as one form of land use in the Savannas. Strictly conservation should primarily serve to the ecological stability of landscapes which subsequently should the ecological services to man and other land uses and should not only be conceived as a means of protecting certain wildlife species. Conservation should itself orientate on the ecological problems of the Savanna, seen as the impacts of other land uses and therefore should try to stabilize the whole ecological system and should prevent substantial damages to it. Thus the conservation has an key role to play in the sustainability of other forms of land uses. In the following chapter we will discuss conservation approaches in the African Savannas from the background of their effectivity and deficits. In most parts of Africa conservation in the Savannas mainly consists of the so called "in situ", conservation, an example of a sectoral conservation approach which designates protected areas as priority zones for conservation.

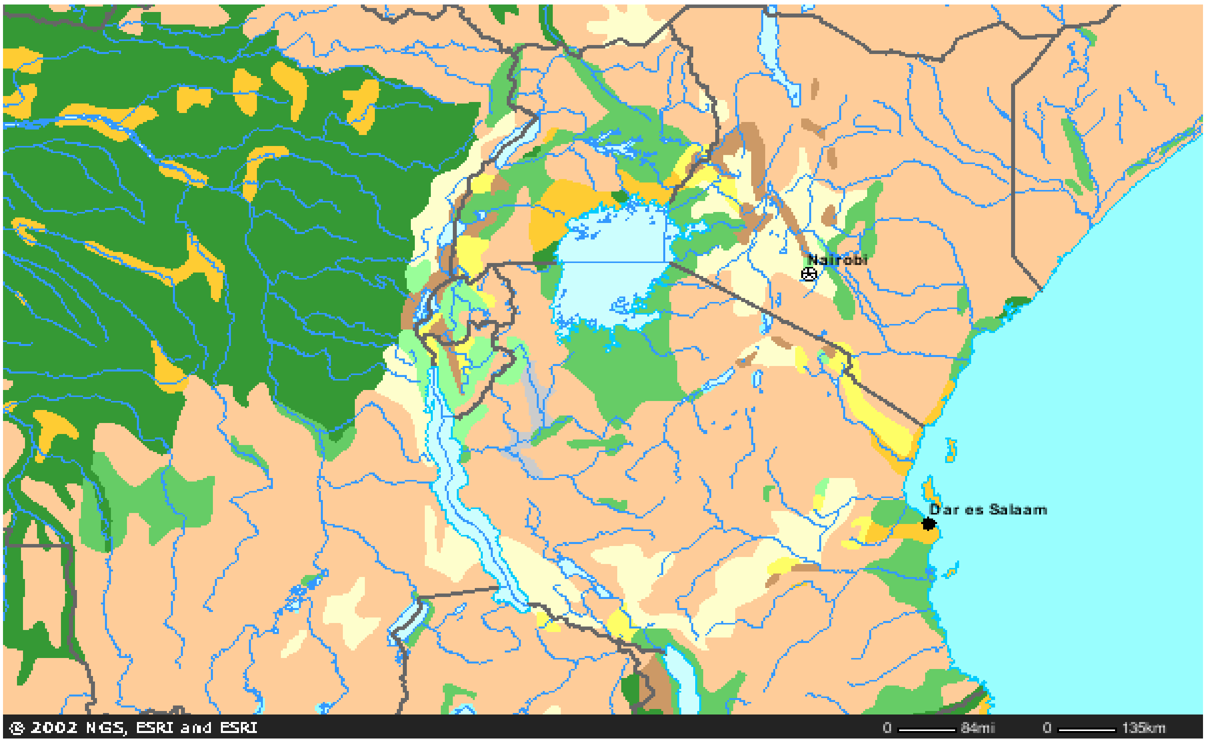


Figure 12: Land use in Africa / East Africa. Most of the Savanna is used as pasture land. (ESRI World GIS: Land Use)
Key:
Plains: Arable Land - Permanent Crops - Grazing Land - Forests
Mountains: Arable -Permanent Crops -Grazing Land - Forests

3 PROTECTED AREAS AND NATURE CONSERVATION IN THE AFRICAN SAVANNAS

Conservation is defined as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations (IUCN 1980).

The word “biodiversity” is used in this paper in synonymous with the widely used terminology-“nature”. It refers to the variability among biological organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part. It includes diversity within species (genetic diversity), between species and of ecosystems.

A protected area as defined by the “Convention on Biological Diversity” is a *"geographically defined area which is designated or regulated and managed to achieve specific conservation objectives"* (IUCN 1994).

Conservation of biodiversity in the protected areas (also referred to as “in situ” conservation), therefore seeks to preserve ecosystems and natural habitats and to maintain and recover viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. At the fourth World Congress on National Parks and Protected Areas, held in Caracas (Venezuela) in 1992 (IUCN 1994), the protected areas were re-defined to include areas *"of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means".*

The table below presents a summary of the six international categories of protected areas. A detailed description of these categories is attached in the appendix of this paper.

Table1: IUCN Protected Area Categories	
Category	**Primary Management Objectives**
Strict Nature Reserve (Ia)	▪ Scientific research ▪ Preservation of species, genetic diversity
Wilderness Area (Ib)	▪ Wilderness protection ▪ Maintenance of environmental services
National Park (II)	▪ Preservation of species, genetic diversity ▪ Maintenance of environmental services ▪ Tourism and recreation
Natural Monument (III)	▪ Preservation of species, genetic diversity ▪ Protection of natural / cultural features ▪ Tourism and recreation
Habitat / Species Management Area (IV)	▪ Preservation of species, genetic diversity ▪ Maintenance of environmental services
Protected Landscape (V)	▪ Protection of natural / cultural features ▪ Tourism and recreation ▪ Maintenance of cultural / traditional attributes

By ensuring the protection of natural habitats to the extent that the integrity of all of its ecological functions are maintained, this protected area approach has been demonstrated to be the best opportunity to ensure the fullest possible protection of biodiversity in the Savanna landscapes of Africa.

Biodiversity conservation in the protected areas is also a vital contribution to the conservation of the world’s natural and cultural resources. Its value ranges from the protection of natural habitats to associated flora and fauna, against destruction and extinction respectively, to the maintenance of both the environmental services of the respective ecosystems as well as the maintenance of the environmental stability of the surrounding regions.

The examples of the ecosystem services described below proves the importance of conserving biological diversity in the Savannas. The range of those environmental services, provided by the biological organisms, include the regulation of the gaseous composition of the atmosphere, regulation of the hydrological cycle and climatic conditions, generation and conservation of fertile soils, dispersal and breakdown of wastes, pollination of many crops, absorption of pollutants and protection of coastal zones (UNEP 1995). Human health and well-being are directly dependent on biodiversity. For example, some 75 per cent of the world's population rely for health care on traditional medicines, which are derived directly from natural sources.

Biodiversity also provides genetic resources for food and agriculture, and therefore constitutes the biological basis for world food security and support for human livelihoods. A number of wild crop relatives are of great importance to national and global economies. For example, Ethiopian varieties have provided protection from viral pathogens to California's barley crop, worth US$160 million per year (UNEP 1995) .

Apart from these services, protected areas also provide opportunities for rural development and rational use of marginal lands, generating income and creating jobs for research and monitoring, for conservation education and for recreation and tourism. It is estimated that 85-90 percent of all species can be protected by setting aside areas of high biodiversity before they are further degraded, without even having to inventory the species individually (UNEP, USGS & NASA 1996). The tropics are a home for majority of the listed biological species. Since however only a small portion of areas is likely to be devoted to biodiversity conservation due to the rapidly growing population and land use changes, conservationists see it as absolutely necessary to identify areas rich in species biodiversity, unprotected species diversity and endemic species and take whatever measures possible to protect them.

In the last decade not only have pressures from the scientific community and the efforts of non-governmental organizations led to stronger language in international agreements, but segments of the development community have accepted the idea that a large degree of compatibility exists between the need to develop and the need to maintain biodiversity and ecosystems. Further acceptance depends, however, on a number of attitudinal adjustments on the part of living with or directly involved in biodiversity conservation, as well as on a clearer understanding of the rationale behind it by those whose activities conflict with it. The success of conservation also requires a modification of how we value economic goods and services in the short, medium and long term (MCNEELY 1988).

Globally, the possibilities for undertaking conservation programs of areas such as national parks, biological reserves and other conservation areas appear to be somewhat favourable. However, the status of these protected areas is often not healthy and unforeseen problems as discussed in the Greater Serengeti Ecosystem example later on in this paper repeatedly arise.

In Africa protected areas occupy slightly over 2 million sq km or 7 per cent of the continent’s 30 million sq km (UNEP, USGS & NASA 1996). Among various bioregions in Africa, the barren and sparsely vegetated lands comprise about 9.6 million sq km with about 4 percent under protection, whereas biodiversity-rich tropical evergreen broadleaf forests comprise about 3 million sq km with about 6 percent of the area being under protection. The closed shrub lands, estimated to be over 700,000 sq km in extent, have the largest proportion, approximately 14 per cent of the protected areas of the total area. About 2 million sq km, or about 8 per cent, of croplands and a mosaic of croplands mixed with natural vegetation are under protected status. This makes it clear that the drier bioregions in Africa have more protected area than tropical evergreen broadleaf forests. Unfortunately, these protected areas are poorly distributed and lack adequate policy for their management in a network framework. Many unique and fragile drier ecosystems in northern Africa, for example, are yet to be adequately protected (UNEP, USGS & NASA 1996).

The opportunity for pro-active measures to conserve biodiversity in most of Africa thus is still very high. Low human population densities especially in the drier Savanna bioregions provide such opportunity if action is taken now. After all Africa being an agrarian economy has few other options than concentrate every effort in the conservation of its natural resources, which form the basis for the continents economy and social cultural and environmental stabilities.

It is on this basis that many African countries are now on the rush to develop systems of protected areas based on the six categories defined by the IUCN guidelines for protected areas management categories.

3.1 Evolution of Protected Area Categories

As we have explained, protected areas are primarily designed to preserve species and their genetic variability as well as to maintain the natural processes and ecosystems that sustain life in its various expressions. In the African Savanna regions, with high ecosystem vulnerability as a result of a combined impacts of increasing human population and natural phenomena, the protected areas become key elements for maintaining the diversity of species, ecosystems and wild genetic resources, while at the same time attaining the objectives of sustainable development of the populations living in those areas.

By preserving a biological potential of a renewable natural resource on which certain activities such as hunting, fishing and tourism (particularly nature tourism) depends, protected areas are therefore a great advantage means of diversifying local and regional economies and are also a prized setting for people's recreational and outdoor activities that contribute to the physical and mental well-being. In addition, protected areas have many other uses at the environmental, scientific, educational, social, cultural, spiritual and economic levels. They therefore represent one of the major components of the sustainable development as stipulated by the UNCED.

Although expected to satisfy the above definitions, the precise purposes for which protected areas are managed, in practice differ greatly as shown below:

- Scientific research
- Wilderness protection
- Preservation of species and genetic diversity
- Maintenance of environmental services
- Protection of specific natural and cultural features
- Tourism and recreation

- Education
- Sustainable use of resources from natural ecosystems
- Maintenance of cultural and traditional attributes

To give a greater consistency to their role and scope within conservation planning and sustainable land use, IUCN and the World Commission for the Protected Areas (WCPA) at the IUCN's general assembly in Buenos Aires in January 1994, expanded the categories and definitions of protected areas proposed in 1978 by IUCN by developing and adopted six modified categories that are in use today (IUCN 1994).

Prior to 1994 the IUCN's international classification of protected areas had 10 categories (IUCN 1978). In that system, Biosphere Reserves (BR) and World Heritage Sites (WHS) were denoted as category IX and X areas respectively. However, the realisation that these are only designations accorded by international conventions and programmes and not related to management functions on the ground led to a rationalisation of the system into the present 6 categories. This international classification system reduces confusion of terminology, demonstrates the range of purposes that protected areas serve, provides an agreed set of international standards and facilitates international comparison and accounting (PHILLIPS & HARRISON 1997). By adopting these new management approaches, the role of the protected areas is now also slowly changing to the protection of the ecological processes such water availability, soil erosion, natural food chains etc. and maintenance of human lifestyles that respects the protection of species within the protected areas.

Many African countries have slightly adopted this new conservation model and are slowly moving away from the single species protection approach to the creation of natural reserves, national parks and biosphere reserves (See the Figure 13, Table 2).

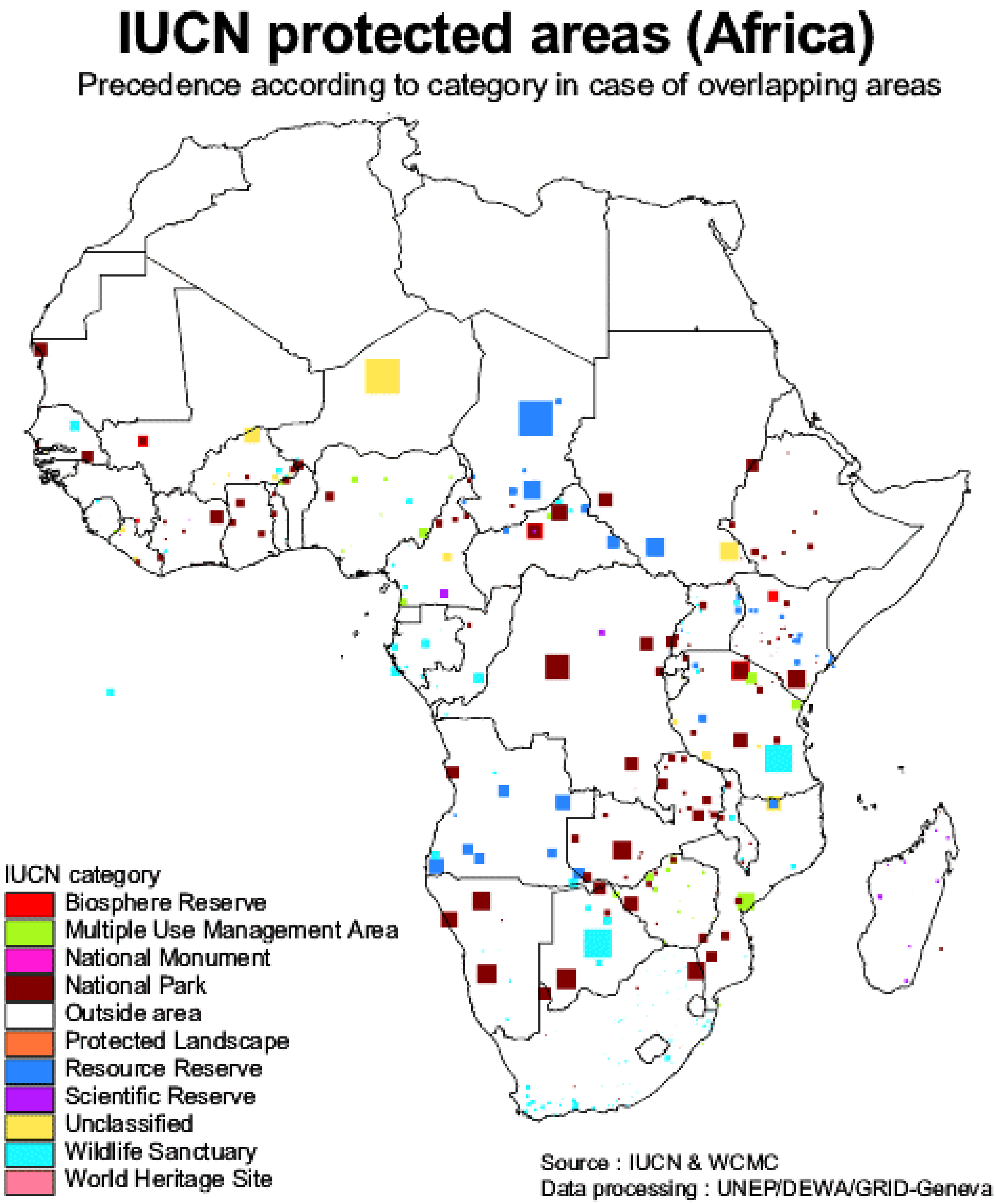


Figure 13: IUCN Protected Areas in Africa. (IUCN & WCMC 2000)

Table 2: National Statistics and Protected Areas (PA) in East Africa

State	Area (1.000 km^2)	Pop. (mill.)	Pop. Density per km^2	GNP per capita (US$)	Life Expect. (years)	% PA* including lower categories	% PA** higher categories
Burundi	28	7	255	140	42	3.4	3.2
Ethiopia	1.104	61	61	100	43	19.0	2.1*
Kenya	580	29	51	350	51	10.6	6.0
Rwanda	26	8	329	230	41	18.1	12.4
Somalia	638	9	14	?	48	?	0.3
Tanzania	945	32	36	220	47	38.9	13.8
Uganda	241	21	105	310	42	27.1	7.9

Sources: WORLD BANK (2000); WORLD RESOURCES INSTITUTE (2000); MCNEELY *et al.* (1994).

** PA = Major Protected Area such as gazetted Parks and Reserves (IUCN category I and II). There are several PA's in Ethiopia that have not been formally gazetted.
*PA = Protected Areas cited here include *all* natural resource management areas, including hunting areas that are outside IUCN categories I–VI.

3.2 Conservation Approaches in the African Savannas

African continent has its economy largely dependent upon its natural resources. Its inhabitants have thus developed intrinsic mechanisms for adapting to the natural rhythms of natures productivity in order to survive.

This interdependence becomes even more complex as one moves from the wet highlands to the drier Savanna ecosystems where the human species has to operate at lower trophic levels for his nutritional requirements and where the numbers of man and his activities are expected to be at mutual balance with the natural systems. Savanna ecosystem functioning and the African social economic and cultural configuration and functioning can therefore not be separated. For any form of resource management to be successful in the Savannas, all the interacting factors must be taken into account. As demonstrated by the Greater Serengeti Ecosystem in the sub-sections below, those past conservation approaches in the Savanna, that did not integrate these aspects are recorded to have triggered conflicts that left the protected ecosystem worse than before thus harming the very resources they intended to protect.

3.2.1 The Greater Serengeti Ecosystem (GSE)

Biodiversity conservation in Africa is faced with a complex and diverse nature of the problems resulting into many conflicts. A generalisation of these conflicts, their causes, impacts and the ecological threats they pose, would not suffice to present the problem of conservation in the African Savannas, without a careful detailed examination of one such threatened protected area ecosystem.

We have chosen the Greater Serengeti Ecosystem (GSE) to serve as a representative Savanna protected area and with it to demonstrate the problems beleaguering conservation in Africa. The Greater Serengeti has been chosen on the basis of its unique vastness in size, diversity of biological organisms, dynamism of ecological processes and the interdependence between these ecological phenomena and the human culture and economic developments. Being one of the most diverse and species rich protected ecosystems in Africa, yet under severe threat from a wide spectrum of human caused problems ranging from tourism, land uses, culture deterioration, poverty of its associated communities and inadequate planning and management practices, the Greater Serengeti Ecosystem also serves is a good example to present the real conflicts and threats occurring in most other protected areas in Africa.

The following subsections present a brief review of the ecological status, management approaches and the ever persisting conflicts and ecological degradation of this most extensive and world famous ecosystem in Africa (See Figure 14).

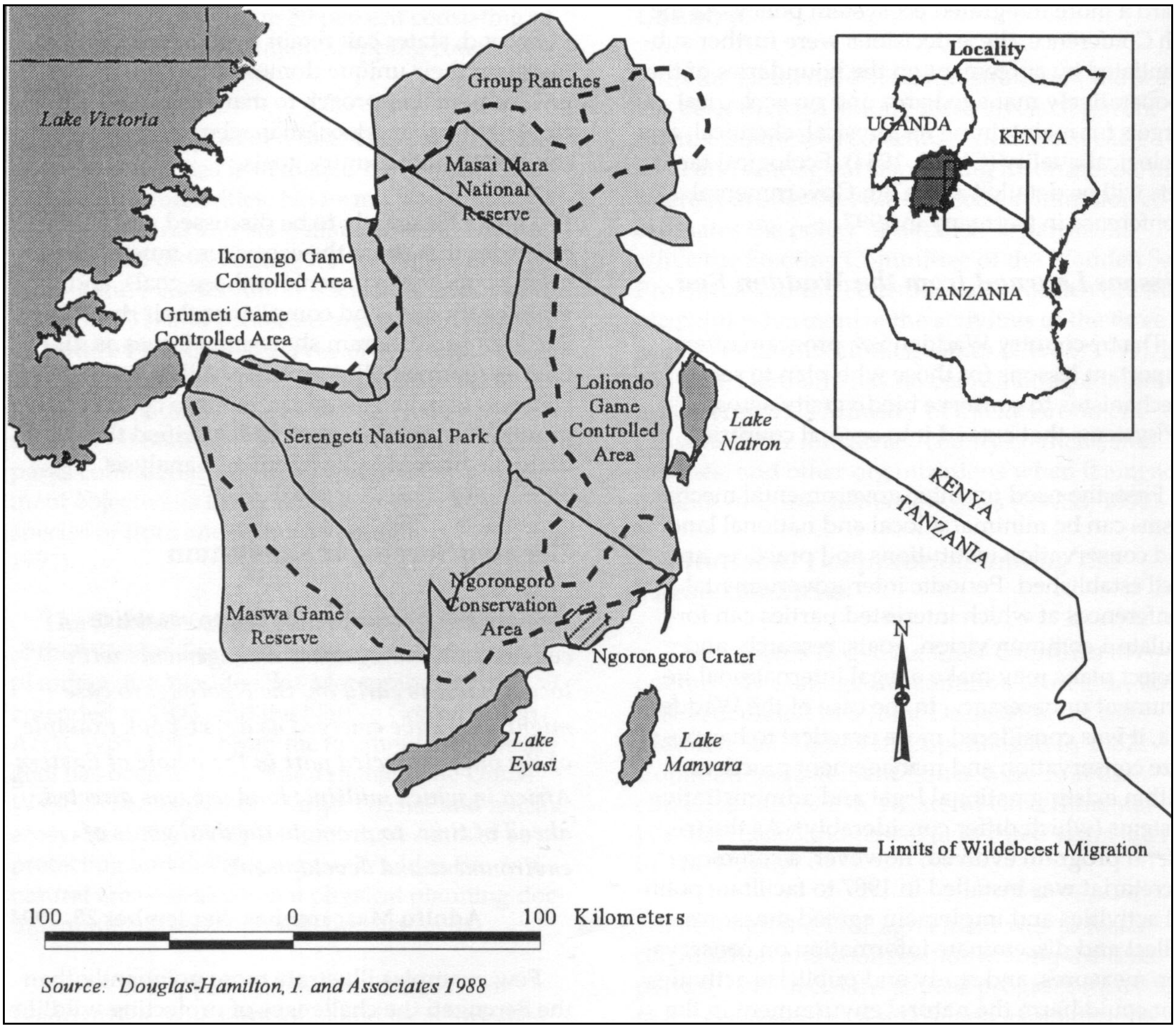


Figure 14: Greater Serengeti Ecosystem showing its management areas. (MILLER 1996)

3.2.1.1 History of Conservation and Management Approaches

The Serengeti has been subject to a long and varied history of externally imposed wildlife management regimes, starting as early as the last century. Figure 15 below shows three distinct phases of these regimes which have characterized wildlife management activities in the ecosystem. Through this time there has been a shift from the Grzimek principle of authoritarian, state-controlled and exclusiveness conservation approach (protectionist model) to approaches which recognize and permit at least some degree of community participation and benefit sharing in wildlife management.

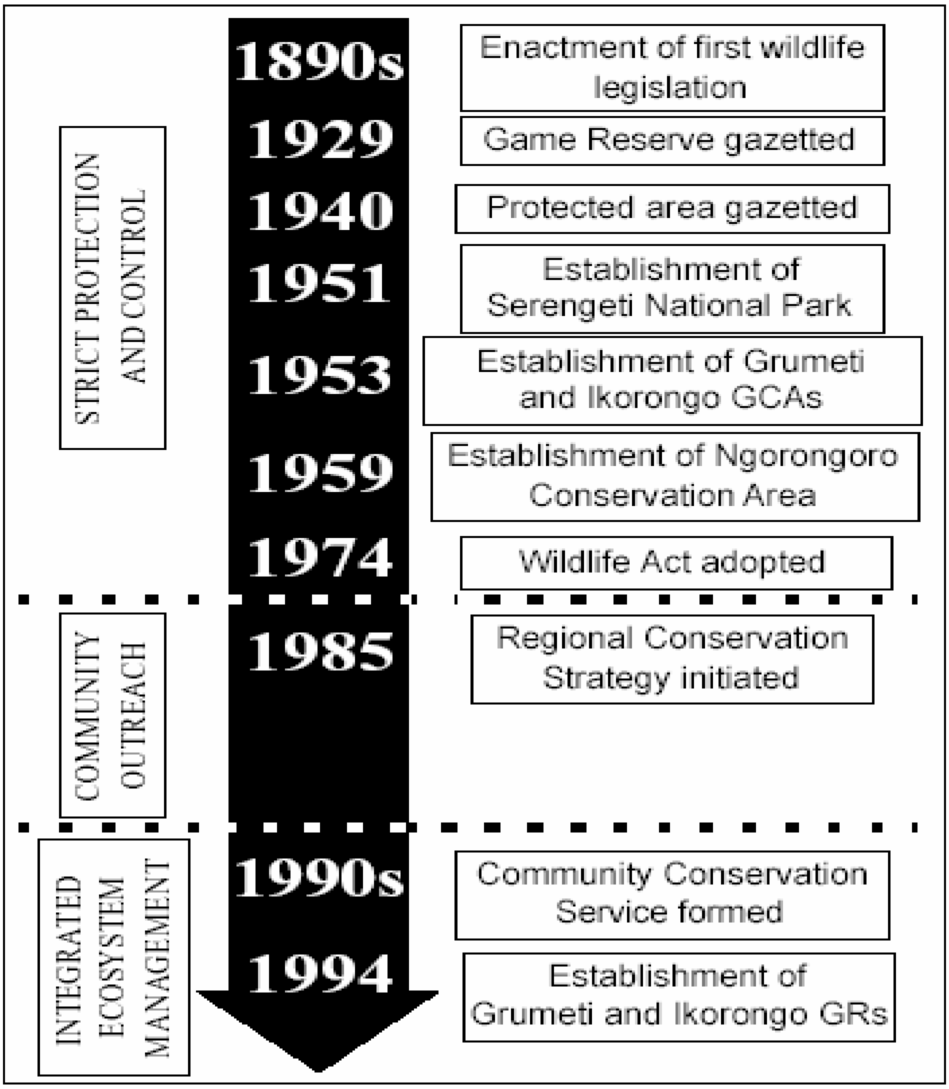


Figure 15: History of the management regimes in the GSE.
(EMERTON & MFUNDA 1999)

Isolationism and Protectionism

Beginning 1890 onwards, the German and British colonial administration enacted the first and longest phase of conservation activities which commenced with a series of legal instruments aimed at protecting the rare wildlife species and habitats in the Serengeti ecosystem. Wildlife management up to 1961 was based on the expansion of the national wildlife estate and on restrictions on human utilization of land and resource in the protected areas. During this period a number of protected areas within the Serengeti ecosystem have been established. These include the Serengeti National Park, declared as national park in 1940, Ngorongoro Conservation Area, as well as Grumeti and Ikorongo which were designated Game Controlled Areas.

Figure 16: The Ngorongoro Conservation Area seen from the crater rim. (by A.S. TANENBAUM)

Conservation approaches, during this period, were based on strict protection and control, following an island mentality of “isolation from surrounding communities" policy (MNRT 1985). The main focus of the policy was wildlife protection and policing. Interactions between wildlife authorities and local communities consisted mainly of law enforcement operations such as anti-poaching patrols and the eviction of resident human settlers. The local residents had no direct benefits from the wildlife earnings, despite the disturbance of reallocation or crop and livestock destruction by the wild animals.

The most striking incidence of this policy was the decision by the colonial government to extinguish, with a mere stroke of a pen, and without prior warning or consultation with the affected local Maasai residents, the traditional land and resource rights of 10,000 inhabitants in the Serengeti in Tanzania (FOSBROOKE 1972).

As both settlement and agriculture expanded, this approach to conservation resulted in an increasingly negative and inherently antagonistic attitude by local communities (LEADER-WILLIAMS 1996).

On the Kenyan side of the Ecosystem, other developments were taking place. Out of the 5560km² , a 1680km² Maasai Mara National Reserve, was gazetted in November

1974 leaving the rest of the ecosystem, surrounding the reserve to be subdivided into private ranches for wildlife and livestock owned by wealthy Maasai clans and influential political personalities.

Community Outreach

The Serengeti National Park in Tanzania was divided into two as a response to the intensified conflicts in the land uses in 1959. The larger western region, covering 14,263km², became the re-aligned Serengeti National Park and the eastern portion, covering 8,292km², was declared the Ngorongoro Conservation Area (NCA).

The NCA was later to be used as multiple land use area combining tourism, conservation and the interests of the indigenous people. This was a result of the realisation that any attempt to conserve wildlife was unlikely to succeed unless it engaged the active support of local human populations. Approaches to conservation began to undergo changes with an attempt to shift away from exclusion and isolation policies.

In 1985 a regional conservation strategy for the Serengeti was established, combining conservation and development objectives and working with government authorities both within and outside protected areas. Education and extension activities among landholders were initiated as major components of wildlife management activities. The main emphasis of this approach to conservation however, was to establish communication with villages living adjacent to the national park rather than to increase directly the local value of wildlife on lands outside protected areas. With time this trend in conservation approaches has led to the two types of wildlife management discussed here below.

Current Conservation and Management Approaches

A spectrum of wildlife management approaches currently existing in and around the Greater Serengeti Ecosystem range from the strictly protected government-controlled protected areas of Serengeti National Park and Maasai Mara National Reserve to multiple land and wildlife uses in Ngorongoro Conservation Area and Grumeti, Ikorongo and Kijereshi Game Reserves, and the relatively uncontrolled Loliondo Game Controlled Area and Ikoma Open Area, private and communal ranches and other land uses. The diagram below shows the levels of conservation and land use in the various zones of the Greater Serengeti Ecosystem under various management regimes.

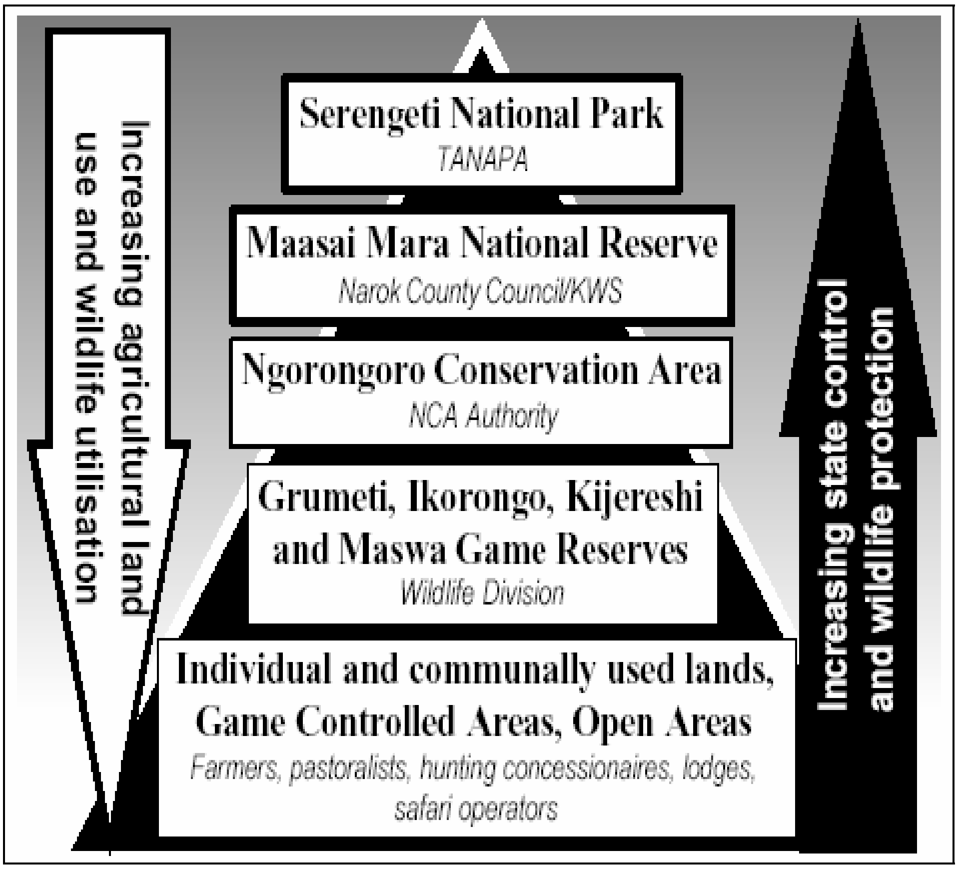


Figure 17: Levels of conservation / land use in the GSE (EMERTON & MFUNDA 1999)

→ State-Administered Core Protected Areas

The core protected areas of the Greater Serengeti Ecosystem today comprises three types of state-administered core protected areas, namely the Serengeti National Park, Maasai Mara National Reserve and Ngorongoro Conservation Area. The three core protected areas have different conservation and management status, namely National Park, National Reserve and Conservation Area respectively. Serengeti National Park is administered by the Tanzania National Parks Authority (TANAPA). No human habitation or extraction of natural resources is permitted in the Serengeti National Park. A similar management regime applies to the Maasai Mara National Reserve, which is under the jurisdiction of the local Narok County Council, assisted in wildlife management and law enforcement by the Kenya Wildlife Service (KWS). Ngorongoro Conservation Area is also administered by the Ngorongoro Conservation Area Authority (NCAA). NCAA is a authority, established to foster a multiple land use in the Ngorongoro Conservation Area by safeguarding and promoting the interests of conservation, the resident Maasai, tourism and archaeology. The NCA thus unlike the Serengeti National Park and the Mara National Reserve was designed to combine conservation with pastoralist residence and controlled, subsistence-level resource use.

→ Strict Government-Controlled Conservation Areas

In Tanzania the government has recently set aside a number of conservation areas on the western boundaries of the Serengeti National Park. In these reserves, human residence is banned but some consumptive utilisation which include tourist hunting and game cropping by wildlife authorities and local communities of the reserves natural resources is allowed (EMERTON & MFUNDA 1999).

→ Communally and Individually used Lands

Other areas outside the gazetted government controlled areas, in and around the Greater Serengeti Ecosystem, fall under a variety of conservation and management regimes usually defined by the presence of large wildlife populations and not necessarily by a specific protection policy. Examples in Tanzania include Loliondo, Makao, Grumeti, Ikorongo and Ikoma, which are referred to as Game Controlled Areas or Open Areas. Permission for land and natural resource use activities within certain limits of the law is granted in these cases. In others interest is vested in the state although primarily under the control of village authorities.

In Kenya the areas outside the protected area status within the Greater Serengeti Ecosystem are held either as trust lands, communal areas or group ranches. The first two are run by county councils on behalf of the local population. The group ranches are enterprises in which a group of registered individuals have a joint freehold title to land while maintaining individual stock ownership and individually owned and titled lands. These areas are important to wildlife as they serve as wildlife dispersal areas.

Wildlife are either let to grace freely in the open areas or are confined in wildlife ranches. These lands have nevertheless no formal conservation status.

3.3 Conflicts: Their Sources and Effects on Conservation

The various changes in the management regimes and land uses in and around the GSE are a representative of the changes that have taken place and are still taking place in most other protected areas of the African Savannas.

The traditional land use systems in African, which encouraged selective utilization of the resources and promoted sustainability of the natural resource use, have undergone a gradual transformation as a result of the land reform policies. Radical land reforms were leading to new land tenure policies that have also undergone changes from the African traditional tenure systems before colonial era and from the colonial tenure system after the colonial era. Of course there are still many land reform issues taking place in Africa even today. The current issues locking up the post colonial land tenureship in Zimbabwe is a case at stake. The rapid population growth around the conservation areas is also influencing land tenure arrangements and thus having a direct or indirect impact on conservation. Other issues include tourism, markets and trade policies. These and other factors are discussed in detail in the section below as being the underlying factors for conservation-land-use-conflicts in the African Savannas.

3.3.1 Conflicts arising from “Hard Line” Conservation Approaches

3.3.1.1 Exclusionism and the “Grzimek Principle” of Pristine Protected Areas

The island mentality of “protectionist” model, based on protecting biodiversity from people by establishing exclusive protected areas and banning consumptive utilization by the colonial governments, had its main focus on the protection and policing of the wildlife charismatic mega fauna from the threats of the growing value of wildlife trophies and other resources in both the local and world market and also from the population growth in the African countries. There were however a few natural conservationists who wanted to conserve the African wildlife and their ecosystems after the American Yellowstone National Park model, which after its enactment in 1872 emphasized the protection of particular elements, deemed to be of high conservation value by shielding them from all human activities. The underlying purpose of banning pastoralists from the African protected area is found in the words of Dr. Bernhard GRZIMEK, a German conservationist who initiated worldwide interest in the Serengeti National Park, when he made the film "Serengeti Shall Not Die" in 1958. GRZIMEK believed that: "*A national park must remain a primordial wilderness to be effective. No men, not even native ones, should live inside its borders"* (GRZIMEK 1954, 1962). It is important to note here that this concept of national parks emphasized the separation of human activities and settlements from the designated conservation areas. National parks should not be altered by human exploitation or occupation. It is this principle of limited, if not zero, human presence in the African protected areas, that led to the expulsion or resettlements of the indigenous communities from their ancestral homes to give room to conservation. While foreigners and tourists were allowed into these areas to carry out "official pouching" for meat and trophies, it was made absolutely illegal for any unauthorized local resident to enter the reserves in search of food, medicine or for hunting purposes.

3.3.1.2 Re-location of local Residents

As clearly indicated by the Serengeti example, many conservation projects and protected areas in Africa still practice the old colonial policy of "protectionism" conservation, based on protecting biodiversity from people by establishing exclusive protected areas and banning consumptive utilization of the resources in those areas by the local communities.

Instead of developing policies for projects which combine conservation and socio-economic objectives in the protected areas, project developers and protected area planners in Africa still tend to expel people from the project areas, electing barriers like chain links or electric wires to separate people from wild animals. The displaced humans settle outside the boundaries and wage a war against the conservation efforts by invading those areas with their livestock or desperately poaching on the wild resources to meet their basic food and financial requirements. Most of the conservation projects in Africa are failing or have failed due to this problem.

The treatment of the Maasai community of East Africa is a case at stake. The Maasai people are exclusively pastoral people who have born the burden of the preservation of the Savanna ecosystems and their biodiversity which provide habitat for about 80 per cent of the East Africa's wildlife (WESTERN 1994). The Maasai, who are displaced from their homelands are now unable to sustain themselves, while the governments, the wealthy immigrants and the tourism industry reap the benefits of the resources in the former Maasai lands. Many of these underprivileged groups are now forming associations that tend to resist the efforts of conservation based on this mentality of exclusionism. In Kenya for example, the Maasai Environmental Resource Coalition (MERC) organization, founded by the Maasai people to create awareness of the illegal appropriation and destruction of the Maasai people's traditional lands, argues that: *"For thousands of years, Maasailand has been a place of cultivated harmony between humans and wildlife. Today, the wildlife of Maasailand is threatened by poaching and the destruction of habitat. Poaching and trophy hunting have claimed 92% of the rhinoceros and 70% of the elephant population. The region's popularity as a tourist destination is growing, and large-scale tourist facilities are being built in pristine areas. Habitat is also being lost to large-scale agriculture and commercial development. Population pressures from the surrounding regions are further distressing the land and its resources. Traditional migratory routes for wildlife are being lost, as indiscriminate development fragments Maasailand. All of these pressures, together with the pollution associated with the tourism industry and illegal bush meat trade, are bearing instantaneous and irreversible impacts on the wildlife of Maasailand thus destroying the very base of the existence of the Maasai people and the Maasai culture."* (MERC 2002).

Privatisation and settlement leading to unplanned migration patterns are adding up to already existing lack of coordinated and integrative land use planning and the diminishing rangeland degradation as both the Maasai and the emigrations scramble for land on the dispersal bioregional areas, increasing pressure on the resources required by some animal in those areas.

3.3.1.3 Poverty and Despair of Residents around Protected Areas

Majority of protected areas overlap with ancestral lands, territories and resources of indigenous and traditional peoples so that the establishment of such protected areas very often aggravate conditions of deprivation, poverty, marginalization, social exclusion and cultural erosion. Remaining on the outskirts of their former lands from which they are excluded, the local people have no chance to get direct benefits from the wildlife earnings despite the disturbance of reallocation or crop and livestock destruction by the wild animals. Protected areas remain just “economic oasis” in the middle of poor residents who are both alienated from their former resources and completely excluded from participating in conservation actions and decisions. Conflicts, resulting from illegal use of wildlife resources and constant invasion of the conservation area’s outskirts by the wild animals either migrating or in search for food and water, are therefore common and often lead to increased resentment of the conservation efforts by the local residents, who see those conservation policies as extension of the domination by their governments. Conservation area managers are viewed as agents of repressive action (GARTLAN 1992). In such cases, protected areas are clearly contributing to the virtual extinction of not only the biodiversity, but both the indigenous people and their culture.

As they struggle to survive and make a living in such desperate conditions, it becomes extremely difficult for these underprivileged people to understand how they could be more damaging to the ecology than the thousands of tourists that converge on these parks each year and if protected areas have to be socially insensitive to accomplish their objectives. Surely, the construction of roads, lodges and the increased demand for the already scant water supplies have had a greater impact than the pastoralists who have coexisted with wildlife for thousands of years before the first protected area was created in the Savannas. Anthony SMITH, in his book *The Great Rift: Africa's Changing Valley*, wrote of two German families that lived within the Ngorongoro Crater in 1908: *"Is it not easy to be appalled that men should have attempted to farm in such a perfect animal preserve? How did they manage to grow crops with such a profusion of herbivores? How could they maintain 1200 heads of cattle when surrounded by so many carnivores?"* (SMITH 1989). On the same breadth we assert, is more atrocious that the Maasai pastoralists, who initially occupied in and grazed their livestock in the Ngorongoro Crater floor, should be removed and restricted to the outskirts of the crater, where their livestock had to compete with wild herbivores and carnivores, while the German families were allowed to settle in the crater floor.

The 'hard-line protectionist' approaches are still the dominant policies in the majority of the protected areas in Africa, but are nevertheless proving difficult to execute in the wake of the growing economic and complex social problems resulting from population pressures. Many African governments are also no longer able to finance those hard-line controls (KRAMER *et al*. 1997; BRUNER *et al.* 2000), resulting into severe conflicts between the conservation managements and the local people.

3.3.1.4 Disharmony between Indigenous and Modern Approaches

With the colonial government's outlawing the hunting of wildlife without a permit, and designing reserves for wildlife only, Africans were given no cause to harmonise the modern "in situ" conservation approaches with their own long practiced and successful traditional approaches to nature conservation. The so called colonial approaches of exclusive biodiversity conservation in the protected areas immediately put the indigenous people in competition with wildlife for resources (NEUMANN 1996). The conflict potential between traditional life forms of indigenous people, including their traditional resource use and the current policies for biodiversity conservation, cannot be underestimated. The worst case of these conflicts is best shown by the destruction of the Waliangulu people around Tsavo National Park in Kenya, who before interference by the modern management practices were depended on wildlife hunting for their livelihood. The Maasai Wakoma tribe of Tanzania, whose depend on the availability of land for their cultural livelihood (NEUMANN 1996, 1998), is another example.

The protected areas were created by the respective governments with little regard for local needs and with the perception that subsistence hunting was decimating wildlife, anti-poaching campaigns, game patrols were heightened. Africans hunters having no permits were jailed and the traditional use of the land was totally prohibited. At one time about one-third of the adult male Waliangulu were in prison for "poaching" (BERGER 1993). Before the Serengeti was gazetted as a national park the Wakoma people of Tanzania ventured as far as Naabi Hill, which now marks the southern boundary of the Serengeti National Park in Tanzania. In the 1950's they were moved by the colonial administration to the Banagi River. In the early 1960's they were moved again to Mochatongarori, near the present Ikoma Gate. In 1970 then they were relocated for the last time to where they are now, when the Serengeti boundary was moved to the Romoti River (EPIQ 2000). The Ik people of Uganda lost their traditional hunting and gathering grounds when the Kidepo National Park was created (INFIELD & ADAMS 1999). Numerous similar examples are documented elsewhere. All these communities, state that they were aggressively persecuted by the various wildlife authorities as intractable poachers for many years.

Figure 18: Maasai men in their leisure time, performing their famous cultural dance (A.S. TANENBAUM). Despite the hardships with the colonial and later post colonial governments, the Maasai, who are the dominant protected area residents in the African Savannas, have shown a persisting resilience in their culture and traditions.

3.3.2 Conflicts arising from Changing Conservation Approaches

3.3.2.1 The emerging Community-based Conservation (CBC)

The traditional African conservation approaches which encouraged selective utilization of the resources and promoted sustainability of the natural resource use, that were changed by the introduction of new land tenure policies by the colonial administrators, saw no major changes even years later in the postcolonial governments. Most of these governments continued to operate under the laid down colonial policies. The traditional African conservation practices have also been a victim of the rapid population growth leading to a scramble for land and resources.

Since the Rio convention, an awareness is developing that achieving sustainable biodiversity conservation is a complex challenge, highly dependent on political, economic and social factors. This awareness has led to the initiation of major changes in conservation practice. Factors like the human population pressures and demands for land, shrinking budgets of protected area authorities and the recognition of the traditional rights of local communities have been some of the driving forces behind this shift. The response has been to make Community-based Conservation (CBC) and the interlinked concept of “sustainable use” of ecological resources, the prevailing paradigms of conservation practice today.

The emergence of biodiversity conservation as a prominent issue on the international environmental agenda, has also been accompanied by the mobilization of substantial financial and technical support from bilateral and multilateral development agencies like the World Bank, the European Union, USAID and others. Much has been discussed on how to change from the “protectionist” model based on protecting biodiversity from people by establishing exclusive protected areas and banning consumptive utilization, to a “stakeholder participation” model, which emphasizes community-based Conservation (CBC) and the “sustainable use” of biodiversity as well as “ecosystem management” to encompass habitats and processes outside protected areas based on gaining peoples’ cooperation and support for biodiversity by making it valuable to them. Benefit sharing arrangements through Support to Community

Initiated Projects (SCIP), such as education, health, veterinary services, and water and roads, though not capable of offsetting the direct financial losses incurred at the household level by the presence of wildlife, are being initiated in collaboration with the local administration in the areas involved in wildlife conservation.

Community participation in projects that promote conservation in the bioregions are also sometimes referred to as Integrated Conservation and Development Projects (ICDP) and are in this regard defined as attempts to link conservation within a protected area to social and economic development of outside that protected area (NEWMARK & HOUGH 2000). ICDP's incentives are supposed to be provided to the local communities in the form of shared decision-making, employment, revenue sharing, limited harvesting of plant and animal species, or provision of community facilities, such as dispensaries, schools etc. in exchange for the communities support for conservation.

The community projects in the western Serengeti conservation areas, the private and communal ranches in the Maasai Mara and the Tsavo regions in Kenya and the multiple land use in Ngorongoro Conservation Area (NCA) in the Greater Serengeti Ecosystem discussed earlier in this document are examples of some of the attempts to involve communities in conservation activities, as a form of participation. They are also an indication of the change of attitude, by those concerned, from isolationist wildlife conservation towards involvement of the local communities with the aim of establishing linkages between local socio-economic development and biodiversity conservation.

In Kenya the Kenya Wildlife Service (KWS), established in 1990 and mandated to conserve wildlife and preserve its economic, education, scientific and cultural benefits for the country and its citizens, has since spearheaded the conservation of biodiversity efforts in the region. To achieve the goals of biodiversity conservation and by recognizing the fact that most of the wild live outside the protected areas, the KWS formed the Community Wildlife Services (CWS) department in 1994 with the aim of stepping up the involvement of the local residents in biodiversity conservation efforts and recognizing their rights and the impact wildlife is having on their livelihoods. The Maasai group ranches located around the Maasai Mara wildlife dispersal areas is one example of the efforts KWS to involve local communities in both conservation and benefit sharing (THOMSON 1998; MURIUKI 1998). Some of the interventions of the CWS are:

- The enhancement of the Maasai wildlife relations through:
    - Creating clear revenue sharing agreements
    - Creating common resource development plans
    - Establishing extension conservation education programme to ensure sustainability
- The establishment of the buffer zones, where no farming activities should be carried out
- Encouraging formation of associations within the subdivided group ranches in order to help retain the continuity of the rangelands and corridors
- Allowing limited wildlife utilisation through eco-tourism activities and revenue sharing with the local communities
- Provision of social amenities such as schools, clinics and water
- Support for further education of students selected by local Maasai elders and training local people as game scouts

Sporadic conflicts, sometimes severe ones have however continued to occur due one or both parties not honouring their obligations (See examples in section 3.3.2.2 below).

3.3.2.2 Lack of Integrative Planning and Satisfactory Stakeholder Participation

The intensity of conflicts and ecological degradation in the conservation areas has continued to worsen despite the efforts discussed above. A study by EMERTON & MFUNDA (1999), conducted to test the effectiveness of such community initiatives in the western Serengeti, indicates that the problems of ecosystem deterioration, declining wild resources and increasing poverty among the local communities still persist and could be worsening in some cases.

Economic Marginalization of Local Residents

In their study entitled *“Making wildlife economically viable for communities living around the western Serengeti, Tanzania”* EMERTON & MFUNDA (1999) found that shifting conservation approaches in the western Serengeti has done little to change the way in which the resources in the region impact on the local economy. They found out that there was little or no gains or real improvement in the level to which landholders could gain economically from wildlife. Instead they found out that the local economic costs of wildlife in terms of agricultural land uses, precluded and interfered with, have risen over time as arable farming expands and land pressure intensifies especially in the Serengeti district. The study also reveals that, despite the efforts to integrate the communities in the conservation activities in the Serengeti region, wildlife populations are continuing to decline both within and outside the protected areas, poaching and illegal resource utilization are still being carried out, an alarming increase in the area of land coming under agriculture leading to destruction and loss of wild habitats and migration corridors and resulting into the subsequent loss of biological diversity. Within the context of local livelihood systems, wildlife is becoming of little economic value, as its benefits accrue at an insufficient level and in an inappropriate form to balance the costs it incurs to landholders. The gazettement of the GSE as a series of protected areas involved both the eviction of resident farmers and the contraction of natural resource utilization and agricultural land uses. Losses in natural resource use, although likely to be high, are unquantifiable on the basis of available information. The loss of land for settlement and agriculture represents a tangible economic cost to villages in the western Serengeti, because it has effectively taken a large area of land out of agricultural production and simultaneously increased pressure on available farmland outside national park and game reserve boundaries. The reservation of Grumeti and Ikorongo Game Reserves has resulted in the loss of over 94,000 hectares of potential farmland, with a productive value and ultimate opportunity cost of almost US$ 18 million a year. Of this, some 2,800 hectares is actually under cultivation by remaining squatters in Ikorongo Game Reserve. On-going moves to evict this farming population will result in direct and immediate losses to local agricultural production of some US$ 540,000 a year (EMERTON & MFUNDA 1999).

Biodiversity conservation is not economically viable for the majority of villagers in the western Serengeti area under the status quo, as there are no formal means provided by which they can increase biodiversity values to a sufficient extent or in an appropriate form to balance the costs that it (especially the wildlife) incurs to them.

Damage caused to crops from wild animals, mainly wild pigs, warthogs and monkeys and the elephants and migrating wildebeest, despite the measures taken to minimise the damage through reinforcing farm fences and guarding crops at harvest times, is particularly a big hindrance to the policies of community participation to conservation. It is estimated that up to one third of households in the western Serengeti regularly lose an average of a quarter of their harvest to wild animals (EMERTON & MFUNDA 1999).

Despite this range of economic costs on landholders however, little consumptive utilisation of wildlife, and no exploitation of wild resources in protected areas, is permitted (EMERTON & MFUNDA 1999). Wildlife generates only small indirect development benefits at the whole-community level through the implementation of government implemented, benefit sharing mechanisms.

Table 3 of economic benefits and losses for land owners in the section of GSE studied by EMERTON & MFUNDA (1999), shows a great net loss to the communities affected. Because of the significant losses at the farm level in terms of the opportunity costs of cropland and direct damage caused to crops and livestock in the areas surrounding the protected areas, the farming communities around the conservation areas have come to perceive wildlife as more of an economic burden rather than an asset. As agricultural land becomes more scarce and local sources of income and employment hard to access, community members are both unwilling and economically unable to bear the economic costs associated with conserving the wildlife in and around their lands. Wildlife fauna, which forms the highest proportion of the biodiversity in the bioregions, has thus become economically unviable livelihood and land use option and Landholders in those regions have continued to engage in activities which both damage the ecosystem and deplete the biodiversity through unsustainable resource utilisation, poaching and the clearing of natural habitat for agriculture as conservation becomes of little economic value within the context of local livelihood systems with wildlife benefits accruing at an insufficient level and in an inappropriate form to balance the costs it incurs to landholders.

Table 3: Estimates of Western Serengeti Economic Benefits and Costs for Landholders

Item	Value (US$/y)
Tanzania National Parks Authority’s support to the Community Initiated Projects	+ 15 400
SRCS/WD community hunting	+ 3 500
Wildlife crop damage	- 484 000
Agricultural opportunity costs of Grumeti and Ikorongo Game Reserves	- 540 000
Total	**-1 005 100**

Source: EMERTON & MFUNDA (1999)

Human-Wildlife-Conflicts

Rapid human population growth especially in areas of high agricultural potential have resulted in the movement of people into drier and marginal ecosystems where most wildlife is situated. The resulting human settlements and subsequent developmental and economic activities such as livestock keeping and farming has lead to severe conflicts with the wildlife. Conflict-mitigation measures which involve shooting or construction of barriers (e.g. chain-link fences) to separate wild animals from humans and their livestock and crops have often failed to be effective measures. The increasing destruction of the chain-link barriers, crops and livestock as well the number of human attacks and deaths attests to the fact that these measures are far from solving the problem.

Figure 19: Domestic livestock and wild elephants. Who has the right to the protected area? (graphics by KWS 1995, 1996)

Conflicts are intense where agriculture is involved, particularly where cropland bounders the forested national parks or where agriculture is surrounded by rangelands (KWS1994). Thus the CBC approaches have increased the conflicts between requirements of wildlife and the requirements of settler communities especially in the vicinity of protected areas. Apart from crop and livestock destruction, the constant killing or injuries of humans by wild animals is resulting into constant fear and unbearable financial burdens for many families who can not be compensated for the losses. Frustration and anger from people who have come to believe that the governments love the animals more than humans is being directed into uncontrollable destruction of these habitats and their wildlife through poaching and sheer killing of animals for the sake if it.

In Kenya some of the communities bordering the conservation areas, reported to have high frequency of human-wildlife conflicts are the Meru-Immenti, Nyeri, Trans-Mara and Kwale districts (KWS 1994). Crops and livestock losses, destruction of property e.g. fences and killings or injuring of humans are some primary sources of conflict. In the period between January 1989 and June 1994, wild animals killed 290 people and injured 218 i.e. an of average 42 deaths and 40 injuries per year. Elephants caused 173 of these attacks. The fact that the Maasai do not fence their land, exposes them to roaming and hungry wildlife. Some of the complaints by these communities are:

- Deaths and injuries of human beings caused by wild animals
- Competition with livestock for pasture leading to overgrazing
- Loss of livestock killed by wild animals
- Competition for land (protected and trusted areas) between wildlife and the communities
- Hosting and transmitting of major livestock diseases by wildlife
- Denial by the authorities or insufficient revenue sharing with the local communities for wildlife utility in terms of products, tourism etc.
- Compensation for losses or injured is either not there or is too little or comes too late
- Negative environmental and social impacts of tourism
- Uncontrolled animal movements and migration and ineffective techniques for controlling problematic animals
- Anti social attitudes of rangers towards local communities

The Maasai group ranches neighbouring the Maasai Mara game reserve have continued to experience increased subdivision, with some landowners fencing their plots to keep the intruding wildlife out of reach. This is presenting a major threat to wildlife resources in the area as wildlife, especially elephants and plain game require large areas for dispersal. The Kenyan Maasai who have settled in farming the Narok district bordering the Maasai Mara National Reserve are by virtue of their settlement said to be benefiting from conservation of the reserve. The fact is, their mere presence offer extra security for wildlife by serving as buffer against poachers (GAKAHU 1994), but they in return live at constant conflict with the very animals they are protecting.

Figure 20: A frustrated wildlife ranger and desperate local farmers inspecting a farm devastated by elephants. Above: Chain link wire destroyed as elephants fought their way into the farms. (graphics by KWS 1995)

Interpersonal Competition for the Diminishing Resources

Interpersonal conflicts in the regions bordering the protected areas are not uncommon. These are mostly blamed on the greed and personal interests of the local residents involved. It is however worthy noting that although racial, tribal or group conflicts are part of mans history, the escalation of these in the areas bordering the protected areas is fuelled by the wants and needs of those involved. The exclusion from their natural homelands without a matching alternative, the economic marginalization and the diminishing resources at a time when their populations are on the increase naturally leads to struggle for survival resulting into the numerous conflicts currently taking place in those regions of the African Savanna. The primary cause of these conflicts are the diminishing resources like water, grazing fields, political dominance, unjust deprivation of certain minority groups of the power to exercise their rights for their land and resources. These results, sometimes in bloody conflicts and irresponsible destruction of those habitats.

Ecological Degradation as a Result of Land-Use-Conflicts

Dramatic reduction in populations of certain plants and animals species whose ecological niches are disturbed or altered is being caused by the increasing presence of man and his activities in the marginal areas. These changes lead to the development of alternative dietary rhythms, which soon result into further conflicts. Over-exploitation, disease, or the introduction of invasive exotic predators or competitors may result in the disappearance of ecological “keystone species”, such as important pollinators, or seed dispersers like the birds and primates leading to ecological breakdowns, with far-reaching ecological conflicts.

When domestic livestock enter lands occupied by wild game, the first effect is a disruption of predator-prey interactions. The cheetah are often the most vulnerable. Cheetahs are amazing hunters, but timid with potential competitors. Cheetahs are very easily scared off their kills and if feeding young, that disturbance can quickly cause starvation. Furthermore, Maasai herders will obviously protect their herds, which can mean killing wild animals if threatening. On their last remaining lands, disturbed wildlife has no land left to migrate into. Elephants when forced out of traditional ranges can become rogues, especially if they have been injured by spearing or gunshot during encounter with man in the process of searching for their food.

The drastic decrease of elephants from the Savanna ecosystems for example, could be having drastic effects on those ecosystems. Over the past twenty years elephant populations, all over Africa, have decreased significantly. In 1979, there were over 1.3 million on the continent. Ten years later there were only 625 000 (POOLE & THOMPSON 1989). Currently, there are about 20 000 elephants in Kenya, with 1 400 of them being in the Maasai Mara (KWS 1994). This dramatic loss was caused predominantly by poaching and to a lesser extent, habitat destruction. The removal of the elephant from the ecosystem is accompanied by changes in the ecological functioning. The elephant serves as a keystone species in the ecosystem. Keystone species play important ecological roles in their environments and they aid other species and keystone resources that encourage biodiversity. In the dry season, elephants are able to locate water underground and dig waterholes, which are then available to other animals. This is a role only an elephant can play in such dry ecosystems (LAWS 1970). They also clear paths in forests, increasing the natural edge effects and creating land suitable for grazing animals, can play a role as ecological protagonists for the shift from woodland to Savanna (DUBLIN 1995). Dung beetles depend on elephants, as their dung provides an ideal breeding and feeding ground for these insects. Together, the dung beetle and the elephant help promote germination. The dung beetle buries pieces of the dung, which may have seeds in it. Elephants' digestive tracts secrete a chemical which softens the seed coats of the tree seeds (*Acacia tortilis* and Baobab (*Adansonia digitata)* especially), encouraging germination when deposited in the nutrient rich base (THORNTON & CURREY 1991). Elephants therefore also play an important ecological role in seed dispersal (CHAPMAN *et al.* 1992).

3.3.2.3 Impacts of Ineffective Community Participation

The conservation deficiencies and the environmental problems of the Greater Serengeti ecosystem discussed above are just an indication of the ecological deterioration and poverty levels of the marginalized local communities, prevailing in the protected areas and their bioregions especially in areas where biodiversity conservation, especially the wildlife, has not yet become an economically viable livelihood and land use option. The only option therefore left open to the surrounding communities to survive is to defy the very aims for which the community conservation approach was initiated, and utilise the protected resources illegally.

Given the continued lack of integrative planning methods that would involve all parties, and especially recognize the central role of the local people who live in those areas and are directly affected by any management policy, Community Based Conservation approaches, like the preceding approaches offers no solution to conservation in the

African Savannas. It has since failed to maintain a balance between conservation and development activities in the areas concerned. It is based on poor baseline ecological and socio-economic data for resource use planning and monitoring in the protected areas and their bioregions as more time is spent in discussing mitigation measures instead of restructuring the unrealistic conservation policies through intensive research and planning to develop management approaches that are favourable both to the ecosystem integrity and the social economic development of the residents living in those ecosystems. Without this the populations and the landholders in the protected areas and their bioregions are certainly going to continue engaging in unsustainable resource utilisation, poaching and the clearing of natural habitats to satisfy their social needs and in so doing facilitate further the deterioration of the already unstable and overstressed Savanna ecosystems. Communities are also likely to be unwilling, and often economically unable, to support any conservation efforts in those areas as long as wildlife continues to incur economic costs which are greater than its local benefits.

All in all, despite their positive intention, the strategies for achieving participation have often only focused on the economic link between local communities and protected areas in Africa (WILD & MUTEBI 1996). The role of cultural and traditional values in building support for conservation has been noted but has been largely ignored in practice. It has been ignored that the areas where now the protection of nature is established have been the homelands and place for the cultural evolutions and experiences of the people for hundreds or thousands of years. Thus the emphasis lies on economic incentives for conservation stems from the linking of conservation and development. Such strategies are commonly accepted by authorities and project managers (WORLD CONSERVATION UNION 1991), but as long as development agents from foreign cultures are defining for their own cultural background what participation should be, planning for African conservation will not achieve real participation.

Although poverty and environmental degradation often are closely related, only few of Africa's protected areas, from our point of view, do and almost certainly will contribute significantly to the reduction of poverty. Conservation initiatives must recognize economic realities. But the current focus on economic incentives for involving communities in conservation efforts results from the theory that market forces will conserve and protect the environment. This assertion has strongly influenced political and popular thinking in recent decades and has profoundly affected international development aid practices, including many internationally funded conservation programs in developing countries (STRUHSAKER 1998). In poor countries, economic approaches can appear especially attractive, and their presentation as humanitarian in intention (HOLDGATE & MUNRO 1995) has guaranteed them almost universal acceptance.

The intention to make wildlife and protected areas pay for themselves has stimulated a range of community conservation initiatives aimed at building local constituencies for conservation. These include protected area outreach programs with an theoretical emphasis on sharing revenues, resources and opportunities with local communities. They also include collaborative management in which governments and communities join to manage protected areas for sustainable production and community-based wildlife management aimed at both economic development of the areas other than resource conservation (HULME & MURPHREE 1999). This is the simple truth of how many of the new Integrated Conservation and Development Projects (ICDP’s) are understood by most of the “target” communities in Africa. Integrated conservation and development projects attempt to reduce pressures on protected areas by supporting local economic development. Calculation of the monetary worth of wildlife, nature and landscape also contributes to the commercialisation of conservation and also the downplaying of older cultural values of the communities and is therefore another transition of western policies to the African continent and will inevitably force the destruction of indigenous cultures due to the dominance of those policies.

As mentioned above, the provision of tangible benefits from conservation to local communities through the current initiative of projects and investment from donor funds has proved difficult in Africa. Although the political and economic regimes of many developing countries aggravate the difficulties of channelling benefits to communities, most protected areas do not realise sufficient revenue to offset the costs to those communities for retaining them (EMERTON 1998). Beside the most popular examples, many of Africa's conservation areas are unknown, inaccessible and lacking in charismatic species or dramatic landscapes to attract tourists. Even where these exist in abundance (e.g. Uganda's Mgahinga Gorilla National Park), tourism revenues are not sufficient to meet community demands and management costs and to subsidise operations for equally important conservation areas (INFIELD & ADAMS 1999). Although nature tourism earns substantial revenues for some of Africa's protected areas, few benefits trickle down to local communities. The competitive nature of the tourist industry is not conducive to the delivery of sufficient financial incentives to poor rural people living around Africa's protected areas (HACKEL 1999).

3.3.3 Conflicts arising from Tourism Usage of the Protected Areas

Tourism can best be described as a necessary evil in the Savanna protected areas. Its relationship with the conservation area environment may also be seen as a shotgun marriage between conservation and recreation, in which both parties are somewhat interested and at the same time "inconvenienced" by the other. Tourism in Africa is based on the continents' rich biodiversity and the Savanna Safaris. The protected areas, where most of the charismatic mega fauna is located, are the main tourist attractions for the continent. Where conditions for peace and security prevail, tourism becomes one of the main and fast growing economic sector of the respective countries, competing with other main sectors like agriculture and industry.

The creation and management of most of the protected areas is based on protecting those large charismatic mega faunas for trophy and tourism purposes. The 'hard-line exclusionist' command and control approach which exclude the local people from those areas are designed basically to ensure safety for the tourist entering those areas as to protect the ecology of the area which is finally severely damaged by the impacts of the mass tourism. The irony is that the indigenous rightful inhabitants of those areas, who for many centuries have harmoniously co-existed with other components of their ecosystems, are thrown out as an "alien species". The tourist and his machines (motor vehicles, aeroplanes and balloons etc.) who has no long term interest in the area are allowed in. The 'hard-line protectionist' approaches to conservation thus succeeds only in protecting the use of the Savanna landscape resources from their rightful owners like the Maasai to the undisciplined, careless and excessive “rape” by the so called resource managers and the indiscriminating tourists who are only interested in the short term romance and love of nature’s serenity and healing, away from the noise and pollution of their industrial homes. This kind of tourism, in no time become the demise of destruction, by “loving to death”, the very resources and landscapes it so much seeks.

The Maasai Mara as part of the GSE receives the highest number of tourists in East Africa, with an average annual tourist entry of about 200,000 (MUTHEE 1992). Development of tourist facilities in the reserve has been rapid in response to the increasing number of visitors. The first lodge, Kekorok lodge, was established in 1963. By June 1997, the number of permanent hotels had reached 25, excluding the permanent tented camps outside and temporary tented camps inside the reserve (GAKAHU1992).

A study on the spatial distribution of vehicles stopped for wildlife viewing in and around Maasai Mara reserve shows that viewing is extremely concentrated in the neighbourhood of those lodges and camps located in the northwest and the south east of the park (BHANDARI 1992). Viewing also takes place on the Maasai group ranches outside the reserve. This concentration is also explained by the combined interests by the viewers for specific rare species located in those areas. The poor road system and lack of reinforcement for viewing regulations has resulted in numerous off-roads and ecological destruction as vehicles chase the fleeing wildlife in order for a tourist to have a glance or take a photo of a rare animal species located. All these result in serious conflicts from encounters with animals in their natural environments, destruction of the habitats by trampling and off-roads and others.

Poor planning of the natural resource use in the tourist areas is a major cause of the negative impacts of tourism in those areas that result into severe conflicts between tourism and its natural resource base. In the long run the tourism and its economic gains become the single argument for the protected areas. Conservation of the rare organisms and their ecological resource base become a mere reference and a theoretical justification for the protected area. In principle, the lure of the tourism money in the poor economies with rich biodiversity has become the force behind every "act of conservation", a phenomena that is causing more ecological damage, especially if the carrying capacities of the affected habitats are exceeded. Economic models in Kenya's Amboseli National Park showed each lion to be worth US$ 27.000/year in tourism revenues. An elephant herd was determined to be worth about US$ 610.000/year merely for viewing purposes (LINDBERG 1991). This however did not motivate for a sustainable protection and management of this "economic resource" but for its reckless touristic exploitation. The carrying capacities are exceeded because the providers of tourism do not have a clear policy on the tourism activities in their areas. The tourists come to these areas ignorant of the existing environmental needs and what their consequences of their visit could be (GAKAHU 1992).

Tourism however can also be described as the "Green Gold" of the Savannas. Tourism is a relatively new social activity that has recently emerged as a global economic phenomenon in which travellers are trading in over-commercialised mass tourism for recreation, amusement and new cultural and nature-based experiences all generating the much-needed revenue and employment for the regional governments. In many African countries tourism is the second foreign exchange earner to agriculture and is therefore a very desirable economic activity. It therefore plays an important and positive role on the social-economic and political development by boosting the economies and offering new employment opportunities on one hand, and contributing to broader cultural understanding by the creating the awareness through the integration of the foreign cultures and lifestyles to the local people way of life.

3.3.3.1 Main Tourism Impacts on Protected Area Ecosystems

Tourism relationships with the environment are complex. Irrespective of the degree of planning and efficiency in management, tourism will always produce impacts that can never fail to produce negative effects on the ecology of the conservation area concerned. The only way tourism can have zero impact is to remove it out of an area all together. Every touristic activity has the effect of reducing the environmental quality as indicated by:

- The resulting pressure on the resources

- Generation of wastes and the ensuing pollution, eutrophication
- Disturbance and the subsequent harm to wildlife / corresponding habitats
- animal, plant and mineral selection (souvenirs)
- Trampling, soil erosion, biotope degradation
- Import of alien species
- Increasing cultural erosion

It is also noted that the effects of tourism on some aspects of the ecosystems are very intrinsic to the affected organisms, making it difficult to predict. The impacts of the disturbances by tourism do not also remain only within the boundaries of the protected areas in question. The dynamism of those areas maintained by a constant exchange of energy and materials between them and their surrounding regions result in a wide spread of those impacts over a wide area.

Fragmentation

The main internal problem of protected areas is the fragmentation of the inter-connected ecosystems and/or habitats by tourist traffic infrastructure.

Fragmentation of populations leads to decreased effective sizes of local sub-populations and reduced gene flow among the fragments. As a consequence, the coalescence times (time to the most recent common ancestor) become shorter within sub-populations. This increases inbreeding, reduces the level of genetic variation and causes inbreeding depression in small declining populations that have maintained harmful recessive allelic variants. Species vulnerable to habitat loss often are involved in a multiplicity of complex interactions with other species. Many interspecific interactions are mediated and modified by flows of individuals through space. Habitat loss can alter the strength of interactions, and destabilise food web links. Because of the potential of spill over among habitats, there can be transient dynamics putting species at risk, even species expected to persist under habitat loss at equilibrium.

The resulting isolation of habitats is not only leading to increased genetic depression of populations but also inhibits the essential dispersal movements of populations and individual animals. Fragmentation is not only a linear disturbance of ecosystems, because of building barriers, but is also of a gradual interference from the source of the disturbance into the wider spatial context around it, known as edge effect. This edge effect continuous itself as a disturbance gradient into the landscape. If the number and extends of trails and roads in a protected area is exceeding over a specific limit the whole area is actually under a gradual disturbance regime, which could mean a total unsuitability of the whole area for sensitive species.

Having a relatively flat landscape, with few hills, river valleys and forests, the entire Serengeti ecosystem presents an optimum surface for tourist drivers to easily drive off road in pursuit of animals. In Maasai Mara the numerous off-road tracks have seriously damaged vegetation, increased soil erosion and is threatening to completely alter the landscape appearance and naturalness of the area (GAHAKU 1992).

Soil Compaction and Erosion

Both vegetation and soil loss as a result of trampling and compaction of soil by motor vehicles is taking place in the protected areas. Compacted soil changes its texture and structure which eventually changes its ecology. Apart from compaction, the created track paths present open areas for run-off water during rainfall and may in the long run result into severe gullies that do not only encourage soil erosion but may form barriers for animal movements. Increased tourist facilities in the protected areas is therefore causing both the loss of naturalness and the scenic beauty of the protected landscapes.

Harm to Wildlife

Noise from vehicles and people, low flying aircrafts and balloons is a major source of disturbance to the wildlife in the protected areas. The accompanied infrastructure built to accommodate the tourist transport and accommodation needs, which include the roads, hotels and power systems often mean drastic changes in the landscape appearance which results in ecological changes. In her study MUTHEE (1992) observed that the hunting and feeding behaviour of some wild animals like cheetah and lion was grossly disturbed by the constant presence of vehicles.

Animals have their diurnal and seasonal cycles like hunting for food, resting, mating and breeding. These habits and cycles are coming into constant interference from the tourists who are ignorant of them (GAKAHU 1992). Animals could also be affected by the diseases which could originate from the tourists home country or from the garbage they leave behind. Diseases like animal tuberculosis that killed large populations of lions and buffalos in the Kruger National Park (South Africa) were imported from the European lands. The consequences of direct disturbances for population dynamics, reproduction success and behavioural ecology are not easy to predict because of a general lack of empirical data from a relatively new derivate of behavioural ecology, the disturbance ecology.

Figure 21: Safari Tourism. A convoy of tourist vehicles cruising through a protected area in search of wildlife to shoot a photo or to watch. (www.planetware.com)

Harm to wildlife may also appear as secondary or indirect effects triggered by direct interferences in the environment. This is a complex and difficult phenomenon and beyond the scope of this paper, but a practical example can give a slight impression of what indirect impacts are about in the African Savannas: Lodges in Savannas have garbage and sewage disposal problems. Garbage attracts carrion-eaters such as hyenas, baboons, velvet monkeys and marabou storks. This may also influence the food chain relationships as some animals, like the monkey, are drawn out of its natural habitats and create new niches near the tourist lodges and camps. This affects their role as seed dispersers and therefore affects other ecological processes in the landscape.

3.4 The Threat of Landscape Polarisation to Conservation in the Protected Areas

As already evident around many protected areas, the most significant consequences of population growth are the loss and fragmentation of natural habitats through conversion to land uses (including surface water uses) which support relatively low levels of biodiversity. The developments around the Nairobi National Park in Kenya and its migratory corridors on the Kitegera conservation area, are the best example of this danger. The Nairobi National Park is already fenced off on all sides except the southern Kitegera side. The main reason for this is the conversion of conservation or potential conservation areas to crop cultivation or infrastructural development and human settlements. With habitat fragmentation the increase in human population brings a major threat to landscape and ecological functioning. Areas between the parks and reserves, traditionally used by animals (e.g. the migrating wildebeests etc.) as migration routes, are now private properties, some of which disrupt animal migrations with fences and other obstacles. In addition to residents fencing animals out, the government also wants to limit confrontation and poaching by fencing and restricting the animals within the parks.

Those responsible forget that removing people from the protected areas and fencing to restrict the wildlife in those areas, also interferes with the ecological functioning of the concerned landscape systems and their organisms. Closing out the populations from the protected areas has thus resulted into fragmentation of the surrounding area and the isolation of the protected area by various land uses within the landscape matrix, all of which play no role in conservation.

As mentioned earlier, the ecological processes, ecosystem integrity and ecological value of those protected areas are also increasingly being threatened by encroachment and by factors originating outside their boundaries like water pollution, wildfire, etc., and are thus becoming too small to preserve the intended resources. The home range of some organisms may go beyond the defined boundaries. Movements of such animals may thus result into conflicts with humans outside the reserves while confinement of such animals may negatively affect their feeding habits or reproduction and thus lowering their populations.

Simultaneously the protected areas suffer under internal fragmentation of the interior ecosystems due to excessive and unplanned tourism usage. Therefore fragmentation of the landscape is taking place on different scales of the ecological landscape order: as fragmented and functionally disturbed landscape regions and as internally fragmented ineffective conservation areas on lower scales.

3.5 Conclusions

The factors responsible for conflicts and ecological degradation in the Savanna that we have discussed above should also be regarded as the underlying causes for the failure of many conservation programs in the African Savannas.

For conservation to succeed and make the protected areas sustainable, the underlying root causes of the various types of conflicts described above must be analysed and managed. The planning and management must be more outward looking and more integrative than it has so far been if the key habitats, species and genetic materials, both in the core protected areas and across the human modified landscapes are to be maintained. The way people in the region manage and interact with nature inside and outside the protected areas must be well addressed. The planner should therefore address such factors as:

- Human population trends (demographic and migration patterns) the bioregion
- The political, socio-economic and infrastructure in the bioregion
- Land-use patterns in the bioregion
- Land user groups and institutions
- Local peoples livelihood requirements
- Local patterns of access to resources
- Role played by the local people in biodiversity conservation and management
- Existing conflicts involving the protected area
- Likely future threats to the protected area and in the bioregion
- Touristic infrastructure and visitor pressure.

It is only by adopting a larger bioregional participatory planning approach that natural resources in protected areas and those outside the conservation areas, with which they are connected, can be conserved while at the same time giving local communities the chance to derive sustainable livelihoods from those resources in a sustainable manner. This is a big challenge to the planner and the manager. It should however be understood that unlike other parts of the world, the conditions for ecological, social and economic sustainability of the Savannas display a long history of coexistence and can only be managed so if the harmony has to continue. Methods for such a management approach are thus expected to be completely different to those used in the western ecological planning and managements. Many policies for resource management as those discussed above have failed either because they did not address the real problem or they tried to solve the problems in isolation. Much money has been spent in the region in vain by trying to implement sectoral conservation measures which address either certain species loss, decline of certain wildlife mega fauna etc., without perceiving these in the context of such factors as the human rapid population growth, the spread of subsistence cultivation and the cultural relationship of the residents with the species being protected. Directional trends and causal chains of the myriads of the Savanna conservation problems are made even more complicated by the fact that rainfall, primary production, grazer populations, and vegetation formations as described in chapter 2 of this paper, show major unpredictable fluctuations between seasons and years. While core protected areas are mainly used by wild herbivores, the surrounding buffer zones are under human management. The Savanna landscapes are thus a product of human and biophysical drivers.

The attempt to ‘preserve’ a ‘wilderness’ type of nature in its ‘pristine’ state by setting it aside, away from human action is today also being made increasingly irrelevant by the numerous emerging conflicts. The evolutionary capacity of ecological processes sustain the healthy functioning and structure of the ecosystems concerned need to be maintained. This however requires a complex management system that respects both the areas ecology and the human activities that occur and are part of the protected area systems. In such an approach, people are not made to feel foreign to nature, but become part of it and have the responsibility of "good stewardship". This is the very idea behind sustainable development. The question then is: how to manage, in a given territory, the multitude of stakeholders, actors and often contradictory interests represented?

We have used the Greater Serengeti Ecosystem as a representative of the African Savanna ecosystems to allow us analyse the long-term outcomes of different policies for conservation on the one hand, and for community development on the other. The GSE comprises contrasting land-use zones with different tenure arrangements, ranging from state-controlled "fortress" conservation areas to private and non-private tracts with multiple land uses, some with community-based conservation initiatives, superimposed on a rangeland where ecological, micro-economic, and ethnic continuities make it possible to control for many confounding variables. The GSE is bisected by the Kenya/Tanzania border, allowing comparative analysis of the implications of contrasting economic, political and land tenure contexts of Kenya and Tanzania, which by virtue of their endowment with wild-life and other natural resources are a good representative of the African Savanna ecosystems. Any conservation model applied to manage this system must integrate both natural and social sciences data.

The answer to the question of an integrative, participatory and conflict free management therefore lies in an approach that is also based on the understanding of the ecosystem dynamism in its broad sense. It is one that:

1. recognizes ecosystem processes at the micro levels, but sees them in the larger frame of bioregional scales, landscapes scales and long time scales

2. integrates social, cultural and economic information with ecological information about the ecosystem, thus linking human needs to the biological capacity of ecosystems to fulfil those needs

In the sections that follow we will attempt to present an ecosystem based and integrated participatory approach to conservation that attempts to balance both the ecosystem needs and the human needs in the conservation areas.

4 STRATEGY FOR SUSTAINABLE CONSERVATION IN THE AFRICAN SAVANNAS

4.1 Goals, Objectives and Specific Strategies

In this section, we will present the goals, objectives and specific strategies of an inclusive and holistic solution which we consider appropriate for biodiversity conservation in the Savanna protected areas. We consider holistic planning (which integrates ecological, social, cultural and economic aspects) as a means of designing arrangements of collective management, which match social and ecological systems at given scales. The contribution of ecology, and the ecological planning in particular, should thus be seen as presenting the basis for this holistic solution, and not alone as providing an holistic solution for the wide ranging problems discussed above.

The individual elements presented as specific strategies in figure 22 below may appear substantial 'wholes', complete in themselves. This is however the mistake of the past and most of the present approaches that are also responsible for the recorded conflicts. We will in this chapter attempt to demonstrate that those different elements contain synergistic properties that must be brought together in order to understand and create inclusive management for achieving sustainability. The underlying value should however be the sustainable functionality of the environmental resource base.

4.1.1 Goals and Objectives

The main goal of a strategy that would offer a solution to the conflicts hindering conservation in the Savanna protected areas, is the sustainability of the protected area ecosystems. Those ecosystems should also be capable of maintaining the ecological and socio-cultural and economic functions and managed in a holistic manner. For this to be achieved, ecological viability of those ecosystems which serve as the functioning core areas of the landscape should be maintained (DE LEO & LEVIN 1997). This approach differs from the past and most of the current conservation approaches, which focus on the protection of species richness through management of diversity hotspots or species representation areas. The approach we discuss here is based on the ecosystem functioning which is responsible for that biological diversity.

To achieve the goal of sustainable ecosystems in the protected areas, a balance between conservation and human development should be maintained in a holistic strategy.

The following three objectives should therefore be instrumental in the achievement of this goal:

1. That the planning and management of protected areas should be based on scientific/ecological analysis of the structure and function of the earmarked conservation area and its associated bioregion

2. That the planning and management of protected areas should be based on the wider ecological context of the earmarked area and its bioregion

3. That the planning and management of protected areas should involve the participation of the local communities and all stake holders as an integral component of the planning and management

4.1.1.1 Sustainability Defined

To achieve the objectives stated above, and through them ensure the sustainability of the protected areas, a comprehensive analysis of all the relevant ecological, socio-economical factors in the area should be carried out. The outcome of such analysis will later be instrumental in the decision making for the type of management and activities that would ensure the sustainability of the conservation area, ecologically and socio-economically.

The term sustainability is used in many different contexts and means many different things depending on the context under which it is used. This makes it difficult to attach a single meaning to it. Since the Rio conference in 1992, the two most popular uses of the concept have been: the sustainable use of a specific resource or resources, as in sustainable production of a given commodity, and sustainable development. In the context of natural resource use, 'sustainable' simply means that an activity can be carried out within certain limits, through a foreseeable future. This is exemplified by the concept of sustainable wildlife harvesting from a target population. Sustainability of such a population may however be affected by the factors such as biological features of the population, its ecological surroundings, levels of harvest permitted and the effects of any socio-economic controls imposed on its use. The term “sustainable use” of a resource or resources is a more formal usage of the term sustainability with a ecological emphasis. In this context the IUCN (1993), defines 'sustainable use' as “*the use that does not reduce the future use potential, or impair the long term viability of either the species being used or other species”.*

However, the current focus of sustainability is tending to focus on the notion of maintaining ecological processes at large geographical scales, over many (human) generations. This view regards the maintenance of individual elements (species and populations) which make up the ecosystems of lesser importance to the ecosystem functioning at the landscape level. In this context, ecosystem sustainability implies the system's ability to maintain its structure and function over time in the face of external stress (COSTANZA & DALY 1992).

Sustainable development is not a new idea in the African culture. Many indigenous African cultures, like the Maasai, have recognized the need for harmony between the environment and the social economic activities in it. In this way, the Maasai have been able to sustain their numbers and their resources for many years. What is new about the sustainability, is the articulation of this harmony in the context of the global trends in population growth, changing methods of consumption, industry and information technologies.

Achieving sustainability is also an interdisciplinary task and can only be attained through a synergetic integrated approach of the various disciplines: ecological sciences, social and economic sciences, planning sciences and education in such a manner that each contributes towards the goal of sustainability of the system. We have formulated these into five tangible specific strategies and activities that must be implemented and effected alongside the ecological activities in the conservation area.

4.1.2 Specific Strategies for Balancing Sustainable Development and Conservation

Sustainability in conservation requires, that all the factors likely to affect conservation, should be integrated in the planning and management so as to effect a balanced input in the conservation of the targeted resource or resources. Human development is dependent upon the ecological resources. Biodiversity conservation, which is also viewed as an act of development, must be relevant to the needs of the people. Through the introduction of better land-use planning and more appropriate matching of production technologies to local ecological set-ups, it might be possible to stabilize and perhaps even reverse the current trend of conflicts in resource utilisation in the African Savannas. Strategic natural resource and land-use planning at the bio-regional and national level, as well as the provincial and local levels, is therefore needed to ensure that Africa's unique ecological heritage is not sacrificed to the unplanned effects and poorly designed conservation and economic development policies.

Figure 22 presents the five strategies that we find to have a synergy effect in sustainable conservation and that must be brought together during the ecological planning process for the delineation and management of the protected areas. These are:

1. Wider policy and planning frameworks (see 4.1.2.1)
2. Cultural values in participation (see 4.1.2.2)
3. Environmental education and training (see 4.1.2.3)
4. Research and monitoring (see 4.1.2.4)
5. Ecotourism development (see 4.1.2.5)

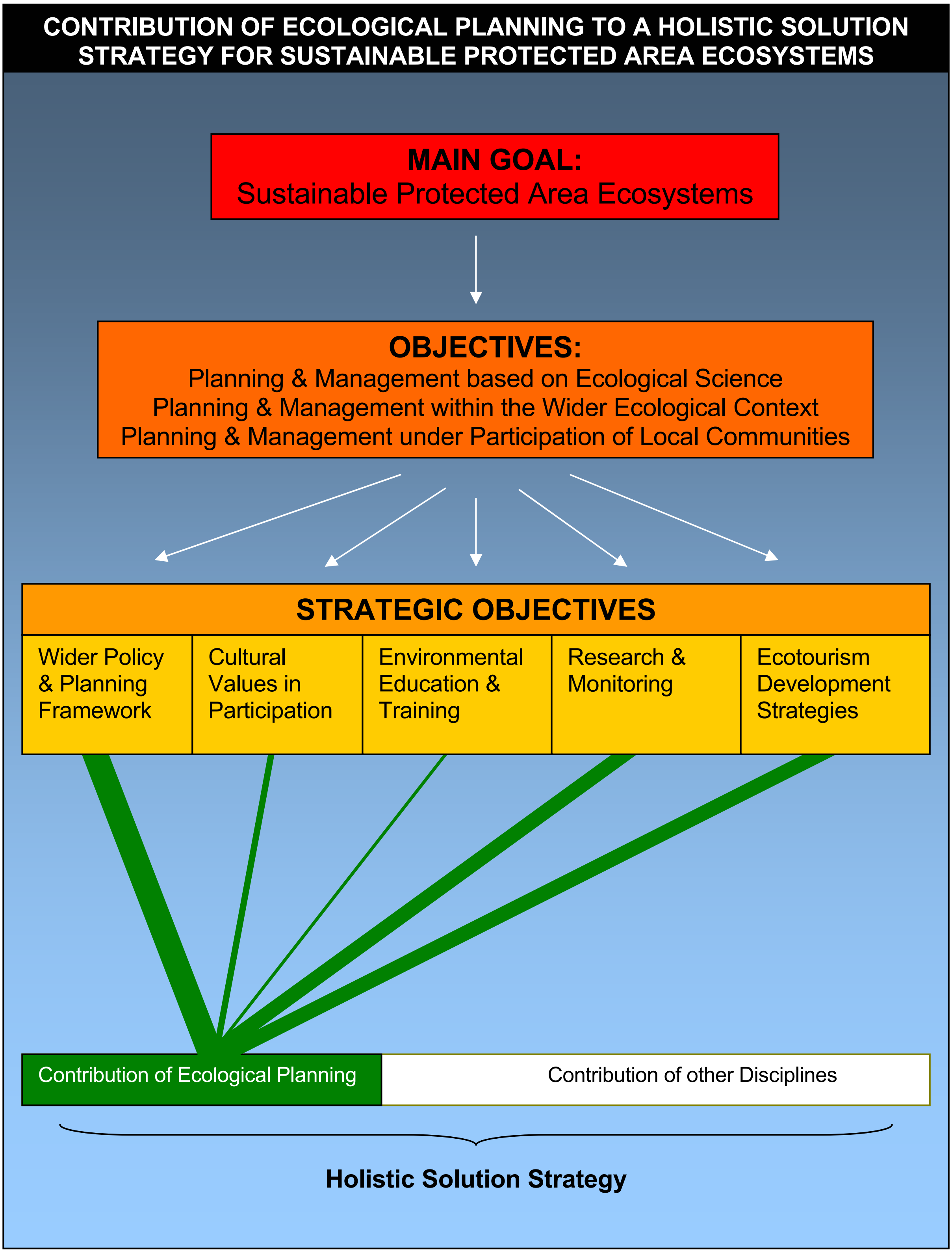


Figure 22: Correlation between a holistic problem solution and the contribution of ecological planning.

4.1.2.1 Wider Policy and Planning Frameworks

To produce sustainable results conservation, projects must be based on a wider policy and development planning framework. There should be a shift from crisis management to strategic planning if significant and long-term improvement in conservation management is to be realized. Concrete conservation plans for the respective areas must be developed with long term, more comprehensive and practical measures, rather than fragmented and uncoordinated responses to the loss of particular species and habitats. All development activities in the area should thus be based on those plans. Development of frame plans for conservation areas at regional and national levels should be the basis for the formulation of the site plans and the subsequent management of the site projects. With the vast majority of biodiversity on land and water outside protected areas, it is necessary for biodiversity conservation efforts to extend also beyond protected areas boundaries. Bioregional activities and ecology should therefore be part and parcel of the protected area managements. Though regional and international cooperation in conserving Africa’s natural heritage should also be promoted, local and trans-regional conservation activities will only work if enabling and supportive policies are developed and enforced by the respective national legal institutions.

Different uncoordinated policies for various sectors in the areas surrounding the protected areas are one main source of conflicts. Example of such policies may be the creation of incentives to exploit certain resources in the ecosystem without regard of the impact of the exercise on other sectors. Creating water dams for fisheries purposes or diverting water courses for irrigation and domestic purposes may be encouraged as an economic activity in the uplands, but may have a devastating effects on the lower ecosystems, thus unsustainable. Encouraging human settlements and farming activities or infrastructural developments on the dispersal areas or migration routes for the protected area wildlife, without regard of its effect on the protected area ecology, may also look attractive in itself but destructive in the long run. Due to land pressure and high levels of poverty, decision-makers may feel they have little choice but to adopt certain policies and activities though detrimental to the ecosystem. It must nevertheless, be emphasized that ways for developing policies and frame plans that balance nature conservation with sustainable development, be sought and promoted to ensure long term sustainability of those resources used.

One way would be the adoption of inter-sectoral approach to conservation. Sectoral conservation (or ‘in situ’ conservation) in the protected areas alone is likely to continue experiencing conflicts or total deterioration if other sectoral activities in the same area are not harmonized with the conservation policies and activities. Success of the protected area conservation also requires conservation activities from the project level to the regional, national or trans-national levels be managed in harmony with the conservation goals at the various levels. All this calls for an inter-sectoral approach. Inter-sectoral means integrating individual sectoral goals and activities which, as is often the case, may hinder the activities of other sectors in their efforts to appropriate goods and services from the same and allied systems (MEGANCK & SAUNIER 1983; OAS 1987).

Policies on land tenure and other legal issues related to land ownership and use around the conservation areas, need to be streamlined to match those of conservation and resource utilisation in the same area and thus avoiding conflicts or duplication. The lack of appropriate land tenure and land-use planning in general, or land-use planning policies sensitive to ecosystem requirements in particular, represents one of the most significant omissions within the environmental policy in most conservation areas.

4.1.2.2 Cultural Values in Participation

Majority of the protected areas in Africa, and in East Africa in particular, do overlap with ancestral lands and resources of indigenous people. However as explained earlier, the establishment of those protected areas has very often aggravated the conditions of deprivation, poverty, marginalization, social exclusion and cultural erosion of those communities.

Before the introduction of the western conservation practices by the colonial governments in Africa, the African people had been practicing traditional activities designed to conserve the environment and its resources (INFIELD 2001). One may as well argue that the idea of conservation and protected areas began with the indigenous people way before the conventional protected areas approach. The Kaya forests on the Kenyan coast and the Mt. Ol Doinyo Lengai ("Mountain of God") in the Maasai region in Tanzania and many other sacred groves, sacred mountains, sacred rivers and lakes, ceremonial grounds, among others, were traditionally protected places covering areas of spiritual, religious and as well conservation value (NEUMANN 1998). Those sacred places were normally put under the authority of traditional institutions or spiritual leaders vested with "statutory powers" and a body of regulations and norms would usually be defined and enforced to ensure compliance with exclusion principles or policies. These areas were restricted for use only by particular class of people specializing in particular skills: medicine, religious practices rituals, etc. "Non-specialists" had no moral obligation to enter those areas. This is the same criteria used today by the modern managements. The question however is why does the modern practices tend to exclude the traditional practices, when both are seen to be operating on the same principles of identifying and managing protected areas? Why is it that the modern protected areas management have been a cause of the socio-political exclusion of traditional people through the so-often-practised eviction and denial of the traditional practices, which otherwise would have offered strong foundation for contemporary conservation strategies?

It was hoped that the IUCN International System of Protected Area Management would provide for the accommodation of the indigenous rights and interests thereby offering a solution to the conflicts. The recent campaign for a new protected areas paradigm of social sensitivity and inclusiveness, flexibility in approaches and integration with local development aspirations, i.e. a shift from the "top-down" approaches to a more participatory "bottom-up" approaches, promising a more favourable policy for the convergence and cooperation between protected area managers and indigenous local people, was warmly welcome when it was first released. However, the inadequacy of national laws and policies to face the challenge of building partnerships, has remained the single stumbling block towards this goal. At the national level, legal and political policies on issues like ownership and statutory powers within protected areas are frequently obsolete and if any at all, extremely ineffective. This of course contradicts the fundamental IUCN concepts for conservation. The areas with the highest potential to respond to indigenous people's interests, like the bioregional landscapes and their resource protected areas, are totally excluded and poorly understood in the African Savanna areas. Other approaches like the Biosphere Reserves of the UNESCO, are really managed as per the original ideals or do not receive enough attention by the managements.

On the other hand, the search for conflict resolution on the ground, and the involvement of the local people, as is often done by the KWS in the human-wildlife conflict areas in Kenya (MWANGI & MWANGOLA 1998), has led to many constructive arrangements for conflict resolution and area-level co-management agreements.

As argued by INGOLD (1992) the new participatory conservation approaches should regard culture as a system of symbols. The symbolic significance of the environment is an important aspect of the African traditional culture. GREIDER & GARKOVICH (1994) also confirm that landscapes are not only important for its biological diversity or physical terrain, but also for its cultural constructions.

Managing protected areas to reflect local indigenous values can therefore help build support for conservation and reduce conflicts. Promoting conservation in the context of local culture would endow protected areas with significance that an emphasis on biological diversity or economics would not (INFIELD 2001), and could also provide a counter balance to economic pursuits in the protected areas thus saving them from unsustainable rape from economic maximisation. Although in the last century economic change, population growth and other factors have brought far-reaching shifts in traditional patterns, many aspects of biodiversity conservation approaches may still be found embedded in the culture of the African indigenous communities, food production practices and religions practices.

By allowing cultural participation, the value systems compatible with sustainable development can be given the atmosphere to emerge from the suppressed traditional beliefs and practices that have effectively conserved biodiversity for many years. In this light a conservation strategy which reflects indigenous cultural values, means also the restoration of old traditional culture and is therefore of social importance.

Participation of the local indigenous people together with all the stakeholders involved, should therefore be made a conservation policy for all the African Savanna conservation areas. Legal instruments and policy changes should be made to encourage co-management agreements and provide for the local people's rights to those co-management and participation procedures and the African perspectives of resource utilisation and conservation of the existing resources need to be incorporated in any new biodiversity conservation initiative. Works by JONES (1999) in Namibia and KANGWANA & OLE MAKO (1998) in Tanzania could demonstrate that managing protected areas to reflect locally important cultural values may be a starting point to justify conservation.

4.1.2.3 Environmental Education and Training

Awareness and understanding of biodiversity conservation issues need to be improved throughout the populace. Awareness-raising, training and human-resource development are necessary steps to the implementation of strategies for conserving biodiversity in and around protected areas.

It is not enough to offer formal education on the values, structure and functional importance of ecosystems. This type of education is only available to a small percentage of the population which may also have no direct contact with the environmental problems, and whose actions may also not have any direct ecological impact. Widespread degradation of these ecological resources is mainly initiated by the actions of the majority of the Africans, whose lifestyles range from small scale farmers / peasants in the moist climatic regions to pastoralists, hunters and gatherers in the dry and remote parts of the continent. Most of these people have no access to formal education. A type of informal environmental education is therefore a need to be developed.

Non-formal education and awareness programmes in specific environmental issues should also be developed and directed to the respective groups of the government officials whose activities and decisions have are likely to affect the environment. The government and parastatal officials in a wide variety of line ministries and departments should be made aware of how their work impinges upon biodiversity conservation and other environmental matters. Greater cross-sectoral understanding and co-ordination is vital to the broad strategy advocated in this study. In-service workshops, seminars and study tours are important conventional means of updating information. Field training should also be an integral component of staff development. Substantial reorientation and retraining is needed in the following three respects:

- All elements of the ecosystem/landscape rather than concentrating upon mega fauna and individual protected areas
- Ecosystem/landscape core processes and ecological functioning rather than concentrate on static species richness
- Importance of making community participation in protected area management and biodiversity conservation activities outside protected areas an integral part of conservation process

Within the protected areas, information should be disseminated and shared in a manner that it will become accessible and understood by all stakeholders. The sharing of information should not be a one shot affair but a continuous process throughout the project cycle. The "Objectives-Oriented Project Planning" (German: “Zielorientierte Projektplanung”, ZOPP) by the GTZ (Gesellschaft für Technische Zusammenarbeit) is a simple workable method that could perfectly be applied in the Savanna conservation areas (see GTZ 1993).

ZOPP is a project planning and management method that encourages participatory planning and analysis throughout the project cycle with a series of stakeholder discussions or workshops. The technique requires stakeholders to come together in a series of workshops to set priorities and plan for implementation and monitoring. During the workshop discussions the stakeholders are encouraged to brainstorm, strategize, gather information and build consensus among themselves and between them and the project managers and other project officials. This approach is appropriate for the African Savanna conservation areas, where in most cases the various stakeholders do not know each other and may never have the opportunity to do so if there is no such a forum as the ZOPP that can bring them together. ZOPP is unique because it brings together a blend of people who have never before worked as a group and who need to create a common language to understand one another's widely divergent concerns. As described by its creators at the Germany Technical Co-operation Agency, the purpose of ZOPP is to undertake participatory, objectives-oriented planning, that spans the life of project or policy work to build stakeholder team commitment and capacity. We believe that this method could be an effective education tool, especially for the indigenous stakeholders who are mostly affected by the conservation activities in the areas they also have interest in. The technical and scientific information, that might be difficult for local residents to understand, should be simplified and communicated in a manner understandable to all participants. This helps to create both the needed awareness and the interest in the project and the its goals.

4.1.2.4 Research and Monitoring

In much of sub-Saharan Africa, there is a serious lack of natural resource inventories and other baseline data that are of fundamental importance to monitoring trends in ecological systems. Consequently, biodiversity conservation projects and development projects are often designed and implemented using inadequate information. The projects usually lack built-in provisions for monitoring changes in biodiversity and ecological relationships, as well as the economic and social well-being of local residents. It is therefore impossible to accurately assess the success of most projects and to provide adequate feedback for making corrections and refinements.

The purpose of monitoring in ecosystems is to recognize changes (direction, size, rate), to assess the reasons for the changes and to predict their consequences. Inventories provide information on existing levels and patterns of biodiversity and landscape. If carefully selected, indicators can help identify both positive and negative trends in conservation, but there still is an urgent need for exploring new alternative methods for the affective evaluation in conservation projects. Although there has been a good deal of effort put into developing biologically based methods for assessing project outcome, few are practical and cost-efficient for use in the developing world

(KREMEN *et al.* 1994; MARGOLUIS & SALAFSKY 1998). Biologically based techniques require specially trained personnel and equipment, which tend to be expensive or not available, or produce a high dependence on external experts because results are difficult for non-specialists to interpret.

Participatory Rural Appraisals (PRA) combine traditional scientific information gathering with the participation of local communities for planning and management purposes (CHAMBERS 1992). PRA is a methodology of learning rural life and their environment from the rural people. It requires researchers / field workers to act as facilitators to help local people conduct their own analysis, plan and take action accordingly. It is based on the principle that local people are creative and capable enough and can do their own investigations, analysis and planning. A long history and tradition of using ecological resources has developed an inherent tendency among local people to monitor ecological resources. Because of the closeness of most rural communities to nature, local people may be quick to detect changes anticipated in projects. It is likely that local residents can recognize changes in habitat boundaries, disappearance of a formerly common plant, animal or fungal species and arrival of alien invading species.

International partnerships, especially those concerned with technical, information exchange and management capacity building, may be important for supporting local projects with information and ideas. In building these partnerships, care is needed to ensure that data gathering and monitoring systems are not expensive and over-elaborated, and that they can be sustained during periods when external assistance is not available. Complex technology often adds only marginal benefits, and cannot be sustained at the local people's level in the long term. Research and monitoring should also involve local research institutions, helping them build up their capacity and avoiding long-term (and usually expensive) dependence on external consultants. Modern "high-tech" approaches in monitoring and research, especially where large areas demand the use of such instruments as computer based technologies like GIS, satellite technology or simulation models, are nevertheless the reasonable means of information gathering. The fundamental research and monitoring for biodiversity conservation and sustainable development, especially in the African Savannas, could however be satisfactorily done by simply getting into the field, walking, looking, measuring, recording, talking and collaborating with the local residents. Modern "high-tech" tools can be useful and sometimes open new horizons in the evaluation after the preliminary assessment of the area, its ecology and people have been done.

4.1.2.5 Ecotourism Development Strategies

Whether referred to as nature tourism or ecotourism, the expected growths in the tourism sector and the increasing reliance of many African countries on it as a major economic activity, highlights the need to pay special attention to the relationship between tourism and the protected areas conservation in the Savannas. This is especially because tourism is to a larger extent based on the biodiversity of the areas it takes place. Like other sectors, tourism uses resources, generates wastes and creates environmental, cultural and social costs.

Tourism in the Savanna protected areas should therefore adopt a strategy of sustainable development as it was formulated at the World Conference on Sustainable Tourism, held on the island of Lanzarote in 1995 (INTERNATIONAL SCIENTIFIC COUNCIL FOR ISLAND DEVELOPMENT 1995). Although it is not practically possible to conduct "sustainable tourism" in a natural ecosystem without leaving traces of harm to the environment (W. WOLFF – lecture notes), tourism in the Savannas, being unavoidable because of its economical role in those areas with little other economical options, should nevertheless be conducted in a manner that minimises its negative impacts on the vulnerable ecosystems. Tourism in the Savannas must also be socially and ethically fairly conducted to benefit the local indigenous communities. Such tourism in the African context would be regarded sustainable especially when it not only minimizes its impacts on the environment, but also attaches a special importance on conservation of the cultural heritage and traditions of local communities, enabling destinations to enhance their social and cultural heritage and improve the quality of life of both their people, the environmental quality and their culture.

A strategy of environmental quality that aims at conserving destinations and satisfying customer needs, should also encourage and make the participation of everyone involved in the tourist industry top priority. The environmental costs should be covered through a system of tourism costs setting that consider ecologically sensitive and degraded areas. The Agenda 21 provided a framework through which related guidelines for the achievement of the sustainable tourism could be developed. Tourism enterprises should be based on these following principles:

- Tourism should assist people in leading healthy and productive lives in harmony with nature
- Tourism should contribute to the conservation, protection and restoration of the earth's ecosystem
- Tourism should be based upon sustainable patterns of production and consumption
- Tourism development issues should be handled with the participation of concerned citizens, with planning decisions being adopted at local level
- Tourism development should recognize and support the identity, culture and interests of indigenous people

The tourism providers should therefore identify actions needed to realise sustainability in their tourism ventures. The ones listed here are just but a few of the many considerations that could be made in the land-use planning and management for tourism.

- minimisation of wastes by recycling and re-use
- efficiency in energy consumption as well as energy conservation and management
- management of fresh water resources
- management of waste water
- management of hazardous substances

- transport management for good coordination
- be participatory involving staff, customers and the communities in decision making on the on financial and environmental issues
- Carrying capacity assessments in a participatory manner involving all the stakeholders involved in any touristic project.

A brief mention of the importance of the carrying capacity deserves a special mention. Though an easy expression to understand, carrying capacity is however very difficult to assess scientifically. In recent years, it has emerged as a tool to be used in measuring sustainability in conjunction with the concept of sustainable development. The very first step of any tourism or other land use is the analysis and evaluation of the carrying capacity of the ecosystems in which the activities should be established. If this step is ignored in the initial planning, the resulting activities could lead to resource degradation. A generalized definition of the term carrying capacity is given by the World Tourism Organization (WTO 1981), and states that carrying capacity is “the maximum number of tourists that can visit a single site without provoking destructive physical, biological, economic or socio-cultural aspects of the areas environment, or an unacceptable deterioration in tourist’s satisfaction”.

4.1.3 Toward a Synthesis of Approaches

Though many protected area authorities in the African Savannas have departments for implementing all or at least some the above strategies, there is however a general lack of an integrated approach as a basis for objectively assessing ecosystem functioning with regard to ecology and social economic aspects of the protected areas. Most protected areas therefore operate with the old conservation goal of:

- maintaining the elements of ecosystems (species, populations and their physical environment)

A synthesis of the above principles with scientific research and monitoring to maintain the ecosystem functioning in the protected areas means:

- adopting an integrated approach that ensures the maintenance of a wide range of species and ecosystems and as large an area of intact ecosystems that goes beyond protected area boundaries, to include all the vital habitats and human communities associated with the conservation area. This approach addresses the very source of the conflicts between conservation (the maintenance of biodiversity in all its features) and other human activities.

An extreme conservationist view would argue that no element of biodiversity should be lost or placed at risk, whatever the cost, by integrating human activities with conservation. Taken to its logical conclusion, this would require the cessation of present human activity in the conservation areas and is clearly therefore an unrealistic proposition under the present global trends. At the other extreme there are those, who would argue that efforts should only be made to maintain those aspects of biodiversity which are indisputably demonstrated to be vital to human survival. This approach will ultimately lead to extreme biotic impoverishment of the biosphere, with unforeseeable consequences.

The most sensible course of action undoubtedly lies somewhere between these two extremes. It will essentially involve a trade-off between the benefits to be gained from maintaining some aspect of biodiversity and the costs of doing so, most of which are likely to be in the form of foregoing the benefits of conversion (i.e. foregoing the financial gain from bush meat or trophies, plus the actual costs of the maintenance of the conservation area). Determining where this trade-off should lie, is not likely to be an easy task. It is therefore essential that it should be determined socially, through such procedures as ZOPP, so that it will be based on the particular standpoints of those involved in the decision making. The sections that follow will attempt to discuss this mix and present alternatives that we think are essential means of attaining functional protected area ecosystems and sustainable social and economic activities based on them.

4.2 Integrated Bioregional Planning as an Ecosystem based Strategy

In the former chapter we have demonstrated the need for a broader and integrative approach to conservation in the African Savannas. The above section has also presented a synthesis of strategies towards the achievement of sustainable conservation areas. An ecosystem based approach to conservation represented by the green part in (Figure 22), provides an alternative approach to the conventional species centred conservation that dominates most managements in the protected areas of the African Savannas. This approach focuses on the ecology of the planned area but also has the potential to integrate the five strategic approaches discussed above. The synthesis of this integrated approach produces a totally new conservation paradigm, but presenting the very needed tool for the solution of the problems militating against conservation in the region. We have named this broad based planning strategy an Integrated Bioregional Planning (IBP) approach. In this chapter we will lay emphasis on the fundamentals of the ecological planning and also show the synergy between ecology and those other aspects discussed in section 4.1 which, together represents an holistic solution.

By adopting strategies for the sustenance of the ecosystem functioning and maximising the involvement of the local people in the conservation effort, the IBP lays down the criteria by which the efforts of conservation in the African Savannas should consequently attain the ultimate goal of sustainability. Such strategies examine the overall cumulative effects of any proposed change on land by judging them in the context of the whole surrounding regions, natural systems, social-cultural issues as well as the adjacent conservation projects. This is a more open approach, where conservation objectives are balanced with development objectives. It is such a strategy that we think can contribute to the solution of the current rate of ecosystem degradation, human-wildlife-conflicts and the devastating poverty, which is mainly caused by unsustainable development activities in the regions, where the protected areas are found. Being both integrative and holistic, the approach both looks at the project area and its bioregion as a unit of management and tries as much as possible not to focus just on particular parts of the ecosystem for some particular interest.

The approach bases the zonation of the protected area and its bioregion on the principle of ecosystem functioning and provides a scientific framework for recognizing and delineating ecological functional clusters as areas of special attention in the management.

The sections that follow attempt to outline this strategy of integrating protected areas into their bioregions. The description of the ecosystem approach in the immediate sub-section is meant to provide a framework and the rationale (links between the ecological, economical, political and cultural) for the bioregional planning (IBP) of the protected areas, viewing them as integral parts of the region surrounding them.

4.2.1 Ecosystem Approach as a Framework for Integrated Bioregional Planning

Review of some of the reports containing the views of both conservation experts and local communities show a general consensus in contemporary thinking that a more open approach, where conservation objectives are balanced with development, should be the only solution to the current rate of ecosystem degradation, human-wildlife conflicts and the devastating poverty (WESTERN 1973, MCNEELY 1993, BALMFORD, MACE & GINSBERG 1998).

MCNEELY (1993) argues that the climate seems right for designing an approach to conserving biodiversity, that is built on the use of economic incentives and disincentives as well as the reduction of perverse incentives. Such an approach should be integrative, looking at both the project area and its bioregion as a unit of management. It should look at the bioregion's natural ecological functioning units, as areas of special attention in management, and focus on the interrelationships among the components of the physical environment, biotic environment, including the human society, as well as the culture and the economy of the region, while incorporating the concepts of sustainability. We consider the ecosystem approach strategy in biodiversity conservation as the only strategy capable of offering such a holistic, broad based and integrative balanced conservation and resource use in both the protected areas and their bioregions in Africa.

4.2.1.1 Development of Ecosystem Approach

Holistic, interdisciplinary studies of ecosystems have gained momentum since the initiation of the International Man and Biosphere Programme of the UNESCO (IUCN/MAB/UNESCO 1979) in the 70's and 80's respectively, and the publishing of the book "System Ecology" by H.T. ODUM (1983). Since then, many different but complementary approaches have emerged in the field of nature conservation. Of particular relevance to protected areas are conservation biology, landscape ecology and ecosystem science (SLOCOMBE 1991, 1993).

The implications of the islandisation of the protected areas stack in a landscape matrix strongly altered by different land uses, is well elaborated by the modern conservation biology studies. Such islands may have difficulty maintaining species diversity (NEWMARK 1996), and may not maintain functional ecosystems, as a result of which they may require intensive management of populations. Conservation biology contributes to an understanding of the dynamics of small-scale population management within isolated ecosystems (SOULÉ 1986, 1987; SIMBERLOFF 1986; SHAFFER 1987). It thus provides an inside-out view of the protected areas and was strongly influenced by the theory of island biogeography (McARTHUR & WILSON 1967).

Landscape ecology on the other hand provides an outside-in view of the protected areas thus regarding protected areas as the remnant of a once much larger landscape element, now isolated in an otherwise modified landscape. Landscape ecology identifies the dominant landscape elements, landscape matrix, corridors and other network features that may link those landscape islands into functionally larger systems. Landscape ecology also suggests quantitative measures of landscape structure and function, and provides a framework for outlining the processes of connection and change between protected areas and other landscape elements (NAVEH & LIEBERMANN 1984; FORMAN & GODRON 1986).

Ecosystem science is critical to the understanding of the actual processes within particular ecosystems at various scales which are also crucial to the anticipation and mitigation of the alterations caused by internal or external threats.

Although the usefulness of the above approaches in collecting and organizing information for assessments as well as for identifying interventions needed for effective management of protected-areas cannot be underestimated, the management of protected areas are today faced with the problems of internal ecosystem deterioration, pressure from their bioregional activities and the unplanned human presence and its activities within and outside them as well as the lack of integrated planning and management of the activities in and around them. It is necessary therefore to develop a more integrative approach based on the ecology of the area, as a framework for integrating all the key factors that are likely to affect the composition, structure and the functioning of protected area ecosystems in their bioregional context (MILLER 1996). This framework should provide us with the knowledge and the tools to manage protected areas as dynamic and complex systems of many interconnected and interacting components and as parts of a wider ecological context.

In the sections that follow we describe ecosystem approach as a framework for balancing biodiversity conservation and the sustainable use of natural resources by integrating ecological, economic and social factors together with an equitable sharing of its costs and benefits in a participatory management of both the protected areas and their bioregions.

4.2.1.2 Defining Ecosystem Approach

Ecosystem approach means, trying to coordinate management across an area large enough to encompass essential ecological processes, whose maintenance has a particular significance for the functioning of landscapes.

The term Ecosystem Approach is often expressed with different terminologies in different settings. In his book “Balancing the Scales” MILLER (1996) defines it as an innovative framework for achieving harmonious and mutually dependent sustainability of society and the environment, that focuses on human and natural systems at regional scales across inter-generational time periods. Another definition often encountered is that of SMITH & MALTIBY (2000), who define Ecosystem Approach as a strategy for management of land, water and living resources that promotes conservation and sustainable use in an equitable manner. Both these definitions do however point out that ecosystem approach is not a method of conservation in itself but a framework under which ecosystem oriented conservation activities operate. Both show that, it is framework to provide the links for biological, social and economic aspects of the area in question in order to achieve a socially acceptable balance between nature conservation priorities, resource use and the sharing of benefits. The bottom line is that ecosystem approach should serve as a framework for the integration of conservation and development in a sustainable manner. To reflect all its components, an ecosystem approach:

- seeks to combine protection of biodiversity with sustainable development
- is based on scientific knowledge of the functioning of ecological systems
- provides the framework for integrating, the ecological, sociological and economic aspects of both conservation areas and their larger bioregions, based on a detailed ecological knowledge
- Provides the framework for the participatory involvement of the local people as the driving force for conservation and development

For its application in planning the relevant unit of an ecosystem approach is the bioregion, which is defined below.

4.2.1.3 The Bioregion Defined

A bioregion should be looked at as a geographical space that contains several nested ecosystems which are characterized by its landforms, vegetation, both animal and human populations, including human culture and history. Thus a bioregion includes a mosaic of ecosystems and communities. A bioregion can also be regarded as a unit of planning and management which seeks to foster mechanisms by which the various components of the region function. In this regard a bioregion can be viewed as an ecological functional cluster over a specific area, which is mainly defined by its geomorphologic features and contains mini landscape clusters of ecosystems. The extent of a bioregion is defined not by political boundaries, but by the geographical limits of ecological systems and processes, that:

- maintain the integrity of the region's biological communities, habitats and ecosystems
- support important ecological core processes, such as nutrient cycling, migration, hydrological or meso-climatic cycles
- include the human communities involved living within the region and determine specific forms of indigenous culture

With this background a bioregion could be as small as both a single protected area and the communities within and around it. It can also cover a small watershed and its various habitats/ecosystems and human settlements within the catchment or embrace mosaics of ecosystems, habitats, and communities of several hundreds of hectares of a landscape, where the whole functions as a unit. In some cases, a bioregion might span the borders of two or more countries. The Greater Serengeti Ecosystem is in this regard a bioregion although it strides the Kenyan/Tanzania boundary. Strictly defined it should include the Amboseli/Nairobi National Parks bioregion (Kenya) as the whole region is governed by the same ecological processes and the Maasai culture.

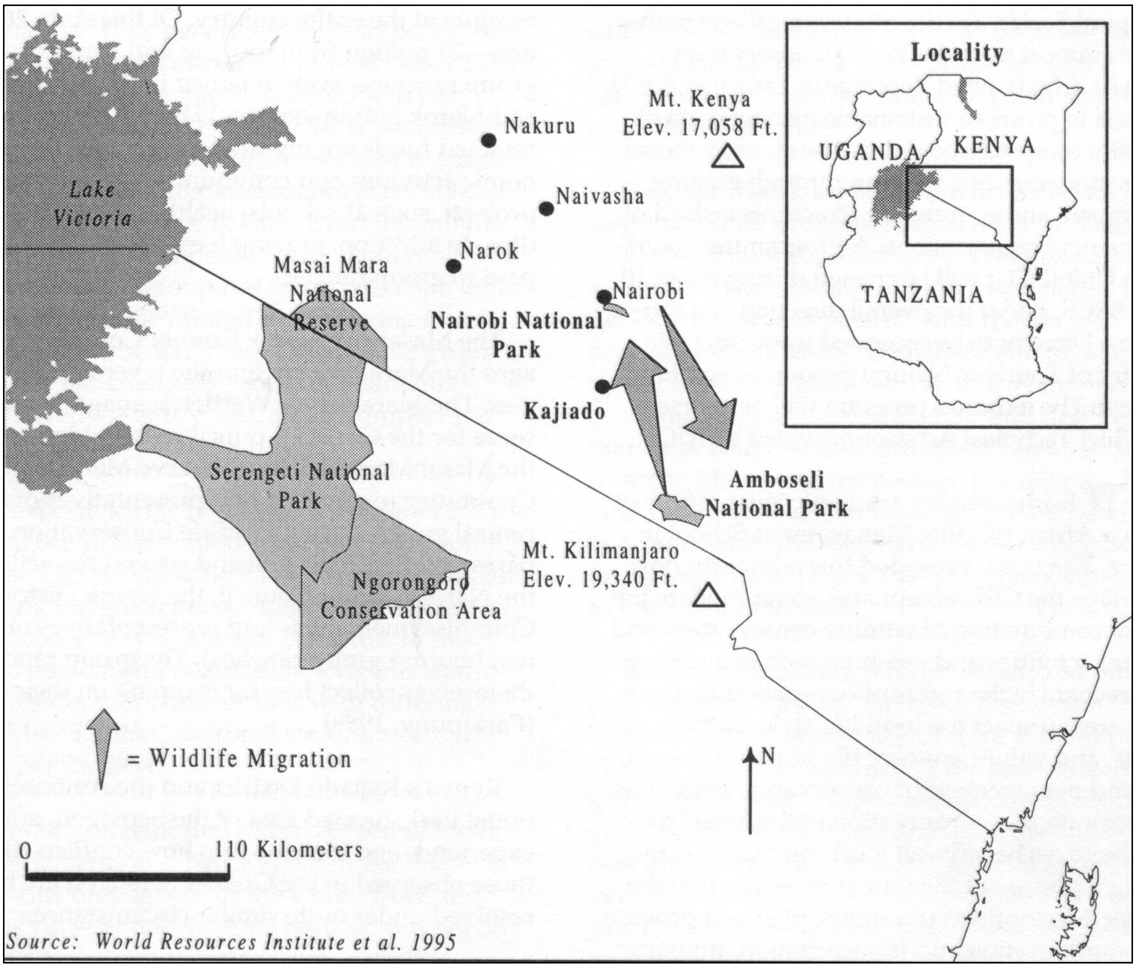


Figure 23: GSE and Maasai land between Nairobi and Amboseli presented as Bioregions. (MILLER 1996)

People are an integral component of bioregions. There is no protected area in Africa that can be described to have been or to be pristine ecosystem without any degree of interaction with human. Being himself a natural being, man is a part of nature and is tenaciously attracted by its goods, services and beauty. Many protected areas today either contain people, are surrounded by people or have both. Human needs are therefore inextricably and inevitably tied up with the future of protected area managements in Africa such that the success of their conservation will depend not only on maintaining ecological health of those ecosystems but also on the social, cultural and the economic aspects of the people and regions associated with them.

Whatever the size it occupies, a bioregion must have a unique ecological and cultural identity and be a place in which local residents have the primary right to determine their own development, so that the livelihoods, claims, and interests of local communities should be both the starting point and the criteria upon which the conservation and other interests must be based.

In a bioregion, each patch of the mosaic of habitats and human settlements and activities, provides localities in which different species, including man, survive and flourish, and each has its own input and peculiar relationship to other components of the region. All the elements of the mosaic are interactive. The kind of management practiced on one part therefore affects other processes like the riparian habitats, crop farms etc. The bioregional components are dynamic and changes over time.

4.2.1.4 Community Participation in Ecosystem Approach

It has already been mentioned that community participation is necessity if the long term conservation goals are to be achieved. It is also necessary to mention here that participation should involve all levels of the population affected by the activity. Community-based approaches to planning tend to be more effective because planning results are usually accepted by the local residents and other stakeholders, because they incorporate the relevant knowledge and experience of those affected by land-use decisions. In this way, participation can help to mitigate potential and existing conflicts and empower the community to take a more active role in conservation matters and initiate possible responses that would lessen any conflicts. Community participation in conservation are either coercive or interactive.

In the coercive perspective, community participation in conservation serves as an enforcement of checks and balances mechanism to natural-resource management (WIND 1991). BROWN *et al.* (1992) describe the communities around a protected area as being in a "bargaining zone" where locals, managers, development agencies, and non-governmental organizations (NGOs) bargain with each other to achieve their own objectives. However, since the bargaining power of the community is generally less than that of the management agency, the education and training offered to communities is often biased toward the perceptions and goals of the management agency rather than the needs of the community.

The interactive approach focuses on community-identified education and training priorities and relies on the concept of co-management. It incorporates community participation at a higher level and gives the community greater control over its own destiny. RENARD & HUDSON (1992) define co-management as simply "sharing of management authority and responsibilities by governments and communities". In their view, a partnership is created in which rights, aspirations, knowledge and skills are respected and enhanced, and in which the importance of human-nature relationships is recognized and valued.

In addition to traditional natural resource questions, relevant social issues raised by the community may include traditional land-use patterns or methods, territorial rights, or the right to self-determination. Besides these social aspects of environmental management, the economic side of integrated development planning is also important, and experience has shown that it may be particularly important in tourism planning, where cultures and environmental quality are central concerns (RENARD 1991; MCLAUGHLIN *et al.* 1992).

Since not all communities, however, are equipped to participate fully at the co-management level, there may be a need for additional education for bridging the information gap to make participation more effective which may require improving technical knowledge within the community and improving communications between the community and other institutions with an aim toward collaboration and institutional strengthening. It is, however, not only the community members that need this additional training and education. Government agencies, NGOs and assistance agencies also may need training and education to foster collaboration and co-management. Chances for success of the project depends on how such training is planned and implemented.

4.2.2 Related Conservation Approaches Currently Implemented in Africa

In chapter 3 we have demonstrated the fact that biodiversity conservation in Africa is becoming increasingly complex, as social, economic and political pressure on natural resources continues to grow.

Many organizations, both local and international, have thus developed approaches which though differing in their objectives have more or less a common goal of a sustainable conservation of biodiversity in the African continent. Of particular mention is the African Biodiversity Collaborative Group (ABCG) whose current project's approaches seem to recognize the fact that conservation must integrate all the local factors and must include a wider region incorporating the human and their social economic aspects.

The ABCG is an umbrella organization of U.S based conservation non-government organizations with projects in Africa. The umbrella organization was initiated in 1999 after the realization that a number of priority biodiversity issues were not being adequately addressed by individual organization, institution or the development assistance community at large and that the complexities of the conflicts and other conservation issues require a wide range of expertise and experience that no one institution currently possesses. In the year 2000 the ABCG was formalized with a vision to conserve Africa's natural resources and biodiversity in a secure balance with sustained human livelihoods. The ABCG organizations also work with the indigenous organizations of which the African Conservation Centre (ACC), based in Nairobi, Kenya is the best example. The following organizations compose the African Biodiversity Collaborative Group (ABCG 2002):

- African Wildlife Foundation (AWF)
- Conservation International (CI)
- World Conservation Union / International Union for Conservation of Nature (WCU / IUCN)

- Wildlife Conservation Society (WCS)
- World Wildlife Fund (WWF)
- World Resources Institute (WRI)

ABCG organizations meet regularly to discuss emerging conservation issues, share lessons learned and look for opportunities for collaboration. Workshops are organized or conservation priority setting and decisions are made concerning the next projects and analysis. The priority setting for conservation by the ABCG organizations focus on two scales namely:

1. Regional Level e.g. the WWF and CI
2. Site-Based Level e.g. the AWF and WCS

4.2.2.1 Ecoregion-Based Conservation by the World Wildlife Fund (WWF)

Since 1961 the World Wildlife Fund has been working in Africa and Madagascar to help maintain the natural heritage and restore the health of natural resources. It has helped in protecting elephants, rhinos, gorillas and cheetahs; establishing and strengthening the management of parks. The WWF's conservation programme for Africa has concentrated on Ecoregion-Based Conservation (ERBC) which has designated six focal ecoregions in Africa with the goal to develop and implement a long-term vision for biodiversity conservation using a 50-year projection. The programme includes both biological and socio-economic information. Although the WWF concentrated on focal countries, mega diversity countries in past, in the early 1990's, it switched to a regional approach, which crosses country borders. Currently, WWF is involved in the implementation and conservation on the ground of such programmes as trans-border conservation in various parts of Africa (ABCG 2002).

4.2.2.2 The Hotspot's Programme by the Conservation International (CI)

The Conservational International's (CI) Africa mission is to conserve the living natural heritage and at the same time demonstrate that human societies are able to live in harmony with nature. CI's Strategies are to:

- Ensure the protection of priority protected areas and reserves
- Create new protected areas in regions of high biodiversity
- Focus on key endangered species to prevent their extinction
- Develop conservation policies and best practices that protect natural resources
- Facilitate the development of locally owned enterprises and environmental education programmes

CI has also decided to make socio-economic and political issues including infrastructure planning part of their conservation objective. On the protected area front, CI has plans for a joint-initiative called "ecosystem, protected areas and people" which is expected to develop strategies, propose policies and suggest field practices that can assist governments, NGOs and communities to ensure the long-term effectiveness of protected areas, natural monuments, wilderness areas, cultural landscapes, community forests and other multiple use reserves. At the regional level, CI works on priority setting in hotspots: areas considered to richly endowed with biodiversity with high endemism. CI considers the hotspots as the richest and most threatened areas for biodiversity (CI 2002).

4.2.2.3 Transboundary Natural Resource Management by the Biodiversity Support Programme (BSP)

The Biodiversity Support Programme (BSP) operated from 1989-2001 as a consortium of World Wildlife Fund (WWF), the Nature Conservancy (NC), and World Resources Institute (WRI) and was funded by the United States Agency for International Development (USAID). BSP's mission was to promote conservation of the world's biological diversity believing that a healthy and secure living resource base is essential to meet the needs and aspirations of future generations. BSP's Africa & Madagascar programme worked with partners both in Africa and elsewhere to help conserve biodiversity and to encourage the wise use of natural resources through the promotion of sustainable livelihoods.

One of the major projects of BSP was the development of an approach called Transboundary Natural Resource Management (TBNRM), which designates large international areas for conservation planning purposes by assessing processes, opportunities and constraints for international transboundary collaboration. Regional reviews and case studies in Southern, Eastern, Central, and West Africa have been undertaken. Transboundary conservation approach focuses on using collaborative natural resource management approaches to enhance or maintain ecosystem function and biodiversity conservation in large-scale natural systems in transborder areas. (BSP 2002)

4.2.2.4 Heartlands Programme by the African Wildlife Foundation (AWF)

African Wildlife Foundation (AWF) operates on a different scale than the hotspot and ecoregion approaches of the CI and WWF respectively. It focuses on the “big picture” large regional landscape blocks which the organization has termed “heartlands”. These are representatives of many different ecological zones of Africa. AWF heartlands programme seeks to build upon protected areas and private reserves to develop landscape areas dominated by natural species, habitats and ecological processes. It addresses the key threat of habitat loss and fragmentation and attempts to manage for site level results through a focus on conservation targets.

The African heartlands are large African landscapes of exceptional wildlife and natural value, where the African Wildlife Foundation seeks to collaborate with landowners, government and others to conserve wild species, ecological communities and natural processes. The goal of AWF’s Heartland programme is to make these varied landscapes both environmentally viable for wildlife and economically successful for people. African Wildlife Foundation (AWF) believes that wildlife will only survive if people value it, and people will only value wildlife if they get some benefit from sharing their land with their wild neighbours. Conservation should thus aim at helping both the wildlife to thrive and the people to prosper.

4.2.2.5 Landscape Species Methodology by the Wildlife Conservation Society (WCS)

Unlike those discussed above, the WCS is not a priority setting programme. Rather, WCS picks where to work, when, and selects sites on the ground. Traditionally WCS concentrated on targeting animals with low densities that are slow at reproducing and need large areas for viable populations. The new programme takes a broader look at these issues by using a landscape species methodology. WCS describes the landscape species as the components of biodiversity that are most threatened and that compete with, or threaten humans and their livelihoods. Landscape species frequently have a significant impact on the structure of the biological communities, in which they live, and thus have major influences on biodiversity as a whole. If predators, they can structure trophic levels and relationships. If large herbivore mammals, they can act to physically structure the landscape. If occurring in large aggregations they can have local and disproportionate effects on biological communities and ecosystem processes. Their loss as ecologically functioning populations can affect the composition of the entire biodiversity, yet these same species are often those that are most valued culturally by local and national people for their value as tourism attracters and others.

4.2.2.6 Other Approaches for Identification of Priority Conservation Areas

To protect land and resources for the future, governments and organizations need to set effective conservation priority areas. The process of doing so, however, is complex and difficult. The biological data in the African Savannas, necessary for setting conservation priorities are often incomplete. The methodologies and procedures for setting such areas are either inadequately developed for the region, are in the experimental stages or are not well understood. Those in place, may also yield profoundly different results. The Minimum Viable Area Concept, developed by the African Conservation Centre (ACC) in conjunction with the Kenya Wildlife Services (KWS), is a good example to demonstrate this problem. Is the method used for identifying the areas shown in their map (figure 25) a standard one in light of the ecology and socio-economical situations of the areas identified? What kind of conservation is earmarked for those areas, and is the implementation likely to gain acceptance by the population already living in those areas? These and many other questions may not be answered until the work gets on the ground. Conservation goals may show great variation between the conservationists and the local people as well as between individuals and organizations having interest in the Savanna landscapes. Despite these difficulties however, priority areas for conservation must be identified and conservation actions must be sustainable, economical and adapted to the social fabric of the people and culture on which it is implemented.

The ACC/KWS's approach that applies scientific analytical tools to identify the ecological factors responsible for the maintenance of biological diversity and then integrates this with the socio-economic factors of the respective communities affected is particular relevance to our IBP concept. The Minimum Viable Area Concept, shown in figure 27 below, which we understand to mean the smallest amount of protected habitat to fulfil the conservation goals of a country, would be useful for identifying the respective bioregions for the country if the areas indicated reflect the actual minimum viable areas on the ground. Identifying the priority areas for conservation will depend on factors that include: element to be preserved, the ecology and the socio-cultural and economic strengths of the human populations living in those areas. Furthermore an area required to support a viable population of an animal species will vary with size, mobility, life history attributes, and ecological requirements of that species (NOSS 1996).

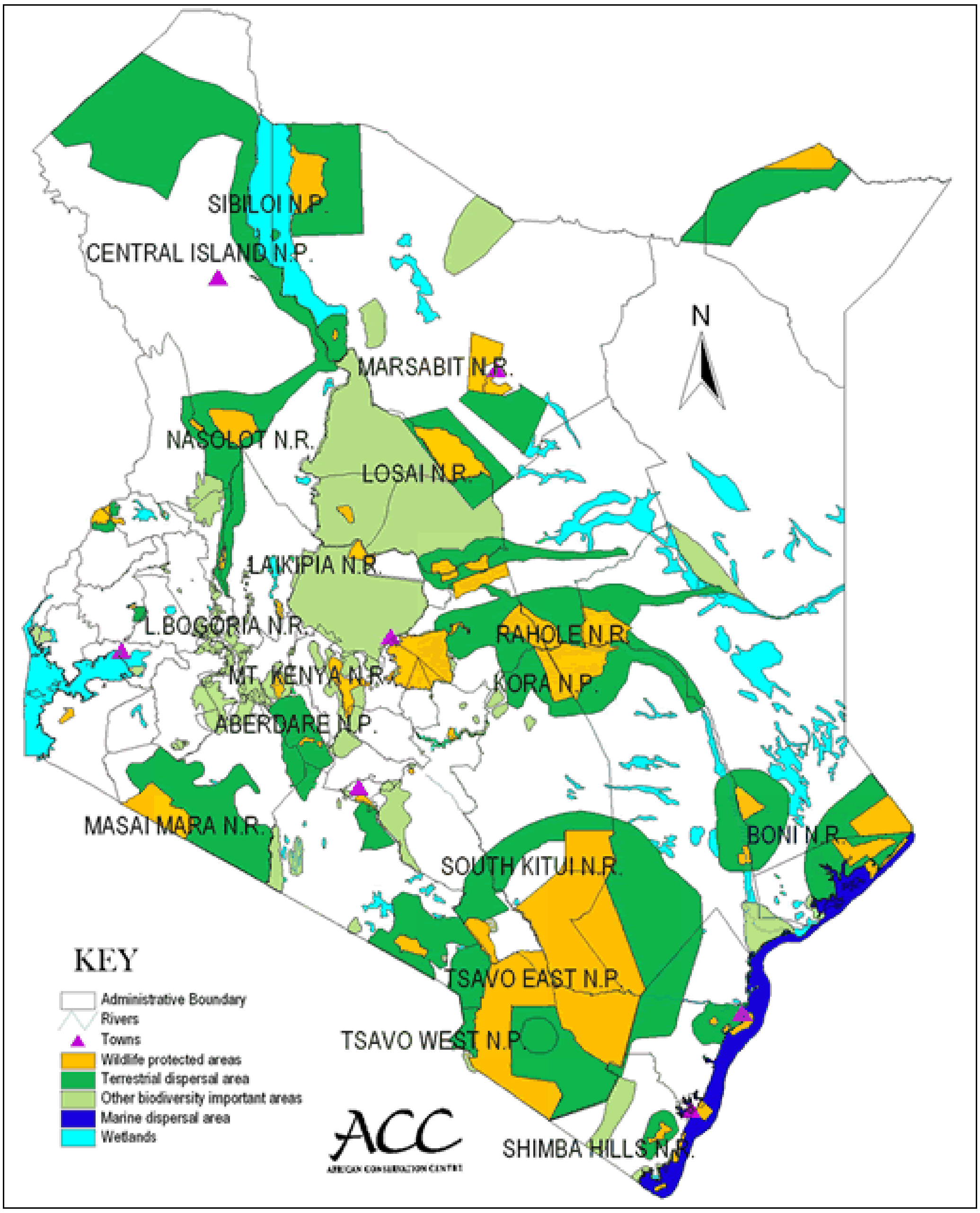


Figure 24: Map of Minimum Viable Area for Kenya: KWS and ACC. (ACC 2002)

4.2.3 Fundamentals of Integrated Bioregional Planning (IBP)

Integrated Bioregional Planning (IBP) considers several aspects as being highly relevant to planning and thus necessary to be integrated in one approach:

1. Different planning scales or planning levels as one comprehensive strategy forming a hierarchical network plan for conservation

2. Protected areas in their wider bioregional context on the basis of functional interrelationships of the landscape ecology

3. Conservation sector in a holistic ecological oriented development sector

4. The participation of the affected people into the planning and management processes of conservation

A critical challenge for conservation planning and management in the bioregions is the practical integration of the conflicting local land use practices and the goals for nature conservation.

Some of the conflicting goals for different land uses in the a bioregion include:

- sustaining the compositional complexity of ecological systems
- resource-extractive activities e.g. agriculture, grazing and other economic activities
- infrastructure for human settlement (housing, transportation and industrial centres)
- recreational activities
- maintaining the services provided by ecological systems
- support of aesthetic, cultural and religious values

These goals and uses often conflict and difficult land-use decisions may develop as stakeholders unilaterally pursue their own different land-use goals.

The paramount role of planning should therefore be to identify those landscape elements whose conservation would maintain core ecological processes of the bioregion. This is a primary requirement for every bioregion if a sustainable use of the other values, such as ecosystem services, cultural and aesthetic values, recreation and extractive uses of the land are to be sustainable. The fact that ecosystems do not exist in isolation but rather function as units in a functional order of landscape meta-systems, means that any activity or change in any part of the bioregion is likely to affect the functioning of other parts interconnected with it and could have an effect on the whole bioregion.

The IBP approach therefore attempts to answer two initial and basic questions on the bioregional scale, namely:

1. What do we need to protect and maintain in order to ensure short- and long-term ecosystem functioning?

Once this question has been answered, the next question should be:

2. What kinds of human activities will lead to a stable, diverse, community-based culture and economy that respects ecological limits?

The process of IBP should therefore define the limits of human activities in the bioregion first by defining the areas in the bioregion that need to be protected to ensure viable priority areas for conservation. The same approach must then be applied to the planning of ecologically responsible human uses for the remaining areas where these uses are appropriate to ensure sustainability of bioregional resources.

Specific stakeholder interests in the bioregion should be integrated right at the planning stage. This will ensure that decisions on the use and management regime for each aspect of the ecosystem to be protected, is determined by those in control of the land, i.e. the internal stakeholders, based on considerations of the carrying capacity (ecosystem sensitivity) and their own objectives and priorities. External stakeholders can only influence these decisions by influencing the goals, objectives and priorities of the internal stakeholders.

The difference between the IBP approach and conventional approaches of development planning is that in IBP the protection of the ecosystem functioning is primary to resource exploitation. By concentrating first on what to protect before deciding on what to use in the bioregion, IBP therefore operates with the adage “if an activity cannot be proved safe, that activity should not be carried out” and so challenges the old conventional thinking that “if an activity in the environment cannot be proved harmful the activity should be carried out”.

IBP applies the concept of ecosystem approach to conservation. It therefore requires broad based criteria that render the approach capable of attaining its goals of being integrative, scientific, participatory and proactive. Although there is no universal recipe in literature suggested for applying the principles of an ecosystem approach, we suggest action in the following areas as absolutely necessary:

1. Bioregions should be managed through a hierarchy of development goals, which are part of a multi-scaled framework planning. The management goals of each individual conservation project must therefore be aligned to the local/sub-regional, bioregional and trans-regional/trans-national development goals respectively.

2. Conservation planning and management should carry out sufficient ecological and social-economical analysis both in the protected areas and the bioregions to understand the functional interrelationships between the ecosystems in- and outside protected areas and other uses in the bioregion.

3. Impacts of local decisions should be examined in a wider spatial and functional context. Local conditions and responses are shaped by the spatial array of habitats and ecosystems. Local changes can also have broad-scale impacts over the landscape. It is therefore critical to examine both the limitations placed on a location by the regional conditions and the implications of local decisions for the larger area.

4. Ecosystem based planning should identify and preserve the rare landscape elements, critical habitats and their associated species. Rare landscape

elements provide critical habitats or ecological processes. Although those elements may occupy a relatively small area of land, they nevertheless contain features important for the region's ecological functioning and biological diversity. Strategies to avoid or mitigate serious impacts should then be developed and implemented.

5. Under IBP evaluation of whether a resource is at risk should be an ongoing process. Actions that would jeopardize natural resources of a bioregion should be identified and considered documented. Land actions which would be inappropriate in particular setting or time should be avoided. Examples are farming on steep slopes, which might produce soil loss, growing plants with high water demands in arid areas, grazing or farming too close to stream banks, which may jeopardize water quality and aquatic habitats.

6. Large areas, that are important to maintaining key ecosystem processes should be retained. Habitat patch size is critical to the survival of a species or population when it is rare or disconnected. In most parts of the Savanna ecosystems large areas of natural habitats are becoming less common as they are fragmented into smaller habitat patches. A useful management approach generally favours protecting large areas and smaller areas that are well-connected to other habitats (BROWN 1998).

7. Public dialogue should be engaged in the conservation management policies. Although the knowledge of ecosystem processes and conditions is essential, it only provides the foundation for informed policies governing resource management. Under IBP the goals for ecosystem management must be derived through an informed public discussion.

8. Local communities should be involved and educated in managing ecosystems. Local communities, through experience and long term contact with their ecosystems, are a rich source of management information. Involving local communities in ecosystem management can also yield a more equitable distribution of the benefits and costs of ecosystem use.

9. IBP also requires that managements should include a component for the ecosystem restoration in those areas of the ecosystem whose functions have been damaged. This is another area not yet explored in many African countries despite the growing ecosystem damage taking place as a result of indiscriminate and unethical ecosystem resource uses in many ecosystems.

10. IBP requires that managements pursue new arrangements that will integrate human activities with conservation goals. Parks and protected areas must fit within an overall strategy of bioregional landscape management that includes compatible human activities.

5 APPLICATION OF THE IBP PRINCIPLES TO THE PROTECTED AREA PLANNING

Given the multi-dimensional threats already endangering the current island constellation of the Savanna protected areas, the need for the expansion of the protected areas beyond the current official boundaries is increasingly becoming a a conservation requirement. Many conservation experts too, are arguing in favour of taking conservation outside the boundaries of the conservation areas, where most of the biodiversity exists (WESTERN, D. & WRIGHT, R. M. (1994); MCNEELY *et al.* 1994; MURRAY *et al.* 1996). In Asia, a review team of experts from Cambodia, Thailand, Vietnam and Laos and from the international conservation organizations is working to *„distil lessons learned globally from protected area planning and management over the past 10 years with particular reference to the relationship the protected areas have on the surrounding landscapes and their economic activities"* (WCPA / IUCN 2000). In his report on benefits beyond boundaries (Title: Taking a Broader View about the Future of Protected Areas) PHILLIPS (2000) argues that, *"….over the past decade or so the concept and practice of the protected areas has seen several notable innovations that reflect the changing context as well as innovations to the immerging challenges. Many traditional views about protected areas are now changing and a new set of ideas and approaches are emerging".*

5.1 Ecological Functional Units - Approach to an Integrative Bioregional Planning

Having shown the necessity of an alternative approach to biodiversity conservation, we further wish to present the concept of EFU which we think, should serve as a tool for an alternative approach to the conservation of the protected areas biodiversity in the African Savannas. Ecological Functional Unit (EFU) approach to planning for conservation, differs from the current approaches in that it attempts to base conservation and the delineation of protected areas on the ecosystem's natural functioning, itself determined by the ecological key processes and structure of the particular ecosystem. With such an approach large clusters of landscape elements can be accessed and evaluated. Basing conservation and management of resources on the knowledge of the systems identifiable and definable dynamic and holistic self sustaining landscape discrete units, has a great advantage over many other methods. It provides the planner and the manager with a definable element of the landscape, whose interacting processes can concretely be identified and studied. Impacts of any activity on such a mini landscape element are easily identified thus making such assessments as ecological risk assessment (ERA) pretty easy. We term such a unit in the landscape or ecosystem an Ecological Functional Unit (EFU).

5.1.1 Definition of EFU

For the definition, of an EFU, to be well understood, one must first and foremost acquaint oneself with the nature of the elements composing the EFU.

In his search to find out the functional components of a complex entity referred to as a landscape, a German biologically oriented geographer, Carl TROLL in 1950, coined up the term “ecotope” (NAVEH & LIEBERMAN 1984). He then went ahead to hypothesize that a landscape is composed of “landscape cells” or “tiles” which are homogeneous with regard to abiotic factors: physical and chemical properties of a particular substrate such as porosity, pH, texture and mineral contents. Such small “cells” are known as physiotopes. When colonised and transformed by organisms the physiotope site, via biotic and abiotic interactions, is transformed into a mini holistic land units characterized by homogeneity of at least one ecological land attribute such as vegetation, soils, water, atmosphere etc. and non-excessive variations of the other attributes present (NAVEH & LIEBERMAN 1984).

An ecotope thus displays such micro-ecosystemic functions as succession in a biological community, establishment of special micro-climates, building up of niches, energy flow and nutrient circulation.

When two or more ecotopes in a landscape are functionally linked together and forming a unique pattern of spatial relationship based to a large extent on at least one land attribute, e.g. the land form and geology (which influences drainage pattern), local climate regime, or due to transport of materials and energy etc., they build a cluster of ecotopes forming a landscape unit with peculiar character and function that differs from other units. Two examples of different ‘topopatterning’ of ecotopes in the landscape can be seen by comparing those that occur on a level terrain showing few lateral interactions and those occurring on inclined terrain displaying a high degree of both lateral interactions (displayed by lateral transport of materials such as nutrients, water etc.) and cyclic interactions (displayed by e.g. cold wind descending to the lower altitudes where after getting warmed up, rises and so repeating the cycle). We describe such factors (water or cold wind descent connecting or integrating one or more ecotopes) as integrating factors. We define the landscape unit so formed as an Ecological Functional Unit (EFU). We recommend that the EFU be treated as the smallest mappable landscape functional unit. This way the EFU can serve as the basis for an integrated bioregional planning and management of the Savanna protected areas.

It is important to note here that the character and functionality of the ecological functional unit is not a sum of the ecotopes composing it. The interactions between the physical and biological factors of the individual ecotopes with each other and with the new topography created through the integrating factor(s) do create a whole new and unique dimension of characteristics that are unique to that particular EFU and differs from those of the individual ecotopes or those of the neighbouring EFU’s. Different EFU’s will differ in their structure (ecotope composition) and functional processes (integrating factors).

5.1.2 The Importance of EFU in Landscape and Bioregional Planning

From the above explanations, it can be concluded that a particular ecotope in one part of the landscape plays a completely different role from another ecotope (of the same type) in another part of the same landscape. It is therefore advisable not to base any judgments of the quality or potential impact or interferences from any activity on the assessments of one particular ecotope without establishing the linkages between that ecotope and the others with which it is connected. Usually an activity taking place on one ecotope has direct or indirect impacts on the other ecotopes with which it forms the EFU. Likewise since the functioning and quality of the EFU is determined by the cumulative quality and cumulative functioning of the individual ecotopes, the performance and quality of the entire EFU is likely to be affected by any activity on one or more ecotopes composing it.

The knowledge of the extent of the EFU in the landscape therefore becomes extremely important in guiding the decisions for management, extents and impacts of assessment and monitoring procedures among others. Knowledge of EFU's in a region is also fundamental to the decisions leading to the creation of a protected area and the decisions for the location of the protected area boundaries. The clustering of functional landscape units is therefore a more realistic means of understanding the ecosystems than the use of their visual appearance and structural homogeneity, as is often the case in traditional landscape planning approaches (see MARTINEZ-FALERO & GONZALEZ-ALONSO 1995). Structural homogeneity is an aspect of a mere human visual perspective.

In principle, the pattern of functional landscape units exists at every level of landscape hierarchy, and not only at the management site level. Landscape ecology recognizes the existence of clusters of sites, ecosystems or landscapes at either local, regional or global scales. The conventional landscape analysis thus tends to orientate itself to the degree of homogeneity of structural pattern in the landscape. With such wider scales as regional, national, trans-regional, continental or even global scales, it becomes easier to recognize broader units of homogenous landscape elements as most of the details of landscape structure disappear in maps or area photographs (see LEVIN 1992).

Deriving from our definition for the EFU, it may be possible to argue that landscapes do not only have functional and structural order but also spatially structured and ordered in a hierarchy of functions at various levels. This is discussed in detail in section 5.3.

To be successful, ecological planning must respond to the functional order of the landscape and identify those landscape units that represent the functional clusters at different scales (Figure 28). This approach in planning has an advantage of maintain ecosystem functioning and health, which are the ultimate goals of sustainable conservation, unlike most of the current conservation planning approaches, which are oriented on static goals of species or structural richness in the nature, ignoring the functional processes necessary for developing the patterns they want to conserve (see also BALMFORD & MACE & GINSBERG 1998). Conserving the structural pattern may not necessarily guarantee the conservation of the processes determining ecological health.

We see our approach as a new attempt to provide the process that would contribute to the solution of this problem and numerous other conflicts in conservation. We refer to the planning process of recognizing the functional units (or functional clusters) at different regional landscape scales as the ecological functional clustering. In this light we see bioregions as functional clusters of ecosystems and broader landscape units interacting with human cultural subsystems. The most determining force in forming a bioregion is thus the geomorphology as the main underlying driver for site conditions of water, temperature or nutrients, in forming ecological gradients and at least a main natural determinant for human settlement and culture. Thus the bioregion is a natural comprehensive cluster of multiple ecological, socio-cultural and economic features and the frame in which all these phenomena should interact in a sustainable manner. The planning process for a sustainable conservation, should thus have the bioregion as its central management unit. A unit can however be managed sustainably if the decision makers have the power, control and access to the main driving forces of the system to be conserved or developed. A protected area in a bioregion must also represent all the directly connected driving features that influence the success of its preservation. In a bioregional context therefore, a protected area should be planned as a priority cluster of key ecological functions. The protected areas serve as management units for the key processing areas, which provide important and essential ecological services to the respective bioregions and at the same time serve as the core ecological units of the bioregion. A protected area must thus be capable of producing and blending together those key ecological services for a sustained and stable flow thorough the broader bioregion.

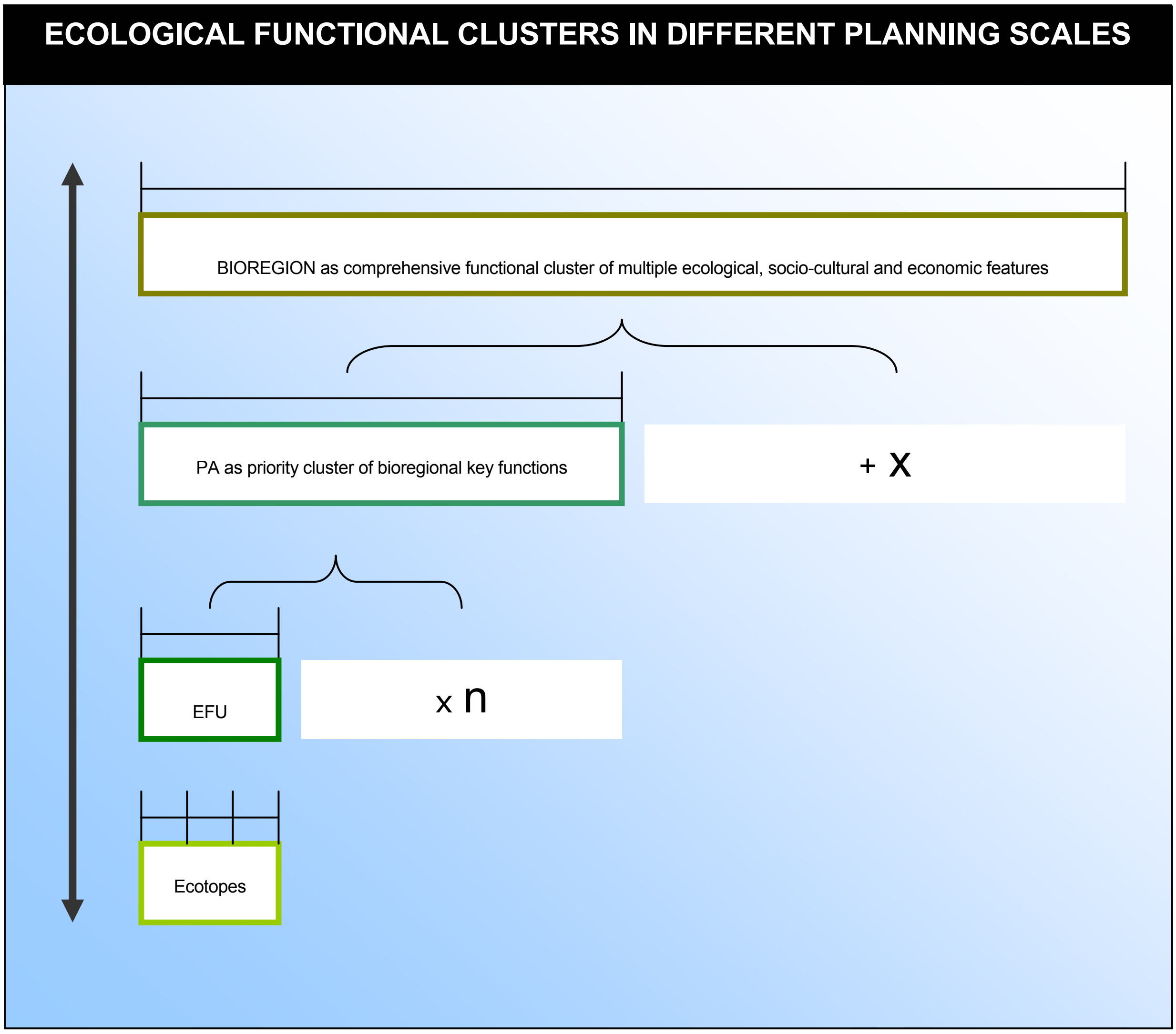


Figure 25: An Association of functional clusters in different Landscape scales.

5.1.3 The Procedure for Functional Landscape Analysis

Being a new idea, the EFU concept in landscape planning has unfortunately no practical field application experience as yet. This paper only provides a theoretical process for the identification of the ecological functional units in the landscape. We hope, the application of these ideas in the future will produce concrete results to a description of an innovative methodology for functional landscape analysis. Positive criticism and useful suggestions from the readers will definitely be a useful resource for the necessary improvements of this functional approach to the planning and zonation of protected areas in the Savannas based on a bioregional context.

Delineation of EFU on the site level, or more generally different functional landscape units in different scales, starts with the consideration of the factors that are likely to determine process functioning and structure of the area targeted for planning. Assessment of those factors could be done using both the inventories of the ecological records accompanied by analysis of the maps, area photographs and satellite derived information with the help of computer technologies such as GIS (Geographical Information System) and simulation programmes. GAP analysis procedure, described in section 6.1.6, is an important tool in the EFU delineation process.

A first impression of the factors composing the landscape is made through a systematic classification of the important ecological drivers for landscape phenology and function. We classify those landscape factors in four groups namely:

- the limiting factors
- the trigger factors
- the conditioning factors
- the integrating factors

→ Limiting factors: These are the ecological factors that control the growth and succession of a plant community and that lead to a gradual change in the ecosystem. Examples in Savannas are water (PAM: plant available moisture), nutrients (PAN: plant available nutrients) or climatic limits for plant or animal communities like minimum temperature or extreme heat in day rhythmic or as seasonal recurring events (STOTT 2000). In some cases also the laterite crusts on soil substrates can be the limiting factor for plant settling.

→ Trigger factors: These are natural phenomena that usually trigger a sudden major shift or change in the ecosystem. Examples in Savannas are fire or flood and drought. Some of these phenomena, like fire, can also be caused by human culture (HARRIS 1980). Particularly elephants as powerful mega-herbivores can cause shifts in the vegetation structure and composition of single ecotopes of Savanna woodlands through the destruction of woody plants (LAWS 1970; DUBLIN 1995).

→ Conditioning factors: These are dominating factors in an ecosystem setting, which play important roles in determining an ecosystem, but do not limit its succession. Examples are water in a river or a lake or soil characteristics like the high nutrient volcanic ashes of the Serengeti grass plains. Also herbivory can be seen as a conditioning factor in the Savannas, because the above mentioned climatic and hydrological limits are the driving force for the seasonal migrations of large animal herds. This demonstrates that the ecosystem plant growth rates are strongly influenced by the herbivores but are not ultimately determined by the herbivore activity. Thus herbivory can be seen as conditioning for the whole Savanna ecosystem (VAN DE KOPPEL & PRINS 1998).

→ Integrating factors: An integrating factor represents the connectivity of the sub-systems of a landscape. Landscape patches, like seasonal ponds, small woodland plots or swamps, can be connected by natural corridors and pathways (e.g. through groundwater layers) in-between a surrounding landscape matrix like a Savanna of a grassy phenology. A corridor can be a linear pattern of trees and bushes or a seasonal brook or river including their riparian vegetation. If such a linear structure is connecting two or more patch elements in a matrix, it is at the same time dividing another structure as a natural barrier in the vertical direction. Riparian ecosystems play a prominent role both as connecting elements and as nutrient filters not only in the Savanna landscape. Further information integrating factors in landscape ecology is given below.

To understand the dynamics of functions of the landscape spatial elements and over time scales, it is necessary to examine the above described limiting, trigger and conditioning factors of landscape carefully. These alone are however not sufficient to explain the dynamics of the functional clusters: Ecological Functional Units. The role played by the integrating factor is of crucial importance in the functional analysis process. The integrating factor provides the frame on which the corresponding (connected) elements (e.g. ecotopes) in the landscape synchronously function, by determining the degree of connectivity between those ecotopes. The integrating factor can also have a different function in different ecotopes in the same EFU. For example water is one of the determining factors in the development of a valley in a landscape where seasonal flood events are occurring. These events form the geomorphology of the valley through the erosive and abrasive force of the flooding water and the materials transported in it. For most of the year in the centre of the valley there is only a small stream, where water is the conditioning factor of an aquatic ecotope. Connected to the stream are riparian ecotopes, which are determined by plant available moisture as a limiting factor and which is provided by the stream. On higher flood plains of the valley water is only available for a short period of the year and can here play the role of the limiting factor for the vegetation growth period. Likewise it plays the role of a trigger for multiple effects in the plant and animal community (e.g. reproduction behaviour) during the flood period. All these ecotopes are depending on one integrating factor: water. Interference in one of the ecotopes (e.g. the valley riparian ecotope) may have serious destructive consequences for the equilibrium of the whole functional unit.

With regard to biocoenology of an area we can recognize other interconnections between different ecotopes of a landscape, which appear from the structural viewpoint of ecotope phenology. Predators, like the lion, can also play the role of integrators over both grassy plains (as hunting habitat) and woodland plots (as refuge or recreational habitats of the species). Alterations within the hunting ground will therefore change the visiting frequency of the lions there and lead to changes in their behaviour in exploring other hunting habitats (dispersion, FORMAN & GODRON 1986). In some cases a river valley with water sources can stand in a strong interchange of energy with grass plains, because the herbivores come here on a specific time of the day to drink. Any interference within the valley would lead to shifted herbivore densities on the grass plains.

Given the above described landscape phenomena, the examination of functional connections between different parts of the landscape is therefore a must if realistic conclusions concerning the impacts of any activity in the protected area or its bioregion has to be drawn. It is evident therefore that landscape analysis on the basis of single ecotopes is likely to produce errors and incomplete information for planning purposes. The answer lies in making every effort to understand the functioning of an ecosystem through a careful analysis of its composition (i.e. the individual parts) and the functional structure (i.e. the arrangement and interactions of those parts) in an ecosystem. Negative impacts on the composition or on the structure grossly affects the function and may lead to the system breakdown with far reaching consequences.

During the landscape analysis and delineation of the functional landscape units process it is advisable that one should:

1. Not to focus on homogeneous structures in the landscape but on the ecological processes determining and integrating these structures and the inhabiting species.

2. Verify the effects any given landscape pattern would have on the landscape functioning before adopting it as a basis for further action (TURNER 1989).

3. Always consider the mechanism and sources of the ecological processes in the landscape which determine other physical factors like the distribution of water, temperature, nutrient or ecosystem quality in an area.

From the background of the above EFU description, an ecological functional clustering can be determined in five major steps (see also figure 26):

1. Examination of the geographical distribution of water (which is strongly connected with the nutrient distribution), the main climate factors (temperature, evapotranspiration, wind systems) and the soil parent material (geology) in the planning area.

2. Identification of the processes which drive those distributions. The landform (geomorphology) thus plays a key role, because it determines the directions and pathways of flows through slope aspect and elevation (e.g. drainage characteristics) (BELL 1998). These flows can occur either in a simple linear connection of source and storage (of e.g. nutrient or water) or as a more complicated cycle (e.g. temperature and local wind systems). A cycle often has a climatic or biological coefficient beside the factor landform. parameter

3. By integrating the above two steps, it is possible to delineate zones in which the processes and flows are taking place. According to BELL (1998), these zones are called Pronounced Processing Zones of the landscape (PPZ) which represent the borderlines for functional landscape units. Unlike BELL, who did not use the PPZ for any practical planning purposes, we assert that the PPZ could accurately be used to mark the boundaries of EFU’s during the IBP planning process, especially if the panning is site based.

4. With regard to a time scale sometimes the dynamic distribution or availability of abiotic factors like water or temperature in an area triggers periodic cyclic movements (migrations) of populations between different parts of a landscape. Therefore animal migrations can be an appropriate indicator of those driving processes and simplify the delineation of processing zones. So the aspect of migrations in the Savannas in particular, should be considered as an integral component of the analysis.

5. In the case of a site based planning, the analysis up to this point is incomplete. This is because we do not yet know exactly the elements composing the ecological functional unit. The distribution of soil-vegetation-systems of the planning area should therefore be examined to define the extent of the ecotopes. This information provides us with an impression of the structural

pattern within an EFU. Correlating this with the afore mentioned energy flows, we are finally able to characterize an EFU. This aspect is logical because the soil and vegetation pattern are a direct result of the afore analysed abiotic processes.

The sequential order of these steps as shown in (Figure 26) is important. It would be an impediment to begin a functional landscape analysis with the examination of soil or vegetation, because this would be obstructing the basic phenological processes responsible for those patterns of vegetation and soil formation. It is absolutely necessary first to focus on the ecological drivers shaping the larger landscape structure and only apply that information at a later time during the down scaling to an ecotope level. Though focussing on structural parameters FARINA (1998) also favours this sequential order for a landscape analysis.

There are further possible refinement and more detailed definitions about energy and material interchange within a landscape, which can be useful for the evaluation which relationship for the background of planning appears more considerable than another. According to FORMAN & GODRON (1986) one can subdivide the transport agents (vectors) which underlie the linkages between different parts in the landscape in:

- Wind
- Water
- Avifauna
- Ground animals
- Human

Of local importance can be several other vectors such as seeds spreading or soil creeping on slopes. Furthermore FORMAN & GODRON (1986) distinguish the forces behind the above named vectors in:

- Diffusion (movement of dissolved or suspended material, e.g. nutrients)

- Mass flow (transport or transfer of a matter, e.g. water flow)
- Locomotion (movement of an object by its expenditure energy, e.g. animals)

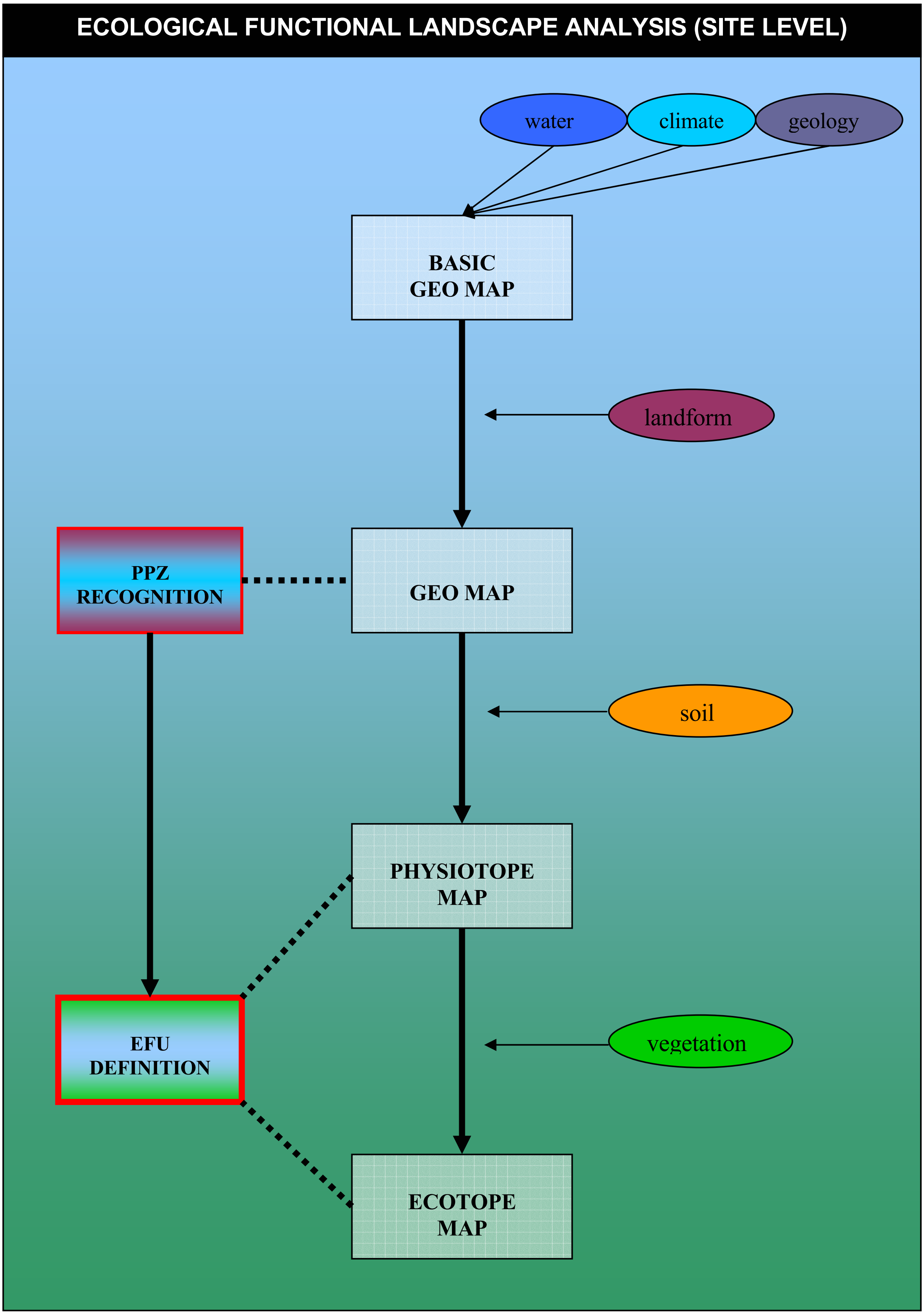


Figure 26: Ecological Functional Landscape Analysis on the site level.

5.2 New Trends in Ecosystem based Planning and Management of Protected Areas

During the "Symposium on the Protected Areas in the 21st Century", sponsored by WCPA and held in Australia in 1997, a call was made to move protected areas from islands to networks of protected areas. Among other things that the participants noted was the need to establish partnerships and encourage cooperation with the protected area and other stakeholders, promote stewardship, enhance the use of relevant information and develop and strengthen the policies, economic and other instruments which support protected areas objectives (WCPA 1997).

This approach to protected area conservation, which places protected areas within their wider context, seeking to maximize the possibilities for successful protection and propagation of species by managing larger areas of surrounding land to provide appropriate habitat is called ecosystem approach. The region which is economically, culturally and ecologically connected with the protected area is known as a bioregion.

In their bioregional context protected areas should therefore be connected to their surroundings and to other protected areas, forming a network through corridors, stepping stone habitats and buffer zones. Likewise protected areas should be integrated into the other economic and cultural uses, particularly those requiring the ecological services provided by the protected area in the region. Involvement of the local people in protected areas management should be done in a manner to create identification about living in their own home land area and determining their own destiny themselves. It means encouraging the same kind of pride in ecological stewardship as exists, for example, in the stewardship of good farmland or in living in a historically important or beautiful built environment. That these feelings exist is well recognized among the Maasai communities in Kenya and Tanzania, who despite the developments in their neighbourhoods have insisted on upholding their cultural values and traditions. The failure to reflect these values and practices in the areas management plans, is therefore a sign of failure in the so called modern management regimes. If protected areas are to work in the long term, social issues of those communities in the bioregional areas have to be addressed not only as an accessory to management plans but as a central part of those plans. The long-term survival of biodiversity and protected ecosystems shall therefore depend upon sustainable management of both the “core” protected areas and the bioregional areas.

5.2.1 The Interaction between the Protected Areas and their Bioregions

The zone of interaction of a protected area is the zone in which the social-economical activities and the protected area ecological processes interact with a mutual influence upon each other. It is also commonly referred to as dispersal area, the buffer or transition zones, and includes some aspects of the protected area and some aspects of the surrounding bioregion together with the intermediary zone in between them and where the ecological processes and the social-economical activities of the human populations run into each other.

The trend in the planning and management of the protected areas now is to create a type of management that looks at the individual protected areas as systems networked with other protected area systems and critical habitats in the region and nested within their broader ecological landscape (including the human developments). This approach is crudely referred to as an “inside out” management approach. The bioregional perspective requires that the PA planning and management adopt an integrative approach which defines accurately a particular protected area from the context of the regional ecological and social-economical issues. The question that arises, however, is how the current perspective of the protected area management should go about this. The solution lies in a strict adherence of the principles of the IBP described earlier. Management of individual protected areas should therefore answer the questions: How is the management consistent with the requirements of the bioregional (and other) planning levels? What are the consequences of the ecosystem approach towards concrete decisions at the protected area project level?

The answers should lie in the change from the strict sectoral management of the protected areas to co-management of the regional resources. This would involve the application of social science tools like social impact assessments, participatory rural appraisal and action research. We define action research as a collaborative process through which a group of people with a shared issue or concern collaboratively, systematically and deliberately plan, implement and evaluate actions. Co-management is also called joint management, participatory management or multi-stakeholder management. This approach requires that the manager involves all the major stakeholders, protected area agencies, local residents, resource users and other relevant agencies and that the reconciliation of local conflicts, articulation of specific objectives, management programmes and zoning controls, and the resolution of many other important site-level issues, be included in the management plans for the individual unit.

This broader outlook in conservation also requires that the goals for the planning and management at the project and bioregional levels be harmonized with those of higher planning and management at the national and trans-national levels. This places the management and the project or individual protected area at the very bottom of the planning and management levels.

The planner and the manager, should define their goals such that they reflect not only the targeted resources and their extent, but also consider the natural mix and the interdependence of the entire landscape resources right at the conception stage of their activity. That means that the protected area and its bioregion interface, defined above as zone of interaction, should first and foremost be defined, identified and planned on the same scale as the project/protected area. Of particular interest in this area are the critical habitats, corridors, home ranges and other ecological drivers (See Figure 27).

This area therefore serves many purposes which are all geared to make conservation more effective. Any activity or development work in it should be ecosystem friendly, adopt alternative cultural and economic activities which encourage conservation and not working against it or cause conflicts. Such activities may include ecosystem friendly tourism and other sustainable resource based economic activities. Weather such activities are ecosystem friendly or not, should be determined by profound scientific ecological analysis of the areas functionality. This also requires that profits from conservation, its ecological services, or ecosystem based economic activities should plough back and help preserve the ecological resource base on which they are based and which is the base for the existence of the protected area and the communities in and around it.

The underlying principles of this approach are not new. They advocate the use of the IUCN management guidelines for the six categories of the protected areas in developing a network of conservation areas within the wider bioregional landscape. Under this bioregional approach the “Man and Biosphere Model” (MAB) with its three-zone-management practice (transition, buffer and core zone) serves an important role.

A combination of the IUCN protected area categories, the MAB zoning system and the IBP approach thus produces a new mix in which the bioregion serves as the landscape matrix on which the individual protected areas of the different IUCN categories are to be managed. In this way certain categories of the protected areas (e.g. the core areas) are to be managed as category I or II and the buffer zones as category IV-VI joined to other core and their buffer zones through biological corridors that allow movement of species (MILLER 1996). The challenge however is how these core, buffer and transition zones are to be delineated especially in the already existing categories under the traditional top down policies that operate under mutual exclusion. Given the current infrastructure and tenure problems, level of conservation awareness among the residents and lack of capital for acceptable alternatives, much effort would be required to restructure the areas around the already existing protected areas, especially those under category I and II.

The concepts of the EFU under the IBP process, attempts to outline the process we believe would be credibly useful in diversifying the protected area managements in the African Savannas to be more outward (bioregional) looking and more participative in approach with the ultimate goal of increasing the ecological sustainability and improving the well being of the residents of such areas.

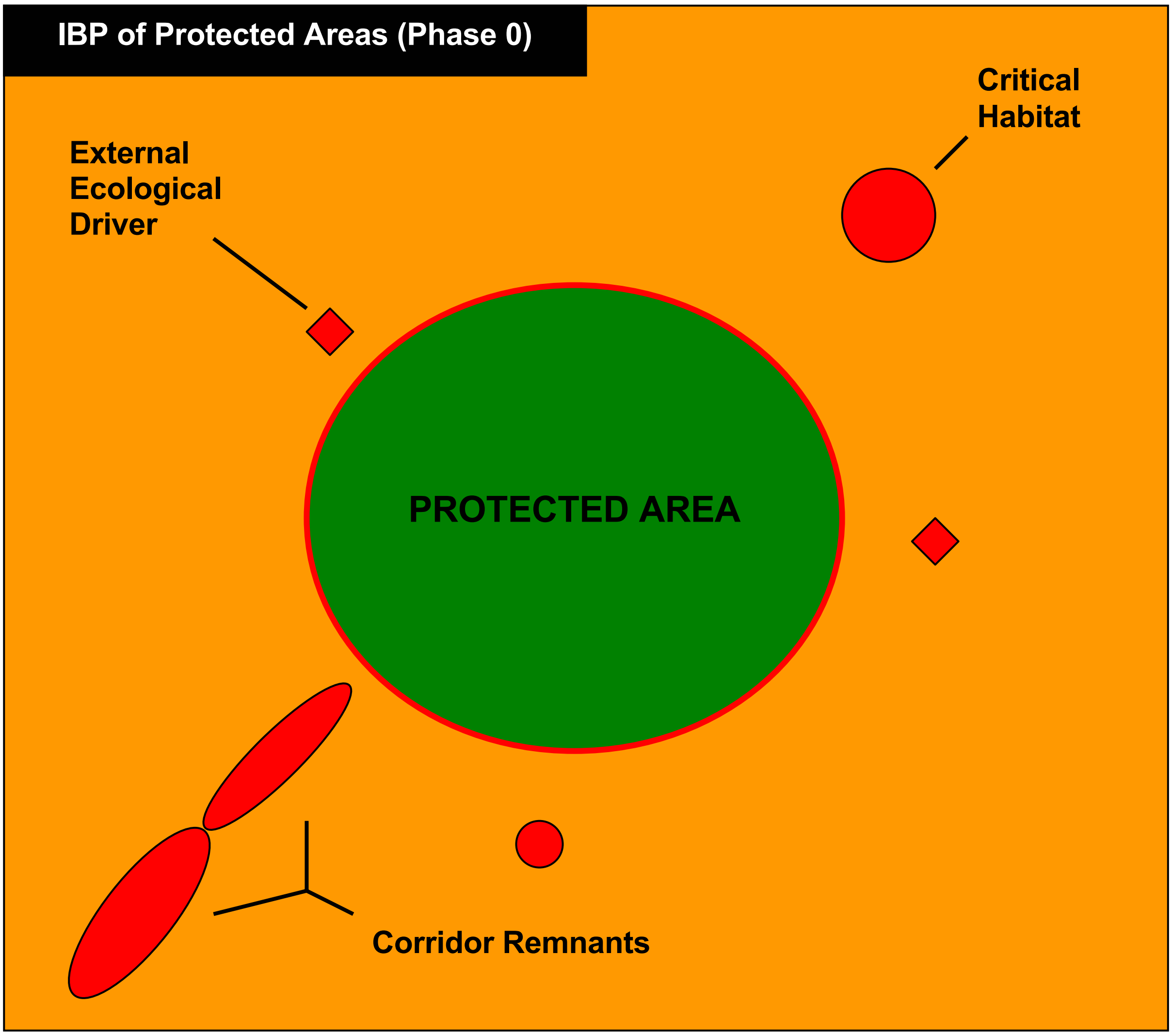


Figure 27: Phase 0 (status quo) of an Integrated Bioregional Planning of a protected area.

5.2.2 Identification and Delineation of the Zone of Interaction

The zonation and management plans for the protected areas under bioregional context could only be effective if the natural and cultural aspects within and without the protected area are first and foremost inventoried and their nature and impacts well studied. This information could easily be got from the existing environmental assessments and environmental action plans or the environmental resource master plans if already in existence. Information about the existing maps of the areas of conservation priorities would also be of primary importance in this respect. With the help of such information the extents of the protected area and its new planning area (including the zone of interaction) could be established. The determination of the limits to human use of specific areas should then be determined based on a chosen criteria like ecological sensitivity to human uses (See Figure 28).

The greater extent, that defines the zone of interaction of the so planned conservation project or protected areas could later be modified by application of the detailed analysis to determine the ecological functioning that help delineate the Ecological Functional Units (EFU). The final location, size and boundaries of the area will be influenced by factors such as:

- habitat requirements of rare or other species and their minimum viable population sizes (critical habitats)
- external essential drivers which serve and determine the ecosystem integrity within the protected area (now priority zone)
- connectivity between units (corridors) to permit wildlife migration
- accessibility to undertake management operations or inaccessibility to deter potentially impacting activity
- existing degradation or external threats
- land tenure issues
- costs involved in acquiring a protected area status (most commonly land acquisition, compensation or transfer costs, or costs of establishing co-management infrastructures)

First to be considered are the essential ecological drivers situated outside the protected area, yet having a direct influence on the protected areas ecological dynamics. Such essential drivers, like a water source, e.g. a stream which continues within the protected area, are of first priority for its ecological stability. Although they are external, they must be secured in an unaltered state or optimised in their function. Apart from ecological drivers, the critical habitats outside the protected areas, should be included in the planning area. Such critical habitats should be considered for animal species resident to the area and with limited home ranges which nevertheless extend beyond the protected area boundaries dictated by among others, seasonal rhythms, feeding or breeding needs. This however does not apply to the large herds with long migratory home ranges like the Gnus or Zebras in the single context of one reserve. This can only be organized in conservation networking which should be planned on the bioregional level in cooperation with all stakeholders of the bioregion. Apart from the critical areas and the ecological drivers, the migratory corridors which are part of the planning area should be considered in determining the extent of the planning area.

The exercise should involve participatory procedures. The importance of the Objectives-Oriented Project Planning (ZOPP, Zielorientierte Projektplannung) is already discussed is a valuable procedure. Ideally the planning should be motivated by a common vision with all the stakeholders. It is only through such a common vision that the exercise can achieve a coordinated and integrated approach. The necessity for an participative approach is necessary as the exercise will involve many activities affecting both the ecosystem and its relationship with the human communities, which will involve both the analysis and the integration of a variety of smaller units into a larger mosaic containing community water catchments, farms, traditional grazing lands, managed forests, cultural monuments, wildlife refuges, and the protected area/s into one integrated functioning whole.

The main determinants for the delineation of the planning area for the purpose of a zonation thus are the art and intensity of different interrelationships of the conservation priority area with its surroundings. The result of this delineation procedure provides us with the very first impression of what the future protected area is to look like and where the potential extents of that area should be. This analysis of the interrelationships should form the first step towards the final delineation of the PA as a functional landscape cluster defined earlier. In the following section we give a slight overview over some problematic facts which could make this analysis, respectively a zonation planning, a complicated procedure.

The external influences on a protected area are so variable and involve so many ambient environment factors, that we are not able to list all of them here. There are hydrological cycles, nutrient flows, local wind systems, animal migrations and other abiotic parameters which integrate and extend the functions beyond the protected areas boundaries. These are parameters important for the evaluation of PPZ and therefore helpful for the indication of management boundaries. The linear borders of different zones within a protected area and transitions between different use intensities and forms of fragmented landscape units are zones of the edge effect (explained in chapter 3). But the surrounding land edge effects are not the only way that conservation core areas can negatively be affected and become inefficient for their conservation goal. The problems of interrelationships are more subtle and complex. Edge effects are only the most direct and simple forms of disturbance of an ecosystem which occurs in form of a continuous disturbance gradient.

To guarantee the functioning and sustainability of the whole protected area system core area, the buffer zones and transition, the mode of interaction between different zones and their human uses have to be carefully studied. Human operations in the transition zones could cause serious disturbances in the core area without necessarily causing a comparable damage on their direct neighbouring areas. In this connection a agent of disturbance can “jump” the adjacent areas to the more distant areas where its effects could be more dramatic. Animals and plants, for example, could serve as carriers or agents. Birds that breed only in the protected core area, but search for food on the surrounding regions, which are modified by agriculture, and could introduce new plant species, introduce diseases or parasites into the core of a protected area, where those organisms could never have reached on their own. A predator population situated in the core of a protected area can negatively be affected, or can become extinct altogether, if its hunting grounds are located outside the core area in a region, where rapid human interference is increasingly changing those hunting areas or its prey population. A neophyte (alien plant) species from the agricultural surroundings establishes itself sometimes at the core, far away from the buffer zones, because only there it finds suitable sites and conditions for growth of the seeds. Disturbance does not only occur in direct manner, and may sometimes not depend on the area conditions.

An ecological process within a protected area should therefore never be viewed in isolation from the processes and activities in their ecologically interconnected areas. In this way the quantity and quality of human activities like tourism or agriculture in view of their seasonal compatibility with the conservation priority area can be regulated. This however requires a deep knowledge of the ecological vulnerability of the different subsystems (Ecological Functional Units, EFU) in the whole planning area. The knowledge of ecological vulnerability is important to determine which form and how much of human activities are compatible to the protected area's preservation. It will be necessary therefore, where ecological sensitivities are high and activities are likely to result to ecological degradation, that those activities be either transferred elsewhere, prohibited or the area per square unit of usage concentration be extended.

This altogether demonstrates clearly the need for the evaluation of the vulnerability of the functional interconnected units of a landscape which is the object of conservation planning.

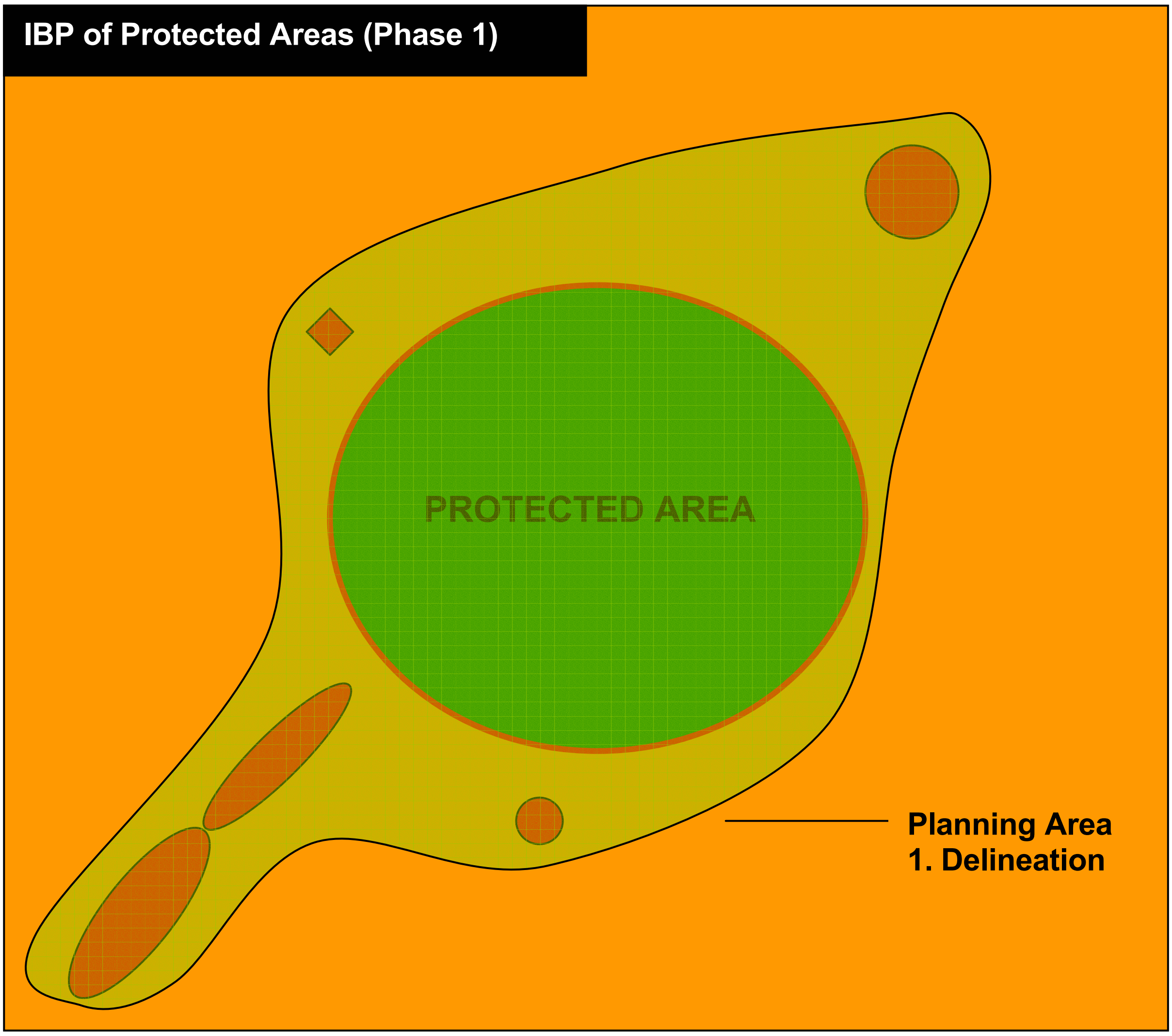


Figure 28: Phase 1 (first planning area delineation) of an Integrated Bioregional Planning of a protected area.

5.2.3 Vulnerability of EFU and the Delineation and Zonation of Protected Areas

Although applied in many protected areas of the world, a zonation concept of a protected area is of little use without a profound assessment of the ecological vulnerability of the whole system against the uses that are currently occurring or are planned for future implementation in an area. The often applied approaches for the landscape evaluation based on such parameters as diversity, maturity, rarity and others (MARTINEZ-FALERO & GONZALEZ-ALONSO 1995), may not be of much use in determining the potential disturbances of human activities in ecosystems as they lack the critical indicators of such disturbances like the ecological vulnerability.

5.2.3.1 Zonation of Protected Areas

In many protected areas in the African Savanna, the zoning system is meant to be an approach by which the protected area is classified according to ecosystem and cultural resource protection requirements, and their capability and suitability to provide opportunities for visitor experiences. It is one of the many management strategies used by national park authorities in Africa to ensure ecological integrity of the protected areas by providing policy framework for specific activities of park managers, research scientist and park visitors.

In Kenya, for example the zoning system adopted by the Kenya Wildlife Services (KWS), the organization responsible for all protected areas in the country, has four zonation categories namely:

- Utility zone
- Tourism zone
- Wilderness zone
- Restricted zone

The utility zone contain the major infrastructure responsible for management and use of the protected area. The tourism zone, as the name implies, is reserved for tourist uses. Wilderness area is meant to conserve natural ecosystems and is supposed to allow low tourism activities. The restricted zone could be specific areas or features which deserve special preservation because they contain or support unique, threatened or endangered natural or cultural features, or are among the best examples of the features that represent a natural region (KWS 1996: Nairobi National Park Management Plan 1996-2000). In Kenya, like many other African protected areas however, these zonations are only known to exist in record as the tourism which takes the upper hand over conservation knows no boundaries.

5.2.3.2 Basing Zonation on Ecological Vulnerability of their Functional Units

The basic objective for conducting zonation exercises in a protected area should be to provide a means for maintaining ecological integrity by protecting conservation areas and their resources through ensuring a minimum and controlled human-induced change. For the protected area zonation to meet this conservation objectives, the zoning process and management require a sound information base that is based on the ecosystem's vulnerability among others. The knowledge of the structure and function of the protected area's ecosystem together with the impacts of existing and potential human uses should provide the basis for this vulnerability analysis. As mentioned above, attempts to base zonation on the homogeneity of the structure or other considerations such as types of protected area uses, diversity, rarity or degree of threat of particular species etc., may not be very accurate measures of the ecosystems sensitivity to the type of use put upon it. It would thus be more useful at this point to apply another method that can assess the risk of a given EFU to be degraded through a given human activity or use of a particular resource within it. Such a method, commonly known as Ecological Risk Analysis (ERA), is explained here below. The difference between the terms "sensitivity" and "vulnerability" is clearly spelled out in the course of the ERA description here below.

Knowledge of the sensitivity levels of a given ecosystem unit helps in the determination of the vulnerability of that unit to any given use. Sensitivity analysis in an ecosystem, as the basis for a vulnerability evaluation, can be verified by assessing such elements as the shape of the terrain, the slope gradient, the soil depth, the soil texture, the amount of moisture available, the local climate conditions etc., and the fauna characteristics, such as the species and populations distribution and composition, their sources and sinks etc., and the plants (structure, cover, density etc.) which live on and interact with the area under investigation.

Sensitivity of an EFU can therefore be determined based on two aspects of the area under investigation, namely: physical factors and biotic factors. The first one deals with the status of the physical aspects such as degradation of sites, based on a group of environmental factors or parameters such as soil depth, slope gradient and moisture conditions (which can also be indicated by the percentage of vegetation cover etc.) (SILVA 2000). Many of this information can be derived from existing inventories of an area or from literature. This provides the first information to be considered before making any statement on the level of sensitivity of that particular unit. We refer to this approach as "Bottom-Up Analysis".

The second factor to consider in estimating sensitivity of EFU are the biological indicators of the area (plant or animal species which serve as bio-indicators for specific states, conditions or disturbances). The sensitivity of the biological requirements of such a bio-indicator, specific to a particular area, could form the basis for the sensitivity value of that specific unit. This forms the second part of the analysis which we refer to as "Top-Down Analysis". An integration of both the approaches provides a better understanding of the sensitivity of the ecological functional units based on both the physical conditions and the biological conditions.

The outcome of the two-step sensitivity analysis of the different units of the planned area are ranked as shown below. It is represented in a map of ecological sensitivity to be layered with other information for further information of the area. The ranking could be ranged from extreme to moderate as shown below.

- Extreme sensitive
- Very sensitive
- Sensitive
- Moderate sensitive

To determine the ecological conflicts of human use of the various units, the vulnerability values of the same units then become necessary. The term "vulnerability" (Latin: vulnus = wound) refers to the environment's risk of being damaged. Such a risk depends on both intrinsic environmental sensitivity and man's pressure. The ecological vulnerability of a given EFU is related to both the intensity of man's pressure on a particular unit and the units coefficient of ecological sensitivity.

The vulnerability of an EFU must thus be developed from the knowledge of the level of sensitivity and the level of potential disturbance of the various human uses of the place. A value for the relative potential disturbances of various human uses like tourist activities or infrastructure can be determined for this use. Once determined such values should be ranked from high to low disturbance levels as shown below.

- Potential high disturbance
- Potential medium disturbance
- Potential low disturbance

By using the data on sensitivities and the levels of potential disturbances of the individual ecological units, a map of that unit’s vulnerability can be developed (See Figure 29). For an EFU with low ecological sensitivity, a small increase in an activity like tourism (which means also a facility with “low potential disturbance”) produces a corresponding small increase in vulnerability, whereas, for an EFU with high ecological sensitivity, a small increase in tourism gives rise to a remarkable increase in vulnerability. The question on why some species are more vulnerable to anthropogenic disturbance than others has been difficult to answer. It is however expected that those species that attract the attention of human are often under great pressure. In addition, species that have evolved in the absence of predators and in the absence of disease organisms seem to fare poorly after the contact with human activities in their habitats. Vulnerability is also associated with limited geographic range, restricted habitat distribution and small local population size.

The vulnerability analysis as a synthesis of the ecological sensitivity and the disturbance potentials of particular activities produces values for the conflicts between those activities and the ecosystem sensitivity. The higher the vulnerability, the higher the likelihood of conflict. Conflicts are also layered up with other parameters to produce a map which should then guide the zonation of the unit in question or the entire protected area. The ranking of the conflicts could be ranged from high to low.

- High degree of conflict
- Medium degree of conflict
- Low degree of conflict

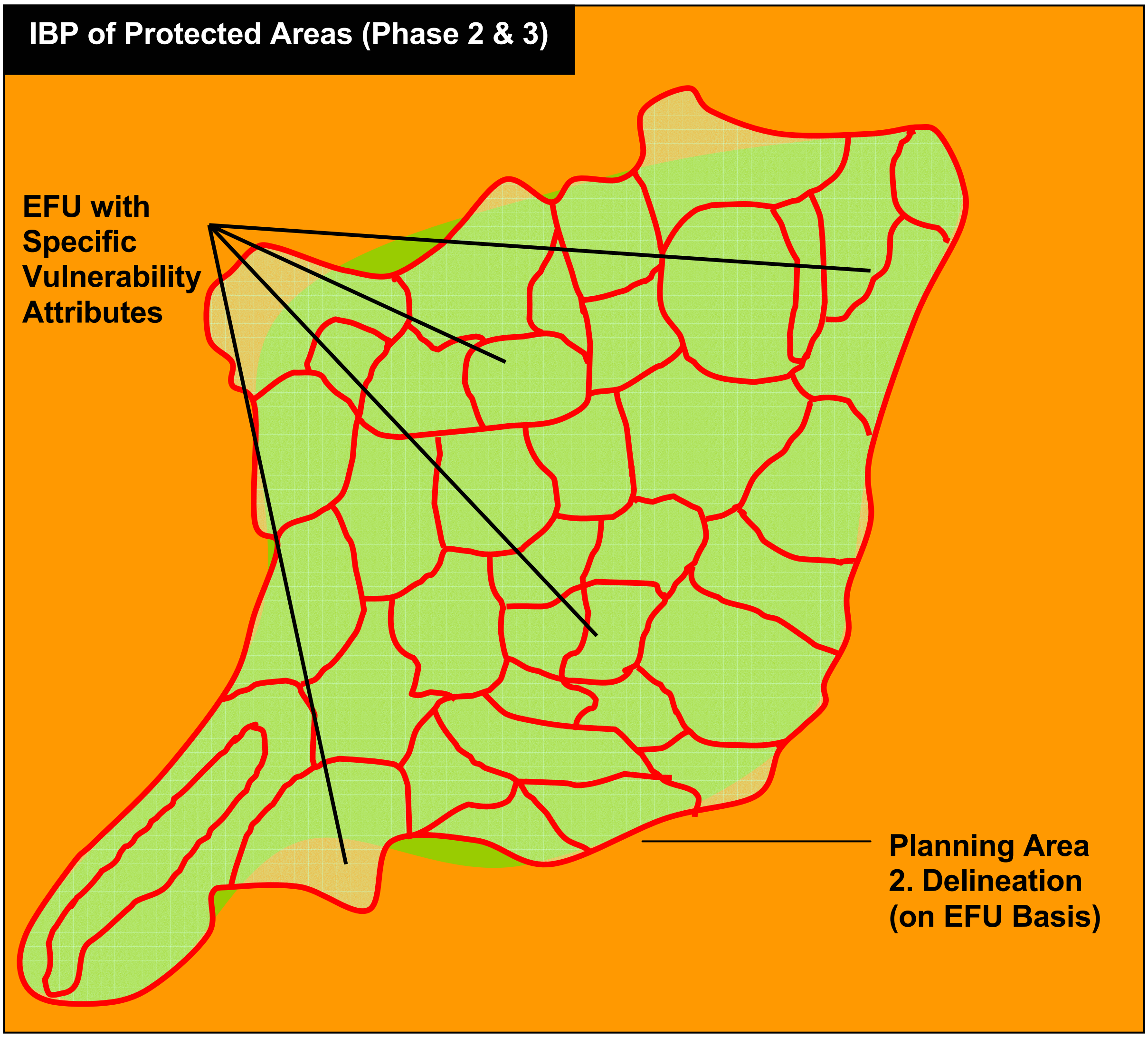


Figure 29: Phase 2 and 3 (second planning area delineation) of an Integrated Bioregional Planning of a protected area on basis of EFU vulnerability.

5.2.4 Zonation and Management of the Protected Areas based on the Man and Biosphere (MAB) Reserve Model

The procedure described in the previous sections helps to determine the ecological limits to human uses in the various sectors of the protected area and their associated regional landscapes. The next step from here is to delineate the management zones to be assigned various uses in the protected area and its associated area of interaction based on their vulnerabilities. For the implementation of the IBP concept on the ground, we have chosen the principles of the MAB to serve as a model. The functions, concepts and logistics of the UNESCO Biosphere Reserve Programme provide us with a related component to the IBP and thus a valuable “on-ground” implementation framework to achieve our goals for presenting a new ecosystem based strategy for social and ecological sustainability in the protected areas. We must however state that though the principles of MAB are a good for our concept, the existing Man and Biosphere arrangement in the African Savannas today lacks this dimension of planning which bases the zonation and management of the protected areas and their associated regions on the scientifically verified vulnerability and functionality of those areas. Many of them are thus unsustainable and result in severe conflicts and ecological degradation.

5.2.4.1 The Principles of the Man and the Biosphere Programme

Man and the Biosphere (MAB) reserve programme was created at a UNESCO meeting in Paris in 1968. In 1971 the MAB International co-ordinating council was created which led to the proposal for an international network of biosphere reserves to protect the worlds major biomes or ecological units. The international network is supposed to provide a unique set of sites and opportunities for monitoring, research and development into the ecological, social and economic aspects of conservation and sustainable development. There are now more than 350 Biosphere Reserves in 100 participating nations in the world (UNESCO 2002).

The MAB reserves are fundamentally concerned with the whole of landscape processes, whether inside or outside the core areas of protected areas and across a variety of land tenures and uses. They aim at sustaining the biodiversity and productive capacity on a regional scale that is appropriate to the ecological processes and human use and cultural identity of that landscape (IUCN/MAB/UNESCO 1979).

The biosphere reserves are structured into "core", "buffer" and "transition" zones which are theoretically portrayed as circular rings on a paper.

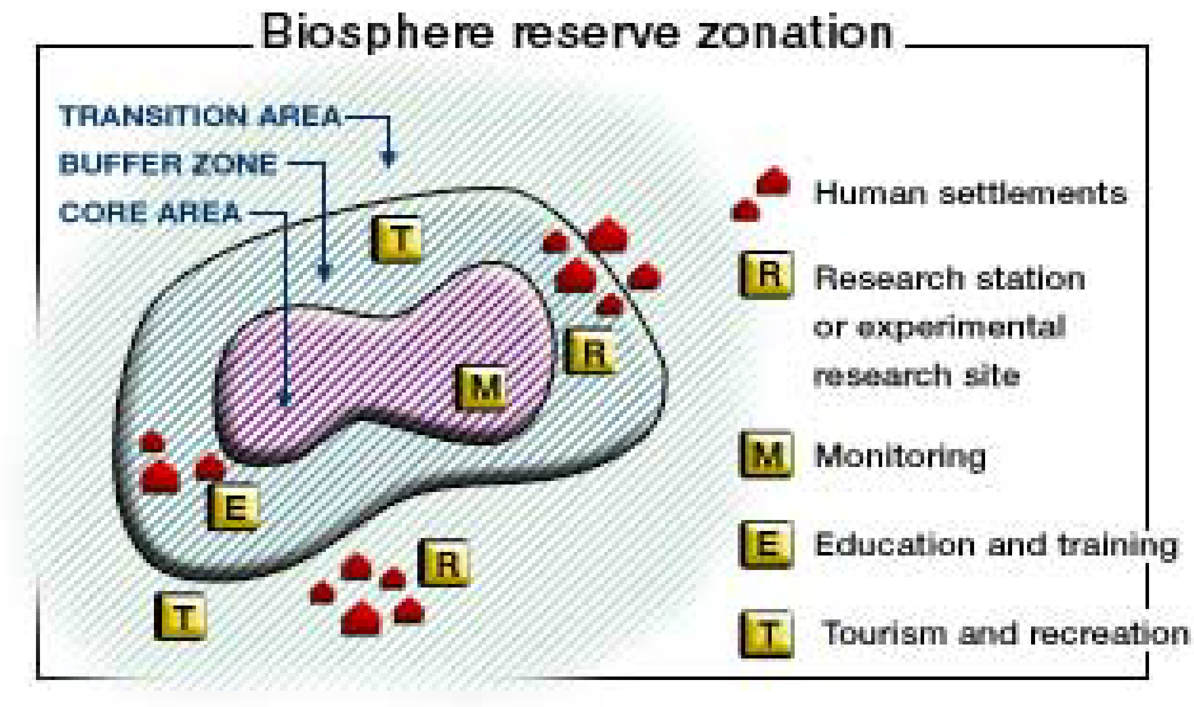


Figure 30: Man and Biosphere Management Concept. (www.unesco-mab.org)

The "core" areas are priority conservation areas (mostly referred to as IUCN category I or III). The "buffer" zones are seen as one end of a continuous “transition” region, extending further into the interface or transition area of where biodiversity threatening influences on the core and the surrounding landscape are active.
The implementation of this concept in the African Savannas protected areas has however been hampered by the great attention given to the protection of the core areas, popularly known as national parks for their tourism value. Most countries in Africa thus simply nominated to UNESCO their "special" national parks and re-named them biosphere reserves for their high conservation value and for research opportunities. Despite being referred to as biosphere reserves, most of them have

been operational at only one of the functional levels of a biosphere reserve: namely the ’core’ area or national park level, areas which until recently were public lands and from which most local people had to be excluded due to the lack of the broad organizational framework required for practical implementation of a Man and Biosphere Reserve.

5.2.4.2 Protected area Zonation based on the Ecological Functional Units and their Vulnerability Values

To be effective in serving their purpose of sustainability, biosphere reserves should be designed not by arbitrary or purely jurisdictional concentric rings. They should not be arbitrarily drawn, but areas of protection of different vulnerability degrees reflecting representative local ecosystems and with the distribution of human populations and land uses. Biosphere reserves should be fundamentally concerned with whole of landscape processes, whether inside or outside of protected areas, across a variety of land tenures and uses. They should aim at sustaining the biodiversity and productive capacity on a regional scale that is appropriate to the ecological processes and human use and cultural identity with that particular landscape. This way the biosphere reserves could serve as vehicles for managing the protected areas ecosystems and their associated social, cultural and economic developments that is adapted to the sustainable land uses and functional ecological flows across an entire landscape mosaic.

Given that the African economy and culture are more or less natural resource based, this arrangement of biosphere reserves would then stimulate a cooperative response from local peoples, whose supportive work as reserve promoter-protectors would turn out to be crucial to the biodiversity conservation component of biosphere reserves. By combining the ecological protection goals with economic activities, that support local populations, biosphere reserves, that are conceived to be part of the regional development, could also be connected with other conservation areas through planned habitat corridors. Those networks would thus be providing for more species diversity and improved resilience of local ecological processes and productive rural land uses and ultimately sustaining both natural and social resources. People and their activities should therefore be considered a part of a biosphere reserve and should be encouraged in their participation and ownership of the programme at several local levels, in addition to more broadly integrative regional landscape levels.

A fully functioning biosphere reserve should thus perform three main roles, namely:

1. in situ conservation of the diversity of natural and semi-natural resources, ecosystems and their landscapes (conservation function)

2. the establishment of demonstration areas for ecologically sustainable land and resource use (development function)

3. and the provision of logistic support for research, monitoring, education and training related to conservation and sustainability issues (logistic function)

These functions are associated through a zonation system (Figures 30 and 31), consisting of a core area or areas with minimal human disturbance, the surrounding area which acts as a buffer for the core and accommodates more human activities such as research, environmental education and training as well as tourism and recreation, and the outlying transition area that serves as a liaison with the larger region in which the biosphere reserve lies, and promotes in particular the development concern with activities such as experimental research, traditional use or rehabilitation, human settlements and agriculture, etc. Efforts are made to develop cooperative activities with research scientists, landowners, farmers and local populations. The management of this zone therefore requires innovative coordination mechanisms. It is here that the local communities, conservation agencies, scientists, civil associations, cultural groups, private enterprises and other stakeholders must agree to work together to manage and sustainably develop the area's resources for the benefit of the people who live there. Given the role that biosphere reserves should play in promoting the sustainable management of the natural resources of the region in which they lie, the transition area is of great economic and social significance for regional development.

The benefit of biosphere reserves to local indigenous communities and rural societies including country home owners are (MABP 2002):

- protection of basic land and water resources

- a more stable and diverse economic base
- additional employment
- more influence in land-use decision-making
- reduced conflict with protected area administrations and interest groups
- a continued opportunity to maintain existing traditions and lifestyles
- a more healthy environment for the local communities

Furthermore biosphere reserves provide access to training and demonstration projects on alternative land-uses and management strategies which maintain natural values, such as soil fertility and water quality. By applying this approach it is also possible to conceive that the many protected areas in Africa, originally designated the protection status, without necessarily being based on the MAB management requirements, could be restructured to assume this structure and thus integrating the multiple functions and participatory approaches that are intrinsic to the biosphere reserve concept. The problem of the already existing fixed infrastructure around some of those protected areas should be re-assessed. Integrating protected areas with their surroundings and wider bioregions based on MAB model as illustrated graphically has therefore the following advantages:

- Well protected critical ecosystems, or core wild lands, that could be managed under the appropriate IUCN protected areas management categories. The objectives of such core areas could include maintaining wild habitats that produce a range of ecosystem services, and the cultural and spiritual sites that have cultural connections with the local people.
- Buffer and transition zones that surround core areas to manage unfavourable impacts that flow between core areas and their surrounding landscapes, including stray animals like elephants, invasive plants, fire, and other agents.
- Corridors that connect critical ecosystems to encourage and facilitate migration and dispersal areas.

- Cooperative programmes that foster collaboration among farmers, management authorities, local governments authorities, NGOs and indigenous people who live in, utilise or own the majority of the landscape held in private or communal ownership.

The MAB approach therefore has relevance not only at the individual protected area level, but also at the bioregional level, the national system level and between countries, in the form of trans-boundary protected areas, which is the object of chapter 5.3.

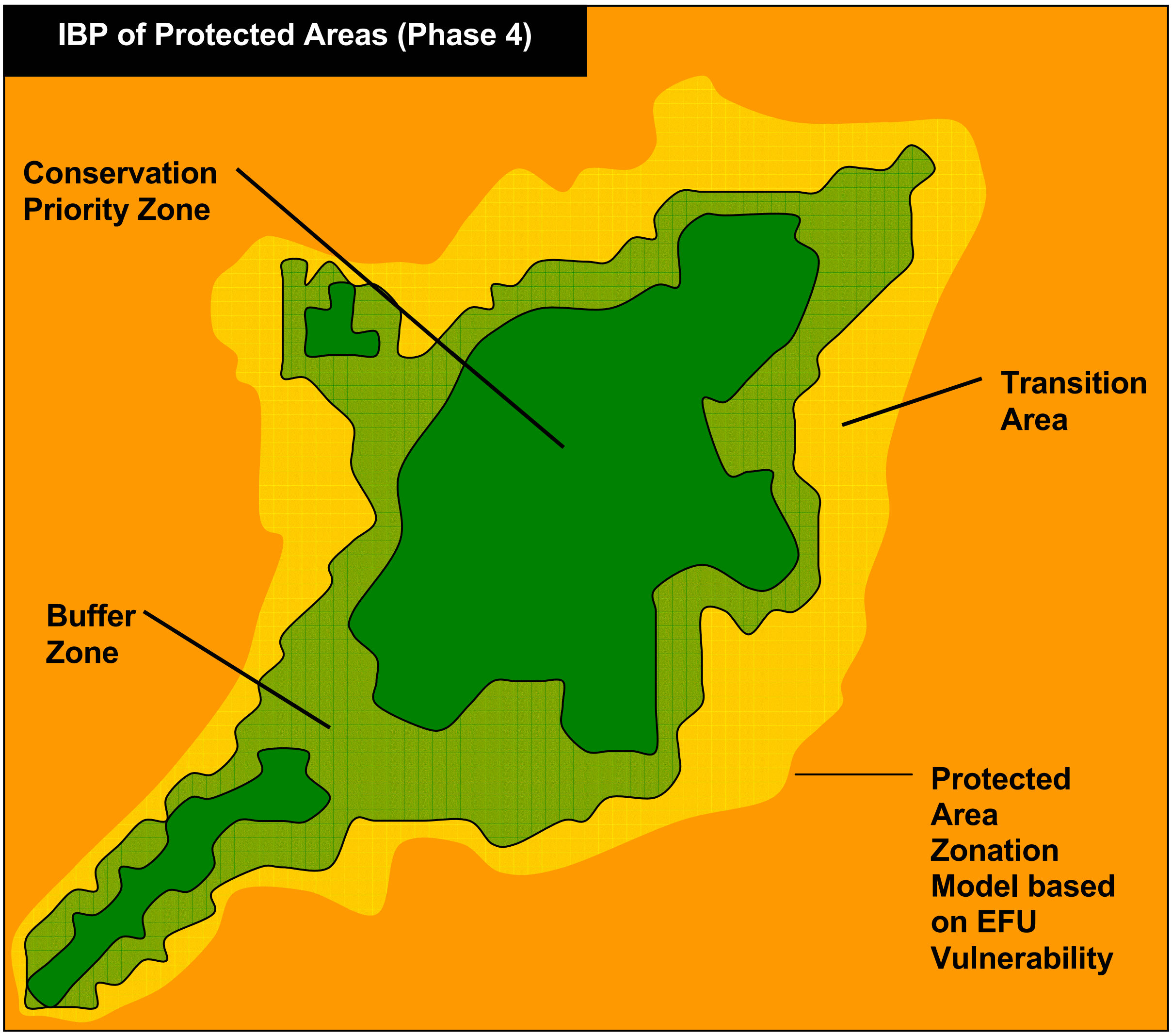


Figure 31: Phase 4 (zoning) of an Integrated Bioregional Planning of a protected area on EFU basis.

5.2.5 Monitoring as an Integral Component of Dynamic Management for Protected Areas

During the management process, the various intermediate results of implementation of the plan, should periodically be evaluated against the background of the main planning and management goal. This process is known as monitoring and is a major and essential component of innovative planning concepts for protected areas. Ecosystems are dynamic and change over time. Planning must therefore be adapted to possible natural changes arising from natural succession, unexpected events or natural / artificial disturbances. Monitoring of protected areas cannot repeat the complicated deep analysis procedures we have described in the above sections, but must adopt relevant methods which are suitable to the financial, social and scientific conditions of the area and which have time constraints. Without going into detailed description of the wide variety of methods used in monitoring procedures, we here do attempt, to present the basic essentials of a monitoring strategy.

To begin with, a planner must develop a model of the conservation area system in order to effectively design a monitoring strategy of the system. One common technique to do this is to develop a model that shows the *state* of the system, the *pressures* that affect this state and the *responses* that can be used to modify these pressures (TUNSTALL *et al.* 1994; ALDRICH *et al.* 1995). This is known as pressure-state-response model. This can then be used to design a specific monitoring strategy. In a basic conceptual model of a conservation project, we broadly define a project to be any actions undertaken by a group of people interested in achieving certain defined goals and objectives (MARGOLUIS & SALAFSKY 1998). Although for the purposes of presenting the fundamentals of this model we assume that the group is interested in specific biodiversity of an EFU in a conservation area, the same principles apply for conserving larger functional units of protected landscape like biosphere reserves or a bioregion or a country.

1. In developing the model, the first step is to outline the *target condition* that the group is trying to influence. In pressure-state-response model, the target condition is similar to the state of the system being conserved. In conservation

projects, the target condition is assumed to be the biodiversity of the site where the group is working. The biodiversity of the site can be thought of as having three main attributes:

- the species present (individual species),
- the area of habitat present and degree to which it is intact (depending of interconnected ecotopes of the entire EFU),
- the degree to which the habitat is able to maintain target systems and processes (ecosystem functioning) as one component of a greater ecological functional unit (EFU).

2. The second step is to identify the *threats* that can affect the biodiversity in the ecotope. Threats can be subdivided into several classes.

    - *Internal direct threats* are caused by the stressors acting at the project site, and
    - *external direct threats* are caused by outsiders from connected ecotopes of the same EFU. These proximate direct threats are in turn affected by
    - ultimate *indirect threats* that lie behind the direct threats.

3. The third step is to identify specific *interventions* that the project can use to counter the threats to the biodiversity and the functioning of the EFU.

Most monitoring approaches rely heavily on biological indicators for success. These approaches generally involve assessing biological parameters at a given site that serve as indicators for changes in the overall biodiversity community of the site (surrogate species). For the context of the eco-region approach by the WWF OLSON & DINERSTEIN (1997) grouped biological monitoring parameters into three categories that examine changes in

1. *habitat integrity*, as measured by the area and degree of fragmentation of different habitats at the site;

2. *habitat quality*, as measured by the density of

   - species thought to be sensitive to habitat loss,

   - species thought to be sensitive to habitat degradation, and

   - species directly exploited by human activities; and

3. *ecological processes*, as measured by monitoring the maintenance of vital processes such as hydrological cycles and pollination guilds.

Although there has been a good deal of effort put into developing biologically based methods for assessing planning outcome, few are practical and cost-efficient, especially for use in the developing world (KREMEN et al. 1994; MARGOLUIS & SALAFSKY 1998). In particular, the biologically based approaches are difficult to implement for participative conservation approaches, which are explicitly favoured in this paper. They generally require complex data sets that have to be collected and analysed by trained specialists. Finally, changes in ecosystem function require careful sampling and sophisticated analyses. All of these techniques require specially trained personnel and equipment, which tend to be expensive or not available, especially in developing countries of Africa. In addition, it is difficult for communities, for example in a biosphere reserve, to use the results for dynamic planning because they are complicated for non specialists to interpret.

By realized this problem, which affects the general chance of success in conservation planning in the developing world, SALAFSKY & MARGOLUIS (1999) developed a method for the monitoring of conservation projects, which operates independent of the biological indicators and is called the TRA (Threat Reduction Assessment) approach. A description of the TRA method is outside the scope of this paper.

5.3 Hierarchical Planning Model for Protected Area Networks in African Savanna

An ecosystem based protected area system plan is a plan that contains guidelines for sustainable protected area conservation, which includes its contribution to socio-economic developments of their bioregions. Such a model should serve as the basis for the primary resource oriented and proactive sustainable development of a bioregion.

In the former chapter we have shown that there are biological, ecological, cultural, social and economic connections between different places and different system components and that these interactions are complex and dynamic. We have also shown:

- that the existing protected area systems give too much attention to charismatic fauna, or spectacular scenery, and not enough to covering the full range of plant and animal species which are characteristic of particular ecological zones
- that it is most unlikely that any one protected area could be representative of the full range of biodiversity of a geographic region having been created in an opportunistic rush to serve as tourism centres
- that no protected area can succeed if managed in isolation was the reason for the suggestion for an integrated bioregional planning approach that is based on the knowledge of the ecosystem conditions

The question that remains however is how the conservation activities at the project level could be coordinated with the conservation and development goals of its bioregions, and likewise how to coordinate the bioregional conservation and development goals with those at the national and trans-national goals respectively. By switching the focus from individual protected areas to looking at their relationships with their own bioregions, which are themselves nested in a greater matrix containing other similar regions with their own protected areas all joined together by a network of corridors and surrounded by human developmental infrastructure, requires that a organizational structure in form of a hierarchical frame plan be put into place to coordinate the activities and increase the effectiveness of conservation activities at the local project level, regional level and trans-regional levels, which would also avoid conflicts or duplication of activities. Such a frame plan should contain guidelines for the development of regional conservation plans and local conservation plan, including also guidelines for development and running of individual conservation projects in the African Savannas. Such a plan should be based on the ecological principles already discussed to meet the goals for a sustainable conservation and to avoid the kind of ecological destruction and its associated conflicts.

In the last chapter we have demonstrated the urgency to integrate the current protected area systems into their bioregions as a measure to solve the numerous conflict problems currently straining those conservation areas and rendering the inhabitants of those regions to live in utter poverty. This however has two requirements:

1. That it should be based on the conservation guidelines of a hierarchical planning model for the identification, development and coordination of the bioregions with other levels. This coordination would be very necessary if the current mistakes of isolated planning activities are to be avoided.

2. That the bioregion should be developed in respect to the requirements of the individual projects, a lower plan which gives the guidelines for project planning a concrete guidance.

Unfortunately such a structure is lacking in many of the African Savannas regions, or if any exists at all, they are sectoral and not integrative.

It is out of this need that we have developed a three layered planning model that would greatly favour protected area conservation in the African Savannas. The main focus of this model however is the planning of the protected areas and their bioregions as defined by the Functional Ecological Clusters.

5.3.1 Trans-regional Conservation Planning

Without going into the details of national or trans-national planning procedures, which would be beyond the scope of this paper, we nevertheless see the importance of mentioning several aspects of the trans-regional conservation planning.

As we have demonstrated with the GSE, a mere environmental master plan or national environmental action plan would be insufficient as they lack the important aspects of planning requirements for trans-boundary planning and the inter-linkages between different scales of planning. In our planning model the different Ecological Functional Clusters (EFC) play a major role in the different planning levels.

Besides the specific description of the trans-regional planning activities, the following statements should be clearly formulated in the plan and should then serve as guidelines for the development of the lower scale plans.

1. A statement for the rationale for identification of bioregions

2. A statement on the characterisation of areas of biodiversity and environmental types within the bioregions

3. A statement of the goals and objectives for bioregional planning

4. A statement for the identification, planning and management of the bioregions through environmental quality standards of the bioregion

5. A statement for the selection criteria of individual protected areas or habitats and the goals of their management

6. A statement of the agreed protocol for a community participatory to planning and management at all levels

7. A statement of the legal framework governing protected area systems and their planning at all levels

8. A statement over the areas to be recognized under international and trans-boundary programmes and agreements

9. A statement on the mechanisms for periodically monitoring the entire system plan

5.3.1.1 Presenting the Bioregions

As stated above the development plan of the national/trans-national level should present different bioregions within a single country or region encompassing two or morel countries. Such bioregions could be regarded as larger ecological functional clusters whose extents could only be determined through a planning process and by basing on the regional natural elements and such ecological processes as the energy and material flows, hydrology and regional climates.

Bioregions could therefore be recognized following an approach based on an integrated study of the structural and functional elements of the landscape in their composition and pattern. This involves studying the elements which form the landscape structure (e.g. physiographic components and land cover) since these are the visible expression of the endogenous and exogenous processes, as well as of the human activity generating the landscape. The identification of such elements also involves their spatial relationships and of the patterns in which they are organized. In this way it is possible to distinguish any particular landscape cluster from surrounding ones because each landscape cluster has a clearly identifiable pattern as described in the earlier chapters. Among those elements forming the landscape, only those whose composition and pattern can be directly observed at this scale, should be considered. These may include the morphological, lithological, vegetational and land-use features.

Thus a bioregion could be defined by a water catchments or hydrological and climatic features as well as the extents of the migratory movements of the Savanna wildlife. A single bioregion could thus be composed of several larger ecosystems which are functionally interconnected. These functional interdependence does not only represent the ecological aspects but also with the human social cultural and economic interdependence. It becomes necessary therefore to include the factor man and his activities in the plan. This is why the participatory role of the local people should be part of the planning process.

5.3.1.2 The Bioregional Prototype

This is a conceptual construct of the bioregional landscape. It is a model of the expected ideal situation on the ground and is based on environmental quality standards. A prototype thus serves as an ideal situation/region that accommodates the contemporary development activities while maintaining the regions specific character and sustainability.

Such environmental quality standards are bioregional specific and are useful in:

- defining the type of human activity suited to area
- defining the function/potential function of the area

Both could be attained either by:

- re-structuring the usage of the area
- or qualifying it to undertake a specific function

Such environmental quality standards should be based on the functions of the respective areas. An example of a quality standard could be the preservation of the Maasai livestock keeping, preservation of traditional culture of the Bagisu, protection of surface and ground water or protection of the migration corridors. Together, such standards present a model for a sustainable Savanna environment: built, cultivated or in balance. The lower plans should then assign such standards to specific areas of the planned region. In this connection, the pattern, extent and structure of human settlements and the open landscape should be reflected as objects of planning at the trans-regional plan for conservation.

5.3.1.3 Trans-regional representative Ecosystems and GAP Analysis

The overriding objective of a trans-regional planning under this context should be to increase the effectiveness of biodiversity conservation. Trans-regional planning serves as the primary policy document for guiding sufficient protection of all biomes and ecosystem types in the planned region in a holistic manner and not through the outdated species oriented approaches commonly practiced in many African protected areas and regions.

The African Savannas contain a variety of ecosystem types which strictly speaking cannot be viewed in isolation from other areas functionally interconnected with them, like the forests, rivers, sees or bush lands. For conservation activities the terms of diversity and ecological representativeness in the Savannas are on many instances treated in the like manner. A conservation planning based on diversity however is oriented on the highest possible structural or species richness of an area (REBELO 1994). Our approach of ecosystem representation is guided by a conservation dogma, that all present ecosystem types should be treated for conservation planning on an equal manner with the main goal of creating a long term stability of the landscape complex.

The analysis and identification of the status of the ecosystem types in a the planning area is facilitated by the use of the GAP analysis . The procedure of GAP Analysis is beyond the scope of this paper. It suffices however to mention that GAP Analysis effectively identifies three primary data layers, namely:

1. the distribution of actual vegetation / ecosystem types delineated from satellite imagery

2. land uses and stewardship

3. the distributions of terrestrial vertebrates (or sometimes invertebrates too)

Once the gaps of the species or ecosystem protection status is verified, attention is then shifted to devising ways to close those “Gaps”. GAP Analysis is therefore of great use during the assessment of the extent of protection of the both the native ecosystems and the environmental character. It can also be applied at lower planning scales like the region, local area or project level. The areas that are not adequately represented in existing conservation plans are this way identified and the information is used by the area planners, managers, scientists and policy makers to make better-informed decisions when identifying priority areas for conservation or managing the already planned areas. GAP Analysis came out of the realization that a species-by-species approach to conservation is not effective because it does not address the continual loss and fragmentation of natural landscapes. Only by protecting regions already rich in habitat, we can adequately protect biodiversity (SCOTT & TEAR & DAVIS 1996).

5.3.2 Bioregional Conservation Planning

As already described, a bioregion is a functional landscape cluster or a geographical space, containing one whole or several nested ecosystems and is characterized by its landforms, vegetation cover, animal and human populations including human culture and history.

The bioregional environment is the main determinant for different forms of human culture, especially in African Savannas, where most of the people deal with natural resources on a day by day basis. A bioregion should therefore not only meet the ecological conditions of that geographical location, but requirements of the human populations living therein. In this regard, planning at a bioregion scale should incorporate both these the ecological and the economical and socio-cultural aspects of the region. Care must be taken to make the scale of the bioregion plan appropriate and capable of incorporating the regional aspects as required by the trans-regional plan overlying it. Bioregional planning should contain guidelines for planning, managing and using bioregional resources. The actual specific management and mode of use of particular resources will be concretised in the lower plans. Some degree of abstractness must therefore be expected in the bioregional plan, which should then disappear in the lower concrete sub-regional or project plans.

The bioregional planning presents the core of the three layered planning model. An overview of the functional perspective of a bioregion shows different aspects which could only effectively be planned and managed in an integrative approach. That is why bioregional planning takes the centre core of this model. The following subsections will attempt to describe these aspects and show how they could better be organized in bioregional planning for the concrete planning and management in the lower plans.

5.3.2.1 Identification of the Existing Protected Area System in a Bioregion

As already mentioned, most of the protected areas in Africa are established in arid or semi-arid areas with low agricultural potential. The growing population and the need for more areas for settlement is however seeing more and more people tending to settle and turn the protected areas into agricultural purposes. Furthermore tourism, which in the last decades has turned out to be a better economical alternative to agriculture in those areas, is making the protected areas operate completely against the goals of biodiversity conservation.

Many ecologically important areas in the biodiversity rich Savanna ecosystems are however left unprotected despite the many national parks that sporadically appear here and there in the landscape. These areas could also include the dispersal areas bordering the established, wetlands and forests, that have been neglected because of the emphasis placed on conserving the Savanna charismatic mega-faunas for their commercial interests. As land use pressures in the areas surrounding these Savanna regions continue to mount, it will become increasingly difficult to establish additional protected areas in these regions.

A major role of the bioregional planning should therefore be to find out the protection status, the effectiveness and connectedness of the already existing protected areas within their bioregion. In this way the planning can also verify (on the background of conservation goals for the areas) to what extent the biodiversity and the ecological features of a bioregion are actually protected, which could also serve as the starting point for the further planning of the whole region. It should also be taken into account that a protected area can only be effective, stable and sustainably conserved, if managed in the framework of its total bioregion, which requires that it be connected to other protected areas and habitats in the region through a network of corridors.

With this initial information, further steps of analysis could show the effectiveness of the existing protected area system in conserving the areas ecological resources and the biodiversity and where in the region an extra protected area can be set.

All categories of conservation demanding ecosystems or land uses (e.g. wildlife management areas) in a bioregion, must be regarded relevant and part and parcel of the bioregional conservation planning. These should also include those areas outside the protected area itself, be they cultural monuments, agricultural lands, settlement areas or tourist centres and activities. The result of this activity should be a map of the region's protected area systems showing all its integrated activities.

5.3.2.2 Bioregional GAP Analysis and Alternative Reserve Selection

As clearly demonstrated by the conflicts around the conservation areas described earlier in this paper, most of the protected areas in the African Savannas do not satisfy the goal of sustainability. The use of bioregional GAP Analysis therefore could also be useful here in unveiling the amount of ineffectiveness in the current conservation policy and thereby revealing areas where conservation gaps still exist.

Though it is a good starting point, identifying the problem alone is not the solution for those conflicts, whose roots reach as far as the economic and the cultural fabric of those people living around the protected areas. Practical and locally initiated and adaptable solutions are vitally needed. This planning model presents some ideas we think are necessary for the integration of the activities and efforts that should aim at making conservation more effective and increasing the living standards of the population affected by its policies thus reducing the level of conflicts.

WILIAMS et al. (2002) has suggested a sequential approach method to be used in connection to GAP Analysis in the planning of protected areas. This sequential approach for an area-selection exercise consists of a series of steps. A treatment of viability and threat could then be integrated at any of these steps. For our model we consider those suggestions but modify them in the following procedure.

1. Prescription
2. Pre-selection
3. Selection
4. Prioritisation

5. Post-selection

→ Prescription: values and goals

Prescription concerns deciding on the values and goals for an area selection exercise. Any area selection procedure must begin with a clear idea of which value are to be chosen for areas to form a protected area framework. This is important for goal definition. That means if the goal is to conserve biodiversity is to be pursued, further decisions have to be made as to which diversity-value surrogate species to use, which areas to choose among (i.e. their location, grain size and the extent of the survey area), and which representation target is to be achieved (minimum-area-sets for complete representation of one or more of everything / maximum-coverage-sets for representing as much as possible for a given number of areas or level of investment). If the goal is preserving ecological key processing on landscape level, pronounced processing zones of the abiotic environment in landscape and ecological functional units of different but connected ecosystem have to be delineated and indicators for the quality of landscape factors therein (integrators) have to be found. As already discussed, we favour the use of ecological functional clustering as one of the basic areas for biodiversity conservation. After the delineation of functional clusters diversity and species representativeness also plays a role and are also a necessary component of area selection, but are secondary to processing zone selection on a bioregional planning level.

→ Preselection: stability and viability

Preselection can be used to restrict which data (areas, species and records) from the raw data are to be included as candidates for selection during the main selection stage. This is done to tailor the data for pursuing the goals established at the prescription stage. One possibility is to exclude records for particular species from those areas where they have very poor viability prognoses due to irreparable environmental degradation caused by human influences. Population Viability Prognosis can be determined for those single species whose home range corresponds to a given processing zone of the ecological unit thus serving as the integrators. The Habitat Suitability Index (HIS) (CARREKER 1985) of the parts of the processing zone therefore could play a major role during the population viability prognosis process. Thus the viability prognosis of the integrator provides a general indication of the status of the processing zones.

In the past, probability models have been used to prognose the expected distribution of moderately well-known and moderately widespread species (WILLIAMS, PRANCE, HUMPHRIES & EDWARD 1996). However, probability models could also be used to seek 'viability centres' for each species. The procedure differs from that of excluding geographically marginal areas in that it regards the ecological niche more important than the geographical space. It may be possible to generate reasonably predictive niche models from distribution data and climatic data alone, without detailed autecological studies of each species, so that the process might be automated for dealing with larger numbers of species at relatively low cost (WILIAMS 2002).

→ Selection: efficiency

Selection is used to choose a set of areas for priority conservation management. Efficiency in representing biodiversity value comes from using complementarity-based algorithms (WILLIAMS, GIBBONS, MARGULES, REBELO, HUMPHRIES & PRESSEY 1996). This has often been seen as the primary purpose of this stage. Efficiency is important because the area of land available for conservation is usually limited and because there is often competition between conservation and other land uses for managing particular areas. Furthermore certain areas of the bioregion have to serve as “ecological hot spots“. In this way, those particular areas in the region that serve as the water sources during the dry seasons and as the main goal for the migrations can qualify as sensitive and threatened areas that cannot be replaced. Such an area must at this level of planning be identified and protected.

→ **Prioritisation: threat**

Prioritisation refers to the selected areas in which greatest urgency for applying conservation management is seen. If levels of threat are predictable, then this would be a good criterion for ranking selected areas with respect to this urgency.

→ **Post-selection: inter-active exploration of flexibility**

Post selection may be used to explore the consequences of modifying a selected area set to satisfy additional criteria. This is especially necessary since we know that conservation in most cases includes those areas sometimes deemed as unprofitable for other purposes and is therefore often “management of the rest”. Using this information on goal-essential species (integrators or surrogate species), it becomes possible to map the selected areas as irreplaceable or as flexible. Alternative area choices can then be applied manually so that other criteria can be explored. If necessary, the new selections can be tested for their effect on efficiency by re-running the area-selection algorithm and re-prioritising. This can be used to assess the sensitivity of particular area sets to the loss of particular areas.

5.3.2.3 Integration of the UNESCO MAB Principles

After the network of the protected areas in the bioregion has been identified, and after the gaps thereafter identified have been filled, a map of the conservation priority zones within the bioregion is developed. These areas are therefore primarily developed for biodiversity conservation and little or no settlement is to be allowed. However to avoid any conflicts, the management of the area should be based on the principles of the “Man and Biosphere” which serves as a good model for the African Savannas if based on the kind of planning described in this paper.

This approach has already been discussed. It suffices here only to present it as the basis for sustainable conservation and resource management of a so planned bioregion. The above conservation priority areas in the entire bioregion are to be managed as the "core areas" of conservation surrounded by "buffer zones" and "transition areas". As explained earlier, the zonation is usually implemented in many different ways to accommodate local geographic conditions and constraints. Such a bioregional approach to conservation is important in that unlike the majority of the current protected area designs, it ensures that the protected areas are not simply islands of biodiversity in an otherwise degraded landscape, but rather are planned and managed as part of a mosaic of land uses in their region and take into consideration the conservation values, social issues and the bio- and physiogeographic characteristics of the area.

5.3.2.4 Corridors: Major Component of Bioregional Planning

One of the main causes of conflicts experienced in protected area bioregions is a result of an isolated conservation policy. The effect of interconnecting corridors helps remove this effect and greatly helps conservation attain its goal for sustainability. Theoretical ecology sees the conservation benefits of such wildlife movement corridors not uncritically (SIMBERLOFF & COX 1987, SIMBERLOFF et al. 1992), but we see no better practical alternative to this approach to foster landscape connectivity within a human determined land use matrix of a bioregion.

Each individual core area of the protected area network should be adjoined to the next and to the larger core protected area in a bioregion through a network of corridors which could be aquatic or terrestrial corridors (these may be further differentiated according to the types of ecosystems enabling dispersal and migration of organisms). The corridors must be positioned in correlation to the actual and natural migratory rotes of the animals, but also to dynamic hydrological cycles, which represent the primary driving force for these migrations. Apart from a cyclic movement of animals the ecological corridor serves as a “channel" for one-directional dispersal of organisms, from the places of their higher concentrations, to the places of their lower concentrations. For the necessary genetic interchange between populations the consideration of meta-population models is of particular significance.

The design of each corridor is also based on the model of the core areas. The interior of the corridor should also serve as a core area zone with little human influence with the outer zone serving more or less like a buffer zone and allowing limited human activities. Both the core sites and corridors are then nested within a matrix of mixed land uses and ownership patterns. The surrounding area acts as a buffer for the core and accommodates more human activities such as research, environmental education and training as well as tourism and recreation.

BEIER & LOE (1992) in MCKENZIE (1995) provide a checklist for evaluating and designing wildlife movement corridors. The following is the criteria provided for this purpose which we find very compatible with our planning model.

1. Select several species of interest (target or "surrogate" species) from the many species present in conservation priority areas. Focus on "surrogate species" whose protection is expected to provide benefits to the greatest number of species, and on species that have the greatest need for a corridor for survival.

2. Evaluate the relevant needs of the selected species. For passing species Identify movement and dispersal patterns, including seasonal migrations. For corridor dwellers, identify habitat needs including special needs such as nesting, rearing or germination sites, as well as dispersal or migratory patterns of the animals.

    a. The level of predation risk strongly affects dispersal patterns and must be considered (HARRISON 1992).

    b. Considering the social structure, diet and foraging patterns of target species which affects greatly the effectiveness of corridors LINDENMAYER & NIX (1992).

3. For each potential corridor evaluate how the area will accommodate movement by each species of interest (i.e. evaluate availability of suitable habitat). Important questions to consider for both passage species and corridor dwellers are as follows:

a. Given the animals' movement patterns, are topography, vegetation and location of the corridor such that individuals will encounter, enter and follow or live in the corridor:

  - Is there sufficient shelter, cover, food and water for passage species animals to reach the their target?
  - Does the habitat meet the life-history needs of corridor dwellers?
  - What are the current and future impediments to use of the corridor (i.e. gaps, domestic animals and human activities)?

4. Effective protection of wildlife corridors requires putting them on a map. This step includes connecting larger habitat areas, stating the corridor widths, describing the vegetation and topography, and explaining how each corridor meets the needs of target species. It is also important to specific management guidelines for each corridor. Important management guideline questions to consider during this step include

   a. Are there any prohibitions on land uses within the corridor that will impede functioning as a corridor?

   b. What land uses may be permitted adjacent to the corridor?

   c. How should domestic animals and human activities be controlled in and adjacent to corridors?

   d. How should future road crossings be designed (i.e. minimize crossings and include underpasses and animal guide fences)?

   e. What recommended changes can be made to enhance the utility of the corridor (i.e. ecosystem restoration)?

A Geographic Information System (GIS) that covers a regional landscape is needed to put such a network of corridors in a planners map. GIS provides the only efficient means of addressing cumulative impacts and an accessible forum on which developers, conservationists, and other citizens can express their vision of the regional landscape. Having sufficient corridors in a bioregion can greatly minimize conflicts.

5.3.2.5 Development Goals for the Bioregional Protected Area Network

So far we have described the identification and delineation of a network of protected areas and their corridors within a bioregion. Within the network and zones of the bioregional protected area network, however, goals have to be set to guide the development of those parts that have not fulfilled the conservation requirements already in place. This may require that the function and structure of certain areas of the network be restored or optimised. This then requires that a development plan for the network be put into place. The concrete planning measures at the site/project level are then proposed and presented in a regional frame plan. Some of the development goals for the protected area network may include:

1. Ecosystem restoration
2. Preservation of the structure
3. Preservation of the function
4. Development of the structure
5. Development of the function

These goals are later to be made more concrete with regard to their respective ecosystems. Goals for development of the traditional economic and land uses by the local populations, investors or NGOs must be developed.

The entire bioregion is however more than the protected areas and their network of corridors. It also consists of human settlements, development infrastructure and other social cultural and economic activities like farming and livestock keeping transportation, tourism among others all together forming a mosaic patch work of different land uses all of which must also be sustainably developed if the conservation has to succeed. The above discussed planning procedure of the protected area network is the first step towards this goal. The development planning process of other sectors and economic activities like tourism, agriculture, settlements are beyond the scope of this paper. We however would like to mention here that without a coordinated and integrated approach to each developmental activity among all sectors in the region, individual sectoral projects including conservation projects would not be sustainable. As explained in chapter 4.1 it is the duty of the planner and the manager to find a way of integrating the other sectoral representatives in the region as well as the local people and other stakeholders whose activities would have a direct impact at this level of planning. Sectoral integration is thus necessary because individual sectoral activities often hinder the activities of other sectors in their efforts to appropriate goods and services from the same and allied systems (MEGANCK & SAUNIER 1983; OAS 1987). Economic interactions are an important part of these systems and landscapes. "The more we overlook the linkages, the more we shall find the sectors fail to function efficiently and productively, with all that implies for sustainable development" (MYERS 1993). Biodiversity conservation is a sectoral activity which should also operate on this principle.

5.3.3 Sub-regional Conservation Planning

The role of the sub-regional planning is to translate the general guidelines formulated in the bioregional and trans-regional plans into concrete specific objectives to be applied on the ground. Sub-regional planning should therefore try to integrate the conservation goals of the overlying plans with the local needs of a specific protected area planning. It also aims at articulating specific conservation objectives, management programmes, zoning controls and resolution of many other important issues at site level in an interdisciplinary and participatory approach, so as to minimize or eradicate all together any conflicts at this level.

Sub-regional planning is thus the organizational level of further site based plans, which implement concrete planning and management measures on the local scale. These further site based or local plans of smaller localities on the protected area ground are therefore the applying instruments of the sub-regional protected area plan. Because these site based plans have no own planning objectives, but are as instrumental plans only coordinated on the sub-regional level guidelines, we are not going to explain them here in detail.

Among other specific objectives of the sub-regional planning are the delineation of the corridors and their interconnections with the specific protected areas or other natural areas of interest. The details of the research activities and other planning procedures for delineating specific project areas or protected areas and their accompanying activities like tourism and the relationship of the protected area with its surrounding land uses are the main areas of concern of a sub-regional plan.

To a greater extent the sub-regional plan, for delineating new protected areas, should be based on the MAB-Model as already discussed in the bioregional plan formulation. The question „HOW?" this is to be done and can only be answered by the ecological and socio-economical conditions on the particular area of implementation. It is important that the plan orientates itself to the ecosystem needs as well as the land use types of that area to avoid any future conflicts. With this background therefore it is expected that different site plans could display much differences depending on the natural conditions and the human needs of their actual project localities. The exact nature of such detailed differences is beyond the scope of this paper. We can here only present the principle requirements for delineating a protected area and tourism planning, which is the main economic activity in the protected areas of the African Savannas. The application of these principles, which employs the guidelines for the German "Umweltverträglichkeitsprüfung" (UVP), a German equivalent to the British EIA method (There are however some differences between the UVP and the EIA which are beyond the scope of this paper to describe), is also fundamental for other land uses in the Savanna bioregions.

For further protected area planning on the sub-regional scale, it is first necessary to delineate the potential planning area (area of interaction), in accordance with the suggestions in chapter 5.2. Of particular interest for the planning area delineation are the following aspects:

- External essential ecological drivers

- External critical habitats

- Connections to movement corridors

Sustainable conservation and development of the protected area, its corridors and its area of interaction can be attained when based on:

1. The environmental resource use plan of the planning area. This serves to guide the type of developments of specific areas and is based on known sensitivity of the ecological functional units of the project area.

2. Information on the essential ecological interdependence between the protected area ecosystem and its dispersal and migration route areas.

The following specific activities at this level, which we believe are basic source of the information that is instrumental to developing a management plan of a given project at a the sub-regional level are:

- The description of the physiogeography and biogeography of the planning area.

- The delineation of the Ecological Functional Units (EFU) and their network of interconnections within the area's ecosystem followed by an overview determination of the ecotope type structure of the area.

- The determination of the specific ecological vulnerability to the existing and potential human uses of the ecological units.

- Identification, delineation and designation of those areas of conservation priority, in-and outside the protected area, as being critical to its ecosystem functioning.

5.3.3.1 Three-Phase-Area-Assessment

This is a project based spatial analysis method to determine the vulnerability of that particular area to a particular expected or already existing use and with it be able to determine the conflicts or potential conflicts between the ecosystem functioning and the applied or intended activity. It is a usual procedural compartment in the German UVS and applies the ideas of ecological risk assessment (ERA) for a particular threat. We made some modifications to the method already explained in chapter 5.2, by basing the method on our concept of EFU.

Before the beginning of the analysis however the ecological functioning of the project area must be determined as earlier explained and the ecological functional units of the entire area delineated for further analysis and for protection. Parallel to this is the inventorisation of the different types of land uses found in the area.

The process proceeds as described below:

1. Inventory and Functional Analysis

Mapping is carried out and an inventory of the relevant physical and biological elements of the planning area is made. Following parameters are of importance in planning for a protected area.

- Major vegetation types
- Key animal species
- Hydrological conditions
- Climatic conditions
- Geopedological conditions
- Geomorphological conditions

An integration of the above information will form the basis for the development of ecologically related units, that will further be presented as Ecological Functional Units

(EFU). The resulting map will be a map of the area's Ecological Functional Units and will serve as the basis for further evaluation and weighting in the determination of the sensitivity and conflicts.

Vegetation structure and patterning are important factors in predicting wildlife habitat quality and distribution. The vegetation will thus be treated as a key variable because of its importance as an indicator of the environmental conditions of the area. Together with physical factors, the vegetation determines the forms, density and variety of the animal life that can survive in the area.

An overlap of this map with the bioregional map will give an indication of the migratory corridors which should then be verified by a more detailed analysis.

The land uses should then be mapped, inventoried and also presented in an map of the sub-regional land uses. They could fall under the following categories:

- Traditional "sacred areas"
- Small scale agricultural uses
- Large scale farming activities
- Free hold livestock keeping
- Ranching areas
- Industrial activity areas
- Urbanised areas
- Settlements and infrastructure
- Touristic infrastructure
- Conservation areas
- Other areas of special concern

At this stage a comparison between status quo and the prototype of the area before the human interference could be made to gain a general view of the ecological degradation in the area.

2. Sensitivity Analysis

Evaluation and weighting of the land uses so inventoried and the determination of a disturbance factor, (d) helps in the ranking of those uses from low to high potential disturbance as shown:

- High potential disturbance
- Medium potential disturbance
- Low potential disturbance

It should be noted here that a map of potential disturbance actually represents the locations with activities whose potential disturbance is determined as shown above. These areas should indicate the degree of land use conflict with the ecological processes if the sensitivities of the same locations is determined. This is shown in the next step.

The sensitivity of the ecosystems to a particular land use should be based on both the disturbance potential against the biological requirements of the bio-indicators specific to the ecological Functional Units, (that means that any touristic or other human action that impinges on a particular ecological requirements of an indicator would be described as being potentially capable of affecting that particular surrogate and hence all the other species it represents in the region) and on the physical vulnerability of the particular EFU with regard to such factors as gradient, soil erosion conditions, vegetation cover etc.)

The outcome will be represented in a map showing five levels of sensitivity as follows:

- Extremely sensitive
- Very sensitive

- Sensitive
- moderately sensitive

3. Conflict Analysis

Areas of conflict can then be directly inferred from an overlay of the map of sensitivity and the map of the areas containing activities with known potential disturbances (as shown in step 2 above).

The degrees of conflicts, so determined are then ranked from high to low as follows:

- High degree of conflict
- Medium degree of conflict
- Low degree of conflict

5.3.3.2 Management Plan / Resource Use Plan

Based on the above information (the ecological interconnectedness between the PA and its surrounding, the land uses in the area, the ecosystem functioning, the land uses and other human activities-recreation, infrastructure and the potential conflicts) a management plan for the area is drawn showing the various zones for conservation activities and land uses including touristic activities.

This environmental concept is the essential basis for an ecosystem-friendly resource usage concept which respects the landscape's vulnerability, the sustainability of the area's ecosystems, the equitability of the resource uses and will give the basic ideas in finding the possible compromise between the protected areas conservation and the economic and cultural developments taking place on its buffer zones, transitional zones and the corridors. For instance from the above analysis levels we can create an Ecotourism Development Plan with clear definition of potentials and limits of tourism use within the area. To regulate the quantity of nature tourism the planning principles of concentration and de-concentration of the infrastructures and activities can now be applied. That means, appropriate locations within the park can be identified, where further developments could be carried out with minimum ecological impacts. On the other hand zones will be defined in which tourism should be forbidden or its intensity reduced in compliance with the ecological requirements.

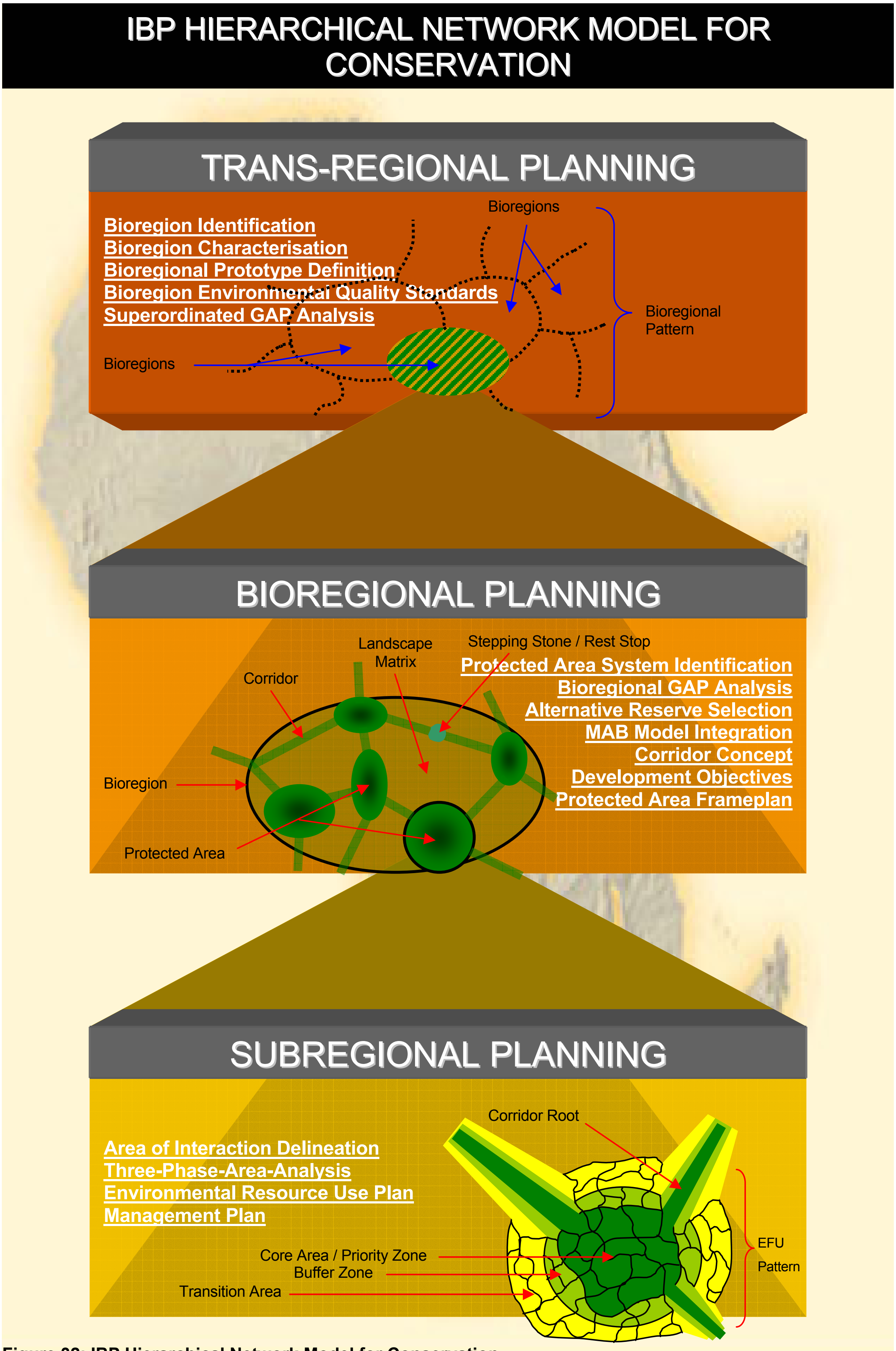


Figure 32: IBP Hierarchical Network Model for Conservation.

6 AN OVERVIEW OF THE PLANNING AND MANAGEMENT INSTRUMENTS

The methods applied in this IBP planning process should deal with both the functional hierarchical components (Ecological Functional Clusters) of the landscape in different scales and at the same time should be able to recognize the whole interconnected mega system as one whole. Ecology is a discipline of how ecosystems are arranged and how these arrangements affect the wildlife and environmental conditions that comprise them. While an ecologist looks at a population of wildlife species in a given habitat, a landscape ecologist looks at how the holistic patterns of the land, such as its topography, water, vegetation cover, and human uses, affect that wildlife population. As a discipline, landscape ecology is quite young, but already many conservation biologists have found its essential elements extremely useful in their work. Those aspects: fragmentation, crowding effect, shredding and edge effect, which are found in conservation areas highly disturbed by human exploitation need to be analysed to determine the levels of such disturbances ad to create new ways in the management of the areas.

The advancement in landscape ecology over the last two decades has been accelerated by the advances in computer and satellite technologies. Today field ecologists can determine their position within 20 yards using Global Positioning Systems (GPS), locate themselves on satellite images from NASA (called remote sensing), and compare their position, vegetation formation boundaries and human land uses on computerised maps using Geographic Information Systems (GIS). These tools allow scientists and conservationists to conduct detailed studies over time and large areas to better understand how to save wildlife in the networks of ecosystems in broader scales. Moreover GIS techniques can persuasively show how human activity impacts wildlife in ways that most people can understand and appreciate. For example, by plotting locations where a certain species occurs in a given area, ecologists can show which areas should be protected, or which human land uses are conflicting with the species autecological requirements. Through science and maps, conservation biologists, ecologists and local people have come to understand the mutual relationship between the landscape and the needs of the organisms therein.

6.1 Description of the Important Mapping and Management Instruments

Ecological mapping is largely concerned with describing organisms and ecological spatial system distributions. It is also concerned with understanding the biological, environmental and anthropogenic driving factors and processes that shape the observed distribution patterns.

Inventorying provides basic data needed for understanding the distribution pattern and dynamics of landscapes. Thorough inventories are the prerequisite to provide baseline information for studying change, which subsequent monitoring (repeated and more limited inventories) seeks to assess. Inventorying and monitoring are therefore essential in efforts to conserve and sustainable use of Savanna landscapes.

Mapping at the scale of a typical conservation area in East Africa presents both logistical and scientific challenges. Constraints of time, expertise, finance and scientific techniques limit the spatial and temporal extent of such studies, as well as the nature of activities that can be undertaken. Recent advances in geographical information system (GIS) and satellite remote sensing technologies provide, however, great potential for developing suitable methodologies. The major constraint has been the lack of reliable field data (known as 'reference' or 'ground-truth' data) with which to test and refine these capabilities (DAVIS *et al.* 1991).

6.1.1 Field Survey

In general our knowledge of ecological pattern and process in Savannas is limited to relatively small areas and short time periods and the data used in mapping exercises tend to be 'patchy'. Many attempts to deal with such data 'patchiness' in conservation planning have resorted to the use of biodiversity surrogates. This approach, however, has significant short-comings (VAN JAARSVELD *et al.* 1998), which highlight the importance of field research.

Basic ecological data are gathered through various types of on the ground field survey. These typically involve one or more of the following approaches: systematic and direct recording and measurement of features; sampling of representative habitats; opportunistic recording of entities as part of other research activities; and also observations made by amateurs naturalists and local inhabitants. The choice of sampling design has important implications for how the data may be subsequently used and is often constrained by logistical considerations such as time available for gathering field data .

6.1.2 Expert Questionnaires and Archive Investigation

For many protected areas of the world and particular for Savanna conservation areas in Africa numerous scientific elevations and studies are already existent and have a good look at the different aspects of the ecosystems. These works frequently provided a knowledge increase in science, but, however, they didn't find any utilization in integrated projects of development co-operation . Before the beginning of a field survey such sources are to evaluate carefully. Beside that consultations of experts for given topics or areas may be of favour. Local advisory boards for projects are useful to be striven. Various chances of the local cooperation and participation arise here.

6.1.3 Satellite Remote Sensing (SRS)

Satellite remote sensing generates data about features on the surface of earth. The usefulness of these data depends on the properties of the sensor. The potential environmental information content of satellite imagery is vast, and the major challenge is to make ecologically meaningful interpretations that are relevant to mapping, monitoring and managing biodiversity. In the last decade, however, research has begun to elaborate methodologies for using such data in reliable ways (see EHRLICH *et al.* 1994; ROGERS *et al.* 1996, 1997; LAMBIN 1997).

6.1.4 Satellite-Derived Data

Various data 'products' can be derived from satellite imagery. For the purposes of ecological mapping, there are two broad categories: spectral vegetation indices (SVI) and meteorological surrogates. SVI are proving particularly useful in ecological studies of land cover, vegetation phenology and classification, and are becoming central to many monitoring methodologies such as detecting drought, monitoring climate impacts on vegetation, and estimating crop yields (JUSTICE *et al.* 1986). Meteorological surrogates are proving very useful in studies of animal species distributions (HAY *et al.* 1996; ROGERS *et al.* 1996).

6.1.5 Geographical Information Systems (GIS) and Computer Models

A GIS is a database system in which data are spatially referenced to particular geographical coordinate systems. GIS are computer-based tools for the storage, integration, manipulation, analysis and display of both spatial and associated non-spatial data sets. The rapid user driven evolution of GIS has resulted in powerful tools for assisting efforts to understand spatial problems particularly those relating to managing natural resources, such as in the identification of areas for conservation (MILLER 1994, FREITAG *et al.* 1998).

In describing the landscape of Savannas, GIS can help to recognize more clearly and to present the functional multilevel order of nature with the major influences and pathways which could have significant effects on ecological functioning with regard to the social-cultural and economic influences of man on the Savanna ecosystems.

Additionally computer models can be used to simulate ecosystem response to different environmental changes. Because so many variables affect ecosystem development and disruption, it is useful to examine current environmental conditions and patterns that can be used as a baseline for the modelling process. In this connection GIS are used to quantitatively define many basic parameters such as soil, vegetation, species densities and topography. Time series of these indices can be correlated with ecological system models, e.g. of biomass production. As models are developed to forecast potential changes in climatic, hydrologic and other ecological conditions, GIS techniques will be used to assess their impacts on human settlement and economic activities. As scenarios of environmental change are developed, GIS maps and information together with simulations will make it possible to evaluate the potential consequences of environmental changes.

6.1.5.1 GAP Analysis

GAP Analysis, developed in US, is essentially a coarse-filter approach to biodiversity conservation. It is used to identify gaps in the representation of biodiversity within protected areas (i.e. areas managed solely or primarily for the purpose of biodiversity conservation). Once identified, such gaps are filled through the creation of new protected areas, changes in the designation of existing ones, or changes in management practices in existing protected areas. The goal of GAP Analysis is to ensure that all ecosystems and areas rich in species diversity are adequately represented in the areas designated for protection. Gaps in the protection of biodiversity are identified by superimposing three digital layers in a Geographical Information System (GIS), namely maps of vegetation types, species distributions and land uses. A combination of all three layers can be used to identify individual species, species-rich areas and vegetation types that are either not represented at all or are under-represented in existing protected areas. Surrogates that could be used to represent the overall biodiversity in the area of study vary from vegetation, common terrestrial vertebrate species, and endangered plant or animal species.

6.1.5.2 An Example: The SAVANNA Computer Model

To represent the modern possibilities of computer technology in terms of support for conservation strategies like we have developed them in this paper, an example of how they could be useful in implementing modern approaches of protected area planning in African Savannas is here described using a simulation model, called 'Savanna Model' (COUGHENOUR & REID & THORNTON 2000). This model was developed by the Colorado State University (USA) in a co-operation with the International Livestock Research Institute (ILRI) in Nairobi (Kenya).

The importance of this model comes from its ability to integrate the landscapes dynamics at regional scales with the changes on a site scale over periods from 5 to 100 years. The model simulates the effects of different natural changes, land-use practices and management strategies, thus serving as a useful tool to the managers and the stakeholders in conservation areas make critical decisions about land use or conservation options especially in and around protected areas. This is made possible by the fact that the Savanna model is capable of incorporating a full range of land-use options and policies facing protected areas with those processes that give rise to ecosystem changes, such as plant growth, animal population growth and nutrient recycling (COUGHENOUR & REID & THORNTON 2000).

In an application conservationists have already used the model to determine critical habitats of bison and elk outside the Yellowstone Park boundaries in the USA (COUGHENOUR & REID & THORNTON 2000). This offers new perspectives for the Integrated Bioregional Planning of protected areas in Africa, which are absolutely consistent with the ideas we have presented in this work. It can for example be a useful tool for the assessment of ecological functional units (EFU) described earlier in this paper. The Savanna model differs from most other models which unlike it are either static, capturing the state of an ecosystem at only one point in time, or non-spatial, representing the ecosystem as a homogeneous aggregate. The wide spectrum of the Savanna model capabilities makes it the most optimum tool with which the hierarchy of functions in a bioregional landscape can be analysed during the IBP planning and management process.

The model comprises several interacting sub models (Figure 33) which enables it to simulate the all the interacting landscape components at different spatial and temporal scales. Such sub-models represent plant growth expressed in terms of biomass production and herbivory, soil water budgets, nutrient cycling, animal population dynamics and human ecology. These sub-models are developed from the main ecological determinants of Savanna ecosystems also described in this paper (chapter 2).

It is important to note that even the Savanna model can only be run accurately if sufficient baseline data sets are available. Such data must be gathered and compiled by use of other data collecting tools which include field observations, remote sensing and meteorological data. The model is especially useful in combination with a detailed GIS of the area under study, which alone needs enormous effort to be established. It is note worth that the model would open a new horizon of research and management of resources in the Savanna protected areas of Africa. The Savanna tool can effectively work in situations where enough data is available and managements based on a wide planning and management framework as exemplified by the Hierarchical Planning Model for Protected Area Networks described in 5.3 above.

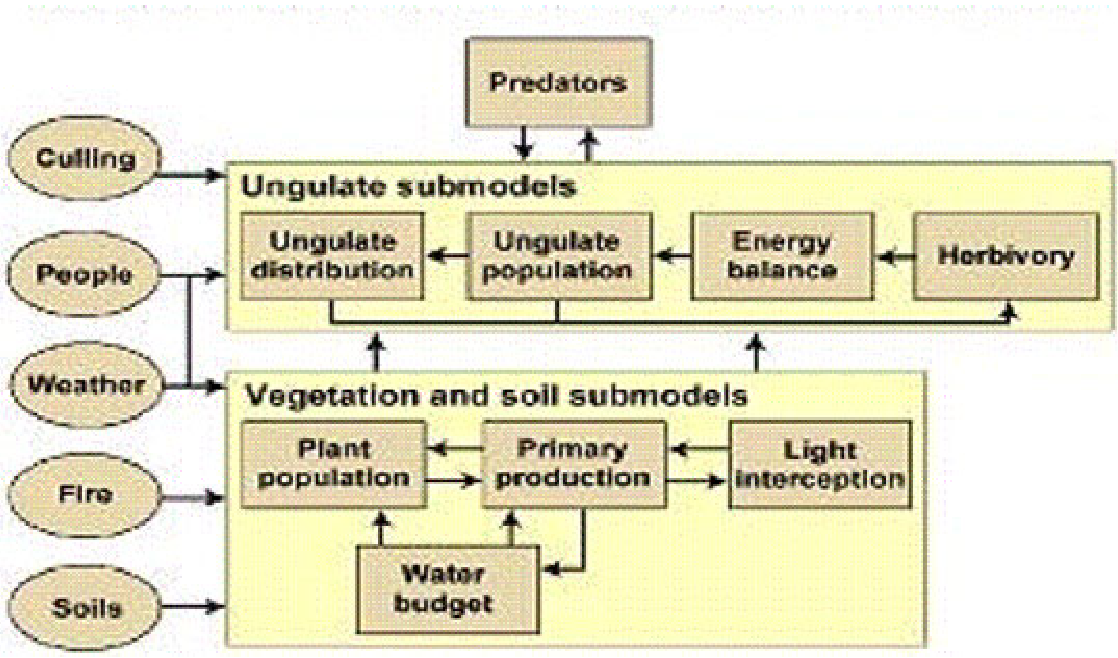


Figure 33: Components of the Savanna Landscape Model. (COUGHENOUR & REID & THORNTON 2000)

7 RESUME

We have been able to demonstrate that Africa badly requires a new approach in nature conservation and that conservation in the protected areas and their bioregions can only succeed if it earns the acceptance of the human population affected by the conservation policies and practice. The conservation approaches during the colonial and the post colonial period, until recently in a few areas, were based mainly on species conservation paying no attention to the ecological processes sustaining those species. They were also based on exclusive policies that resulted in massive destruction of the local peoples economic, cultural and social order, which consequently resulted into extreme poverty among those people who were either driven away or resettled in economically and socially unfavourable places. The frustrations and struggle for survival resulted into massive conflicts between those people and the managements over the conserved resources. The approaches of the 1990s, which emphasized economic development and participation of the local populations were developed out of this need. Laying the emphasis of social economic and participatory goals with little regard for the maintenance of the systems natural processes, as well as little incorporation of indigenous cultural values, has however compounded the problem and is producing undesirable results. This is likely to escalate if appropriate educational measures on the value of balancing species conservation with the maintenance of the ecological processes which supports them, and the economical and social development requirements of the affected people, is not adequately carried out. The danger that currently looms in the conservation areas in African Savannas today is the total conversion of the existing rich ecosystems into human settlements and their associated economical activities rather than ecological activities. This is already evident in those conservation areas surrounded by high human population.

Ecosystem based conservation approaches that have since been lacking in the continent's conservation policies are identified as the only solution if the Savanna ecosystems have to be rescued from the threats cited. Based our arguments on this conservation framework, we present an ecosystem based planning approach that considers the protected areas as conservation development projects that should be treated as part of its greater region, known as bioregion, and whose management and benefit sharing should be regionally based and not, as it is the case today, on the protected area management alone which are also directed by policies made by others far away from those areas, who also have no idea how it feels like to live next to the elephant and the lion in the protected areas. Our planning strategy, known as Integrated Bioregional Planning (IBP), uses an ecological analysis that leads to the management zonation of both the protected area and its associated regions based on an ecological functionality of the region. The respective uses of the various zones of both the core protected area, composing what most current systems regard “protected area” or national parks/reserves, and the bordering regions found to be ecologically associated with the core area, are determined by the ecological vulnerabilities of those zones and delineated based on the Man and Biosphere Model.

It is our conviction that isolated protected areas in the Savanna landscape, that are not based on the corresponding conservation plans of various scales (local, regional and trans-regional, that have also an element of trans-national scale), may still be a hindrance even to this ecologically based integrated planning approach. Duplications of conservation goals, lack of coordination and poor biodiversity assessment to identify areas of conservation value would be overcome if to begin with the national/trans-regional, bioregional and local plans, for all the areas with conservation value are developed through the necessary assessment procedures. We have proposed a model and the accompanying procedures that could guide the production of such plans.

This, we believe, has been the missing linkage in the biodiversity conservation in the African Savannas: the implementation of which is likely to improve substantially the management of those socio-political, socio-economic and institutional factors, thus enhancing sustainable conservation of biodiversity and resource use in the protected areas of the African Savannas.

From the background of its problem formulation, this study originally presents a sectoral conservation planning in the sense of planning for priority zones for conservation. Because the suggested approach of IBP requires the integration of the land use zonation based on the MAB model, our work could also represent a very first step towards an inter-sectoral conservation approach for Africa which is eminently needed. That other steps should follow cannot be overemphasized. Not only other sectors should be linked with conservation, but also standards for conservation should be integrated in other sectors, like agriculture, urban and community planning, traffic and others. This is essentially more challenging than the new conception for the protected areas which cover only a minority of the percentage of the land area. Apart from the fight against poverty, the establishment of an inter-sectoral nature conservation is the next most important activity that can ensure long lasting ecological stability of the African continent in the future.

8 ZUSAMMENFASSUNG

Savannen sind vielgestaltige und dynamische Ökosysteme. Sie nehmen einen erheblichen Teil der Erdoberfläche und einen Großteil des Afrikanischen Kontinentes ein. Sowohl für die Landnutzung, wie für den Naturschutz in Afrika hat die Savanne eine Schlüsselfunktion. Der Naturschutz konnte in den vergangenen Jahrzehnten die rapide Degradation und Fragmentierung der Ökosysteme nicht verhindern. In vielen Fällen hat er dazu ein erhebliches Konfliktpotential mit den direkten Interessen einer verarmten Bevölkerung aufgebaut.

Am Beispiel des sektoralen Naturschutzes in Ostafrika stellt die vorliegende Arbeit die genauen Konflikte dar und bewertet ihre Gründe. Daraus entwickelt die Arbeit einen Lösungsrahmen für Planung und Management der Schutzgebiete, der die Integration der Bevölkerungsinteressen mit einem ökologisch analytischen Verständnis der Schutzgebiete sucht und Schnittstellen mit einem intersektoralen Naturschutz erarbeitet. Innerhalb des Lösungsrahmens wird der Ansatz der Integrierten Bioregionalen Planung (IBP) als Beitrag ökologischer Planung im Sinne des Ecosystem Approach dargestellt. Für die Umsetzung der IBP der Schutzgebiete wird ein Konzept zur funktionalen Landschaftsanalyse (EFU Konzept) entwickelt. Das EFU Konzept ist die Basis einer konkreten planerischen Neuorientierung der Schutzgebiete in den Savannen Afrikas. Konsequent wird daraus ein Modell für eine mehrstufige Netzwerkplanung der Schutzgebiete erarbeitet, dessen zentraler Begriff die Bioregion ist.

Im Einzelnen leistet die Arbeit folgendes:

1. Die sektorale Naturschutzplanung in den Afrikanischen Savannen wird in einen weiteren Kontext (Nachhaltigkeitsorientierung) eingegliedert, der einen allgemeinen, auch politischen, Verständnishintergrund darstellt. Im Anschluss begründet die Arbeit die genaue Wahl des Themas und stellt den grundsätzlichen Aufbau dar. (Kapitel 0 und 1)

2. Die Gründzüge der Ökologie der Savannen, insbesondere in Afrika, werden beschrieben. Die Savanne wird definiert, ihre Verteilung auf dem Afrikanischen Kontinent erörtert; ihre Entstehung, sowie strukturelle und funktionale Kennzeichen werden erläutert. Dabei wird die Savanne als hoch-diverses, dynamisches und meta-stabiles ökologisches System betrachtet, dass sich in ständigem Wechsel zwischen verschiedenen Gleichgewichtszuständen befindet. Als wichtigste Determinanten für diese Gleichgewichtszustände werden genannt: Pflanzenverfügbares Wasser, Pflanzenverfügbare Nährstoffe, Feuer, Herbivorie, anthropogene Ereignisse und regionale klimatische Parameter. Des weiteren werden die Savannen Ostafrikas näher charakterisiert und die Serengeti als exemplarisches Ökosystem vorgestellt. (Kapitel 2.1)

3. Die ökologische Sensibilität und Verwundbarkeit der Savannenökosysteme wird thematisiert. Dabei spielen vor allem menschliche Einflüsse eine wesentliche Rolle für die Schilderung, da sie zusammen mit den natürlichen Störungen der Savannenlandschaften multifaktorielle Störungsregime bilden. Diese Störungsregime sind kompliziert und führen insbesondere dann zur Degradation, wenn menschliche Eingriffe weder natürliche Störungen (in Art, Frequenz und Stärke) simulieren, noch traditionelle co-evolutive Nutzungen der Landschaft darstellen, wie sie in Afrika seit Jahrtausenden bestanden. (Kapitel 2.2)

4. Die Landnutzungsformen der Savanne in Afrika werden kurz dargestellt. Im Besonderen werden ihre ökologischen Folgen thematisiert und wichtige Aspekte der ökologischen Degradation der betroffenen Ökosysteme andiskutiert. Traditionelle Wirtschaftsformen des Menschen in der Savanne werden als integraler Bestandteil der Landschaft betrachtet und von neueren, industriell betonten Nutzungen unterschieden, die die ökologische Stabilität der Savannen im ganzen ernsthaft bedrohen. (Kapitel 2.3)

5. Der Naturschutz und seine sektoral-planerische Betonung auf dem Afrikanischen Kontinent wird dargestellt. Die ultimative Funktion von Schutzgebieten zur Erhaltung der Biodiversität und Sicherstellung ökologisch funktionaler Prozesszonen wird gewürdigt. Anspruch und Wirklichkeit werden im Weiteren diskutiert. Dabei geht die Arbeit auf die verschiedenen Ansätze des Naturschutzes

in Afrika ein und bewertet ihre Effizienz vor dem Hintergrund von Landnutzungskonflikten, die der Naturschutz selbst verursacht hat. Ein Schwerpunkt liegt in der wertenden Stellungnahme, dass der Naturschutz in erheblichem Konflikt mit direkten Lebensinteressen örtlicher Bevölkerung steht. Modernere Ansätze, die auf der Partizipation der Bevölkerung beruhen, haben an diesem Zustand grundsätzlich nichts geändert. Die grundlegenden Konflikte des Naturschutzes werden in drei Gruppen untergliedert: Von traditionellen westlichen Naturschutzplanungen abgeleitete, von moderne sozial inspirierten Naturschutzansätzen abgeleitete, sowie von touristischer Nutzung abgeleitete Konflikte. Die Polarisierung der Landschaft hinsichtlich Nutzung, Planung und Management wird als stärkstes resultierendes Problem herausgestellt. (Kapitel 3)

6. Der Rahmen einer ganzheitlichen Lösungsstrategie der diskutierten Probleme wird dargestellt. Dabei leistet die Arbeit eine grundlegende Zielordnung für Planungsansätze: Oberziel ist die Nachhaltigkeit der Ökosysteme der Schutzgebiete. Damit verbunden sind die Unterziele einer Planung auf der Grundlage ökologischer Analysen der Landschaft, die Interpretation der Schutzgebiete in ihrem weiteren bioregionalen Kontext, sowie die Integration der Bevölkerung in Planung und Management des Naturschutzes. Als strategische Ziele verschiedener Formen von Planung werden identifiziert: Naturschutzpolitik und raumplanerische Integration des Naturschutzes, die Betonung kultureller Werte bei der partizipativen Planung, Werte der Umwelterziehung und Ausbildung, Forschung und Monitorring, sowie ökotouristische Strategien. (Kapitel 4.1)

7. Der Beitrag der ökologischen Planung zur vorher skizzierten Lösung wird erörtert. Dabei wird ein Anforderungsprofil an diesen Beitrag ermittelt. Die Arbeit reflektiert an dieser Stelle die Erkenntnisse verschiedener ökologischer Subdisziplinen (wie Naturschutzbiologie, Landschaftsökologie und Ökosystemforschung) vor dem Hintergrund des Problems. Aus dem international diskutierten aktuellen Ansatz des Ecosystem Approach wird ein eigener Planungsansatz entwickelt (Integrierte Bioregionale Planung – IBP). Der zentrale Begriff der Bioregion des Ecosystem Approach dient dabei als Orientierungspunkt. Die Grundzüge und Handlungsfelder von IBP werden kurz umrissen. Die Arbeit betont die strategische Abkehr von

artenorientierten Schutzkonzepten, hin zu ökosystemaren und funktional prozessbetonten Ansätzen, die den Menschen als Bestandteil des Prozessgefüges auffassen. (Kapitel 4.2)

8. Für die Umsetzung von IBP für die Schutzgebietsplanung wird einer neuer Ansatz der ökologisch funktionalen Analyse der Landschaft entworfen (EFU Konzept, Ecological Functional Units). Dabei wird im Sinne von funktionalen ökologischen Clustern und zusammenhängenden Prozessräumen argumentiert. EFU werden definiert, ihre strategische Bedeutung für die Landschaftsplanung und Bioregionalplanung hervorgehoben. Abschließend wird das Vorgehen einer funktionalen Analyse der Landschaft in den Grundzügen beschrieben. (Kapitel 5.1)

9. Aufbauend auf das Konzept der funktionalen Analyse wird die Schutzgebietsplanung neu interpretiert. In Anlehnung an eine dreistufige Raumanalyse werden die Phasen einer Schutzgebietsplanung oder Neuplanung eines bestehenden Schutzgebietes Schritt für Schritt erläutert. Dabei werden die zweite und dritte Stufe der Raumanalyse (im strukturellen Kontext einer Umweltverträglichkeitsstudie) mit dem Raumkonzept der EFU verbunden und damit eine neue Bewertungsgrundlage eingeführt. Zielpunkt dieser Planung ist ein Zonierungskonzept von Schutzgebieten, wie es die Biosphärenreservate der UNESCO darstellen. Diese Zonierungskonzept wird auf die Basis der Nutzungsempfindlichkeit ökologisch funktionaler Einheiten (EFU) erstellt. Die Bedeutung des Monitorring für dynamische Planung wird hervorgehoben und ein Grundsatzmodell für Monitorring umrissen. (Kapitel 5.2)

10. Die getroffenen Aussagen über Schutzgebietsplanung werden in einem hierarchischen Planungsmodell vereint, das zur Planung und Koordination von Schutzgebietsnetzwerken dient. Das Modell wird im Sinne strategischer Raumplanung entwickelt und umfasst drei Stufen: Transregionale Naturschutzplanung, Bioregionale Naturschutzplanung, sowie Subregionale (und lokale) Naturschutzplanung. Die Trans-Regionalebene hat dabei die Aufgabe der Erarbeitung von Prioritäten und Protokollen, der Entwicklung von Leitbildern und Umweltqualitätszielen für die Bioregionalplanung. Sie ist koordinativ betont. Die Bioregionalebene setzt die Leitbilder in der Schaffung von Netzwerken von

Schutzgebieten um, die prinzipiell nach dem Zonenmodell der Biosphärenreservate gemanagt werden sollen. Die Subregionalplanung organisiert konkrete Planungsmaßnahmen in den Räumen, wie etwa in der konkreten Schutzgebietsplanung. Dabei werden das EFU Konzept und die Dreistufige Raumanalyse wieder aufgegriffen. (Kapitel 5.3)

11. Instrumente für die Umsetzung der eingeführten Konzepte werden kurz dargestellt. Dabei liegt ein Schwerpunkt in der Anwendung Geographischer Informationssysteme (GIS) und Computersimulationen. Exemplarisch wird das Savanna-Modell, ein Computer-Simulationsprogramm, in seinen Möglichkeiten und in Bezug auf die vorliegende Arbeit andiskutiert. (Kapitel 6)

12. Die Arbeit wird wertend rekapituliert. Schließlich weisen die Autoren darauf hin, dass die sektorale Planung des Naturschutzes, in Form von Prioritätszonen, eine nur ungenügende Absicherung des Ziels der Nachhaltigkeit natürlicher Systeme sein kann. Die größere Herausforderung, insbesondere auf dem Afrikanischen Kontinent, liegt in der Entwicklung eines intersektoralen, querschnittsorientierten Naturschutz. Die Arbeit konnte in der Entwicklung innovativer Schutzgebietskonzepte allerdings bereits Schnittpunkte verifizieren, die Ausgangspunkte weiterer Konzepte sein könnten. (Kapitel 7)

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APPENDIX

The IUCN Protected Area Management Categories

(Source: WCPA 2000, modified)

Category I: Strict nature / scientific reserve and wilderness area

Protected area managed mainly for science or wilderness protection. Equivalent category in IUCN (1978*)*: Scientific Reserve/Strict Nature Reserve. This may fall under two management categories, namely:

Category I (a) – Strict Nature Reserve:
A protected area managed mainly for research and science and defined as an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Management objectives:
to preserve habitats, ecosystems and species in as undisturbed a state as possible

- to maintain genetic resources in a dynamic and evolutionary state
- to maintain established ecological processes
- to safeguard structural landscape features or rock exposures
- to secure examples of the natural environment for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded
- to minimize disturbance by careful planning and execution of research and other approved activities
- to limit public access

Guidance for selection:

- The area should be large enough to ensure the integrity of its ecosystems and to accomplish the management objectives for which it is protected.
- The area should be significantly free of direct human intervention and capable of remaining so.
- The conservation of the area’s biodiversity should be achievable through protection and not require substantial active management or habitat

Category I b - Wilderness Area:
A protected area managed mainly for wilderness protection and defined as:

A large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Management objectives:

- to ensure that future generations have the opportunity to experience understanding and enjoyment of areas that have been largely undisturbed by human action over a long period of time.
- to maintain the essential natural attributes and qualities of the environment over the long term
- to provide for public access at levels and of a type which will serve best the physical and spiritual well-being of visitors and maintain the wilderness qualities of the area for present and future generations
- to enable indigenous human communities living at low density and in balance with the available resources to maintain their lifestyle.

Guidance for selection:

- The area should possess high natural quality, be governed primarily by the forces of nature, with human disturbance substantially absent, and be likely to continue to display those attributes if managed as proposed.
- The area should contain significant ecological, geological, physiogeographic, or other features of scientific, educational, scenic or historic value.
- The area should offer outstanding opportunities for solitude, enjoyed once the area has been reached, by simple, quiet, non-polluting and non-intrusive means of travel (i.e. non-motorised).
- The area should be of sufficient size to make practical such preservation and use.

Category II – National Park:

This is a protected area managed mainly for ecosystem protection and tourism. It is defined as:

a natural area of land and/or sea, designated to protect the ecological integrity of one or more ecosystems for present and future generations, exclude exploitation or occupation inimical to the purposes of designation of the area, and provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible. Equivalent category in IUCN 1978: National Park

Management objectives:

- to protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes
- to perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity
- to manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation
- to maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation
- to take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management

Guidance for selection:

- The area should contain a representative sample of major natural regions, features or scenery, where plant and animal species, habitats and geomorphological sites are of special spiritual, scientific, educational, recreational and tourist significance.
- The area should be large enough to contain one or more entire ecosystems not materially altered by current human occupation or exploitation.

Category III: Natural Monument

These are protected areas managed mainly for conservation of specific natural features.
They are defined as areas containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Management objectives:

- to protect or preserve in perpetuity specific outstanding natural features
- because of their natural significance, unique or representational quality, and/or spiritual connotations
- to an extent consistent with the foregoing objective, to provide opportunities for research, education, interpretation and public appreciation
- to eliminate and thereafter prevent exploitation or occupation inimical to the purpose of designation
- to deliver to any resident population such benefits as are consistent with the other objectives of management

Guidance for selection:

- The area should contain one or more features of outstanding significance (appropriate natural features include spectacular waterfalls, caves, craters, fossil beds, sand dunes and marine features, along with unique or representative fauna and flora; associated cultural features might include caved wellings, cliff-top forts, archaeological sites, or natural sites which have heritage significance to indigenous people).
- The area should be large enough to protect the integrity of the feature and itsimmediately related surroundings.

Category IV: Habitat/Species Management Area:

This is a protected area managed mainly for conservation through management intervention. It is defined as:

An area of land and/or sea subject to active intervention for management

purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species. Equivalent category in IUCN (1978): Nature Conservation Reserve/Managed

Nature Reserve/Wildlife Sanctuary.

Management objectives:

- to secure and maintain the habitat conditions necessary to protect significant species, groups of species, biotic communities or physical features of the environment where these require specific human manipulation for optimum management
- to facilitate scientific research and environmental monitoring as primary activities associated with sustainable resource management
- to develop limited areas for public education and appreciation of the characteristics of the habitats concerned and of the work of wildlife management
- to eliminate and thereafter prevent exploitation or occupation inimical to the purpose of designation
- to deliver such benefits to people living within the designated area as are consistent with the other objectives of management

Guidance for selection:

- The area should play an important role in the protection of nature and the survival of species (incorporating, as appropriate, breeding areas, wetlands, coral reefs, estuaries, grasslands, forests or spawning areas, including marine feeding beds).
- The area should be one where the protection of the habitat is essential to the well-being of nationally or locally-important flora, or to resident or migratory fauna.

- Conservation of these habitats and species should depend upon active intervention by the management authority, if necessary through habitat manipulation (c.f. Category Ia).
- The size of the area should depend on the habitat requirements of the species to be protected and may range from relatively small to very extensive.

Category V : Protected Landscape/Seascape:

These are protected areas managed mainly for landscape/seascape conservation and recreation. They are defined as:
Areas of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinctive character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity and where safeguarding of the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area. Equivalent category in IUCN (1978*)*: Protected Landscape.

Objectives of management:

- to maintain the harmonious interaction of nature and culture through the protection of landscape and/or seascape and the continuation of traditional land uses, building practices and social and cultural manifestations
- to support lifestyles and economic activities which are in harmony with nature and the preservation of the social and cultural fabric of the communities concerned
- to maintain the diversity of landscape and habitat, and of associated species and ecosystems
- to eliminate where necessary, and thereafter prevent, land uses and activities which are inappropriate in scale and/or character
- to provide opportunities for public enjoyment through recreation and tourism appropriate in type and scale to the essential qualities of the areas
- to encourage scientific and educational activities which will contribute to the long term well-being of resident populations and to the development of public support for the environmental protection of such areas
- to bring benefits to, and contribute to the welfare of, the local community through the provision of natural products (such as forest and fisheries products) and services (such as clean water or income derived from sustainable forms of tourism)

Guidance for selection:

- The area should possess a landscape and/or coastal and island seascape of high scenic quality, with diverse associated habitats, flora and fauna along with manifestations of unique or traditional land-use patterns and social organizations as evidenced in human settlements and local customs, livelihoods, and beliefs.
- The area should provide opportunities for public enjoyment through recreation and tourism within its normal lifestyle and economic activities.

Category VI : Managed Resource Protected Area
This is a protected area managed mainly for the sustainable use of natural ecosystems. It is defined as: An area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Management objectives:

- to protect and maintain the biological diversity and other natural values of the area in the long term
- to promote sound management practices for sustainable production purposes
- to protect the natural resource base from being alienated for other land use purposes that would be detrimental to the area's biological diversity
- to contribute to regional and national development

Guidance for selection:

- At least two-thirds of the area should be in, and is planned to remain in, a natural condition, although it may also contain limited areas of modified ecosystems; large commercial plantations are not to be included.
- The area should be large enough to absorb sustainable resource uses without detriment to its overall long-term natural values.
- A management authority must be in place.

GEMEINSCHAFTLICHE ERKLÄRUNG

Hiermit erklären wir an Eides statt, dass wir die vorliegende Arbeit selbständig und nur unter Verwendung der angegebenen Hilfsmittel erstellt haben. Literaturzitate wurden als solche kenntlich gemacht.

Diese Arbeit ist eine gemeinschaftliche Diplomarbeit. Kein Teil der Arbeit wurde von einem der Bearbeiter allein erstellt, sondern jeder Teil unter starker inhaltlicher und ausführender Beteiligung des anderen. Es ergeben sich daneben jedoch Arbeitsschwerpunkte:

Klaus Krumme hat schwerpunktmäßig folgende Teile bearbeitet: Kapitel 2.1.1-2.1.4, 2.2, 3.3.2, 3.3.3, 5.1.3
Henry Muraa Ajathi hat schwerpunktmäßig folgende Teile bearbeitet: Kapitel 2.1.5, 2.1.6, 2.3, 3 - 3.3.1, 5.1.2, 5.2.5
Folgende Teile wurden vollständig in Gemeinschaft erstellt: Abstract, Kapitel 0, 1, 3.4, 3.5, 4, 5.1.1, 5.2 – 5.2.4, 5.3, 6, 7, 8

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