Managing the Wetlands of Kafue Flats and Bangweulu Basin

Proceedings of the WWF-Zambia Wetlands Project Workshop

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IUCN—The World Conservation Union

Founded in 1948, IUCN—The World Conservation Union—is a membership organisation comprising governments, non-governmental organisations (NGOs), research institutions and conservation agencies in over 100 countries. The Union’s mission is to provide leadership and to promote a common approach for the world conservation movement in order to safeguard the integrity and diversity of the natural world, and to ensure that human use of natural resources is appropriate, sustainable and equitable.

Several thousand scientists and experts from all continents form part of a network supporting the work of its Commissions: threatened species, protected areas, ecology, environmental strategy and planning, environmental law, and education and communication. Its thematic programmes include forest conservation, wetlands, marine ecosystems, plants, Sahel, Antarctica, population and natural resources, and Eastern Europe. The Union’s work is also supported by 12 regional and country offices located principally in developing countries.

WWF—World Wide Fund for Nature

WWF—World Wide Fund for Nature—Founded in 1961, is the largest world-wide, private nature conservation organization. Based in Switzerland, WWF has national affiliates and associate organisations on five continents. WWF works to conserve the natural environmental ecological processes essential to life on earth.

WWF aims to create awareness of threats to the natural environment, to generate and attract on a world-wide basis the strongest moral and financial support for safeguarding the living world and to convert such support into action based on scientific priorities. Since its founding in 1961, WWF has channelled over US$ 130 million into more than 5000 projects in some 130 countries which have saved animals and plants from extinction and helped to conserve natural areas all over the world. It has served as a catalyst for conservation action, and brought its influence to bear on critical conservation need by working with and influencing governments, non-governmental organisations, scientists, industry and the general public.

IUCN Wetlands Programme

The IUCN Wetlands Programme coordinates and reinforces activities of the Union concerned with the management of wetland ecosystems. The Programme focuses upon the conservation of ecological and hydrological processes, in particular by developing, testing, and promoting, means of sustainable utilisation of wetlands. It does so in collaboration with IUCN members and partners, in particular those other international institutions with a specific wetland mandate, especially the Ramsar Convention Bureau, and the International Waterfowl and Wetlands Research Bureau (IWRB).

The core of the Programme is a series of field projects which develop the methodologies for wetland management, in particular in the countries of the developing world where wetlands are used intensively by local communities which depend upon these for their well-being. Related strategic and policy initiatives draw upon the results of these projects and present their conclusions in a form useful for government decision makers and planners.

The activities of the Programme are designed on the basis of the concerns and information provided by IUCN members. To facilitate this, the Programme works through IUCN’s regional offices. The Programme also works closely with the major development assistance agencies to ensure that conservation considerations are adequately addressed in their projects.

The Wetlands Programme receives generous financial support from the World Wide Fund for Nature (WWF), the Swiss Directorate of Development Cooperation and Humanitarian Aid (DCA), the Finnish International Development Agency (FINNIDA) and the Government of the Netherlands. Project support has been received from the Norwegian Agency for Development Authority (SIDA), United States Agency for International Development (USAID), the Ford Foundation and a number of IUCN members including the Finnish Association for Nature Conservation (FANC), Institut Français pour le Développement en Coopération (ORSTOM), the Royal Society for the Protection of Birds (RSPB), the United States National Park Service (USNPS) and the World Wide Fund for Nature (WWF). It is coordinated from the IUCN Headquarters in Switzerland, with regional coordinators in Central America, Brazil and West Africa. As of late 1990 regional coordinators will be appointed in southern Africa and Asia.

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Foreword

The World Conservation Strategy (WCS) published in 1981, emphasized the urgent need for effective integration of conservation and development in order to ensure that modifications to the planet do indeed secure the survival and well-being of all people. In pursuit of this goal, the Strategy identifies three principal objectives:

(a) to maintain essential ecological processes and life-support systems;
(b) to preserve genetic diversity;
(c) to ensure the sustainable utilization of species and ecosystems.

As Zambia’s response to the World Conservation Strategy, the Conservation Strategy for Zambia lays the basis for pursuing these three objectives at national level.

Zambia’s Strategy gives high priority to wetlands which cover over 6% of the national territory and whose conservation and effective management will make a major contribution to pursuing the three objectives listed by the WCS. In 1983, at the third meeting of SADCC’s Sub-Committee on Fisheries and Wildlife, held at Victoria Falls in Zimbabwe, Zambia presented a proposal for a regional initiative on wetlands. And while this was not pursued immediately at regional level, it resulted in increased international interest in the conservation problems of Zambia’s wetlands. As a result, WWF and IUCN worked with the Government of Zambia over the course of 1985 and 1986, and in mid-1986 the first phase of what has become known as the WWF-Zambia Wetlands Project began.

Zambia’s concern for wetlands stems not only from the large extent of these resources, but from recognition that, in the absence of management and conservation, some of these have become heavily degraded, and wildlife and fish populations are threatened with over-exploitation. In addition, the construction of two dams below and above the Kafue Flats, with little consideration being given to the rural communities of the area, gave rise to increasing concern for the future of other wetlands. On the Kafue Flats, the effects of these developments were aggravated further by the National Parks and Game Management Areas whose management bore no relevance to the welfare of the local inhabitants of the floodplain. In response to these concerns the wetland project was designed to develop and implement integrated land use plans based upon sound management and sustainable utilization of wildlife and other resources. By bringing sustainable benefits to local people, such management provides wetland conservation as a credible alternative to wetland conversion as a development investment strategy.

The specific goals of the project are:

1. to maintain the productivity of two major wetlands;
2. to improve and broaden the benefits which local people derive from these wetland resources;
3. to mobilize support amongst local people for conservation of living resources.

The workshop whose proceedings are presented here, formed the final stage of the Project’s first Phase. This was designed to review the status of the natural resources of
the Kafue Flats and Bangweulu Basin, draw upon this information and other inputs to design a fully integrated wetland management project for these two areas, and develop public awareness of the projects’s approach to integrating wetlands conservation and development. Specifically the workshop examined:

1. the precise project boundaries and activities, and in particular, the geographical scope of both the Kafue and Bangweulu elements, project organizational structure, and factors necessary for facilitation;
2. the structure of wildlife harvesting schemes and quota determination (especially the harvesting of the Kafue lechwe), including harvesting techniques, and subsequent utilizations which are most feasible and permissible under Zambian law;
3. the most effective means of achieving full local involvement, and support for conservation for development initiatives, in both the Kafue and Bangweulu areas;
4. the appropriate design for, and the implications of, integrated resource utilization for wildlife, fisheries, forestry, water, livestock grazing, subsistence agriculture, and the development of tourism, in both areas;
5. the priority focus for activities in Bangweulu during 1987-1988.

A traditional view of wetlands as sources of disease and impediments to development has been behind the limited investment in efforts to improve the well-being of the communities living on the Kafue Flats and Bangweulu Basin. Continued destruction of natural resources and the resentment of Government that is widespread amongst local people, are a direct result of the areas’ longtime neglect through isolation and limited resources invested by Government and the aid community. In addition to the decline of wildlife populations, and depletion of fisheries, specific effects have included continued food shortages and unemployment, and the general poor standard of living among the inhabitants. These and many other problems were discussed by the workshop, and this concluded with a set of resolutions which advised on the project structure, land use planning, rural development and wildlife utilization, and encouraged the long-term continuation of the wetland project.

H.N. Chabwela
Project Leader
Part 1. Opening Ceremony

1.1 Introductory Remarks by WWF Regional Representative, Eastern & Central Africa
Dr H.F. Lamprey

Honourable Minister, Honourable Member of Parliament, distinguished participants in this Workshop, Ladies and Gentlemen.

It is my duty and pleasure to introduce the Minister and to ask him to open the Workshop, but before I do so, I would like to make a few introductory remarks about its aims and background.

First let me say that I am very grateful to have been invited to Zambia as the WWF Representative. I regard it as a privilege to have the opportunity to visit this country and its magnificent National Parks. The venue of this Workshop, at Musungwa Lodge in the Kafue National Park, is an appropriate one.

The subject of the Workshop, Bangweulu Basin and Kafue Flats Conservation and Development, is a co-operative project, supported jointly by the Government of Zambia, WWF and IUCN. I should explain that WWF, formerly the abbreviation for World Wildlife Fund, now stands for World Wide Fund for Nature, the organization’s new name introduced this year on WWF’s 25th Anniversary.

The International Union for Conservation of Nature and Natural Resources (IUCN) works very closely with WWF providing technical advice. The representatives at the Workshop are: Dr Patrick J. Dugan, Specialist in Wetlands Conservation from IUCN Headquarters, and Mr Stuart Stevenson, the IUCN Consultant in Zambia.

WWF and IUCN have as their main objective the conservation of the Earth’s major ecosystems - the natural habitats, including rain forests, the alpine zone, arid lands, savanna plains and woodlands, the oceans, the freshwater lakes and rivers, and wetlands.

Zambia is notable for its wetlands which are some of the most extensive in the world. The great swamps and floodplains of this country are of worldwide importance as natural ecosystems and their conservation has become a major concern of WWF and IUCN. The Government of Zambia shares this concern and has asked for the support of these organizations in a working partnership to undertake a conservation project in the Bangweulu Basin and the Kafue Flats. The nature of this project is innovative, and its aims are far-reaching, both for Zambia and for wetlands in other regions of the world.

In other years, conservation practice commonly attempted to separate nature from human influence and other forms of land use. The effects of this policy, commonly seen covering
the boundaries of National Parks, tended to create an atmosphere of confrontation between the conservationists and the local people.

In more recent years a new appreciation of the changes of this situation has arisen. It is understood that in many areas, human land use and conservation cannot be approached separately. The long-term conservation of a Park or Reserve or a particular ecosystem will depend upon the active support and participation of the people of the region concerned.

This principle is to be demonstrated in the Bangweulu Basin and Kafue Flats Project and is also a central theme of the Luangwa Integrated Resource Development Project, represented at this Workshop by its Co-Director, Dr Richard Bell.

The aims of this Workshop are to examine the objectives of the Wetland Project, to identify priorities for action, limitations imposed by funding and manpower, and to produce recommendations and guidelines on what is practically feasible for a project of this kind. We shall be told about many aspects of land use and natural resource management in the two project areas to provide a background for our discussion.

We are fortunate to have with us the Honourable Mr B.C. Kakoma, Minister of Lands and Natural Resources, who has kindly agreed to address us. It is my privilege to ask you, Sir, to open this Workshop.
1.2 Opening Address by Hon. Minister of Lands and Natural Resources, B.C. Kakoma, MP

It gives me much pleasure to be with you this morning to open the Workshop on the Conservation and Development of the Bangweulu Basin and Kafue Flats. First of all, I would like to welcome you to Kafue National Park. I have no doubt that your stay here will be a pleasant one.

It has taken four years to plan this programme. The Wetlands Project has been intensively discussed, and the SADCC Technical Consultation Meeting on Fisheries and Wildlife, and Member States support the Programme as the right approach to conservation. In fact, the conservation of wetlands has been strongly emphasized in our Conservation Strategy which the Party and Government consider as the most appropriate course of how the resources of this country should be developed.

Our current initiatives on the conservation and management of wetlands are based on a number of reasons. Firstly, we know that these areas are endowed with abundant resources. Areas such as the Bangweulu Basin and the Kafue Flats are not only important for fisheries and water resources, but they also contain diversified resources such as wildlife unquestionably capable of supporting mankind. At one time, the black lechwe population of the Bangweulu floodplain and swamp was estimated at nearly one million, but today, it is less than 40,000. The Kafue lechwe population used to number up to nearly half a million in the past; eight years ago they were as many as 100,000, but today they have been reduced to less than 50,000.

Obviously, with these figures, it became abundantly clear that despite the creation of National Parks and Game Management Areas, wildlife continued to decline. Further evidence is shown through our past efforts in the protection of areas such as the Kasanka National Park in Serenje District where numbers of wildlife have been reduced drastically. It has consequently become clear that unless we change our approach, Zambia will continue to lose this precious resource.

It is this change of approach which brings me to my second reason why we decided on the Wetlands Programme. Wetlands have traditionally been regarded as dangerous, sources of diseases, or areas of impediments and evils, and associated with human suffering. They have consequently been ignored by development investment. The people of the Kafue Flats and Bangweulu Swamps have, however, lived in these areas since time immemorial and they will continue to live there. Figures show that nearly 270,000 people live in Bangweulu Basin alone, while the Kafue Flats and the surrounding areas are also densely settled. These statistics indicate that the growing population is likely to exert pressure on the available arable land in these wetlands which are also needed for the conservation of wildlife. We know that the local communities of the wetlands have great knowledge of the wildlife and depend on it for their food. But we are living in an area in which these wild animals are diminishing. It is for this reason that it was decided
to use both local and professional knowledge in conserving our wetlands resources in the two areas.

Perhaps I should expand this point even further. Our experience in this country has shown that rural projects like this one have been enthusiastically started; have had their objectives carried out; but most of them have had mixed success each time they have been completed. In other words, they tend to lack continuity largely because the inhabitants who were the target recipients hardly understood them. I am therefore very pleased that in this workshop, as shown in the Programme, you will be discussing this issue on how effectively the local inhabitants of both areas would be involved in such development initiatives. It is gratifying indeed that the traditional bias which plagues many rural programmes, the bias which totally ignores local participation and local knowledge, will not be the case with this project.

In this instance, the local people from Kafue Flats and Bangweulu Swamps have been represented adequately through their Chiefs or Ward Officials. From the Kafue Flats I welcome the representatives of Chief Hamusonde and Chief Muwenzwa, and the representatives of Chief Choongo and Shakumbila, who are present here. Similarly, I wish to welcome delegates from Chief Bwalyamponda and Chiundaponde of the Bangweulu Swamps. It is this kind of local participation, at its grassroot level, which the Ministry is advocating strongly.

Let me make a few remarks about how my Ministry intends to make use of wildlife in these two areas. For nearly 30 years the main objective of the Government was to protect wildlife so that populations of species such as those of the lechwe would be allowed to increase in numbers to levels acceptable for management. To achieve this goal most, if not all, local traditional ways of exploiting wildlife were withdrawn from the people of these areas, and I am glad to record that indeed animal herds increased.

Nevertheless, while this objective was achieved, in the absence of a suitable and fair mechanism that would allow local inhabitants the access to wildlife resources, additional hardships to their lives were created. The result of this was the local attitude of resignation and resentment, resulting in our field operations being severely hampered. This should not have been the case had we involved them from the beginning. However, through this project it will be possible that once the populations of wildlife have built up to harvestable levels, the rural communities of the Kafue Flats and Bangweulu Basin will be able to utilize benefits derived from such activities. It is hard work requiring good planning. Nevertheless, using this approach, we would be fulfilling the obligations which the Party and Government have long advocated, that is to raise the standards of living of the rural people directly from the resources that they live with.

Before I go on to my final point, perhaps I should mention briefly the aspect of tourism for which both areas have great potential. I want the recommendations of this workshop to include tourism development. Going along with the programme of harvesting of wildlife, possibilities for expanding tourism facilities by providing adequate infrastructure at Lochnivar and Blue Lagoon should be fully explored. Similarly, tourism development in the Bangweulu Basin should be studied seriously. There is no doubt in my mind that whatever is agreed in this Workshop will be assisting potential investors in the development of tourism in wetland areas.
My final point, Comrade Chairman, is on the Project itself. When we decided to begin the initial activities on the Kafue Flats and the Bangweulu Basin, it was not because other wetland areas were not important. Take the Liuwa Plain, for example, there is no doubt that this area is among the world’s most attractive wetlands, and so are the Mweru Marsh, the Lukanga Swamps and the Busanga Plain. We do realize that the wetland project is in its initial stages, and although the deliberations of the workshop will be confined to these two areas, the results of the project will have wide application to the other wetlands.

Comrade Chairman, I would like to take this opportunity to thank the World Wide Fund for Nature, for supporting our Programme by providing initial funding of this programme. I wish also to thank IUCN (International Union for Conservation of Nature and Natural Resources) for supporting us throughout and providing technical assistance.

Comrade Chairman, Distinguished Delegates, whatever the deliberations, it is my sincere hope that the implementation of your findings will not be delayed by lack of funds. I believe that those among us who are concerned with the welfare and depletion of natural resources, will strongly support this programme because I believe also that the success of this project should be seen as a success for all mankind.

With these few words I declare this Workshop officially open.

Thank you.
2.1 International initiatives to conserve the world’s wetlands

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Introduction

Since historical times, much of human society has considered wetlands as wastelands, areas which could be converted to more productive use. As a result, wetlands are today among the most threatened ecosystems on our planet. Indeed some authors estimate that as much as 50% of the wetlands that once existed may now have been destroyed.

Ironically, wetlands are amongst the most valuable of ecosystems. Not only are many areas of exceptionally high productivity, but their role in controlling floodwaters and regulating water quality is worth hundreds of millions of dollars each year. For this reason some governments have in recent years taken dramatic steps to reduce the rate of wetland loss, rehabilitate damaged wetlands, and even create new ones. For example in the USA, where the conservation community has emphasized the public value of wetlands on private land, Government has withheld Federal aid to farmers who drain wetlands. Similarly State and Federal authorities in the USA are now spending millions of dollars each year to create new wetlands as compensation for those which have been lost to development.

However despite these encouraging examples, they are the exception rather than the rule. In general most governments still see wetlands as areas which can be converted to better use, and billions of dollars are spent each year on wetland drainage and conversion. Accordingly there is today very serious and growing concern about the state of the world’s wetland resources; rather than making their considerable contribution to socio-economic development, their loss is reducing society’s capacity to improve the well-being of the rural poor.
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The IUCN wetlands programme

In response to this rising concern for the world’s wetlands, the International Union for Conservation of Nature and Natural Resources (IUCN), with the support of the World Wide Fund for Nature (WWF), began in 1984 to develop an International Wetlands Conservation Programme. This was launched in September 1985, and is now being implemented in over 20 countries on five continents. This Programme is focusing upon four major areas of activity:

1. **Strategic.** The future of the world’s wetlands lies with the Governments and Development Assistance Agencies that today spend large sums of money converting wetlands. Accordingly a major focus of the Programme is to provide this audience with a much clearer demonstration of the value of wetlands, and of the need for their conservation. A series of projects to address this problem are now underway.

2. **Public Awareness.** Throughout the world, the general public, those most affected by wetland loss, are normally poorly aware of the need for, and means to achieve, wetland conservation. The second major focus of the Programme is therefore to develop much greater awareness of these issues. Projects are now underway throughout the developed world, and in selected countries in Africa, Asia and Latin America. Here special attention has been focused upon developing education activities as part of field projects.

3. **Training.** Given the complex nature of wetland management, in particular the need to integrate conservation considerations within the land use planning process, the third major focus of the Programme has been to increase the availability of trained manpower. Accordingly in addition to including training as a major focus of most field projects, the Programme includes a series of training courses, many supported by WWF, which are designed to give more intensive training in wetland issues to wildland managers and development planners.

4. **Field Projects.** Recognizing that the financial resources available to the conservation community are but a fraction of those available to Governments and the Development Assistance Agencies, the field projects of the Programme have been designed not only to conserve wetlands, but in doing so to demonstrate why other organizations should take greater account of wetlands conservation. In pursuing this objective there are now field projects underway in Honduras, Guatemala, Costa Rica, Brazil, Indonesia, Mauritania, Mali, Senegal, as well as in Zambia.

The Zambia wetlands project

The project on Kafue Flats and in the Bangweulu Basin is one of the most important wetland projects now underway world-wide. It is therefore not only of considerable significance for Zambia, but also for the international community. In particular, as we will hear and discuss over the next few days, the focus of the project is upon the
International initiatives to conserve wetlands

conservation and management of wetland resources, not only for, but crucially together with, the local people who depend upon these resources. The project is therefore taking a very necessary, but innovative direction.

Unfortunately, most previous attempts at wetland conservation have focused almost solely upon the importance of wetlands for wildlife, especially migratory birds. However while there is no doubt that this is extremely important, it is an argument which has little impact upon governments struggling with major social and economic problems. Similarly National Parks to protect wetlands have all too often been established without the co-operation of the rural communities, and led to the exclusion of those who depend upon these systems for their livelihood. Accordingly IUCN is today emphasizing that wetlands deserve attention just as much because of their importance for people as their importance for wildlife, and that wetland conservation can make a major contribution to socio-economic development. By adopting this approach, we believe that the Zambia Wetlands Project not only provides an important demonstration for the global community, but because of the focus upon local people, also has an outstanding possibility of success.
The Zambia wildlife project

The project on wildlife in Zambia. With help from the U.S. Forest Service in the U.S., the Zambia Wildlife Project was established in 1963. It was to protect the natural resources of Zambia and to preserve the wildlife that was threatened by habitat loss and over-hunting. The project is funded by the U.S. government and the Zambian government.

The project focuses on protecting the wildlife and their habitats. It has established wildlife reserves and sanctuaries to protect the animals. The project also conducts research and conducts conservation education programs to raise awareness about the importance of wildlife conservation.

The project has been successful in protecting the wildlife and their habitats. It has also helped to increase the awareness of the importance of wildlife conservation. It is a model for other wildlife conservation projects around the world.
2.2 The ecology and resource use of the Bangweulu Basin and the Kafue Flats

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Introduction

The Bangweulu Basin

The Bangweulu Basin is roughly circular with an area of approximately 31,000 km² (Fig. 1). Of this, 20,000 km² is covered by the core and the first terrace of the Basin. It is famous for its fisheries and wildlife. It contains three National Parks and six Game Management Areas. The wetland system (11,900 km²) is the largest and most diversified in Zambia.

The rich biological resources of the Bangweulu Basin nevertheless contrast with the extreme poverty of its inhabitants. As the area is remote from the main centres of development, transport and communication are difficult, and because of the view that swamps are sources of diseases and major impediments to development, the Bangweulu Basin has been ignored and isolated from development investment. Inevitably, the inhabitants, particularly those of the East and South-East areas, have remained poor, deprived of essential social services such as health and education, and have thus subsisted on fish, cassava and wildlife.

Although considerable developments have taken place on the plateau through the construction of the railway line, Great North Road and the oil pipe-line, much of the Basin has remained severely neglected. There are no substantial development activities (whether government - agriculture, forestry, fisheries etc., or otherwise) directed towards much of the Basin. The area has no infrastructure, and current District Development Plans bear limited relevance to the development of the Bangweulu Basin.

The lack of developments and the absence of agriculture to support the growing population in the area has obviously affected the ways in which resources (fish and wildlife) are used. The Bangweulu inhabitants are largely poor and largely illiterate. They have no job opportunities to give them wages, medical facilities are inadequate, nutrition is poor, and health levels are low. The main activities are fishing and hunting; the people therefore depend on fish and wildlife. As a result, fish and wildlife populations
are being depleted. As one remarked "when people starve, they can do anything, and they can be destructive". And indeed, they are destructive.

Poaching is therefore still a serious problem in the Bangweulu Basin. The black lechwe (Kobus leche smithemani), which was nearly exterminated until the Wildlife Department established camps under the black lechwe and sitatunga projects (1969 - 1975), are again being threatened. While local poachers use mostly spears, dogs and snares, poachers from Samfya and Mansa have resorted to the use of automatic and semi-automatic guns. Much poaching is done in the Luapula area of the lechwe range. The lechwe populations which were recorded on the increase from 22,000 in the early and mid-70s are again feared to be on the decline, although the numbers had reached nearly 40,000 in 1983.

The three National Parks and six GMAs have all been under attack by poachers. The ill-financed, ill-equipped and understaffed Wildlife Department has failed to match the poachers pressure. The commercial poachers have used local inhabitants effectively to hunt for them in exchange for essential commodities. Zambia has undoubtedly lost and will continue to lose considerable wildlife in the area, unless drastic steps are taken to arrest the situation.

Among the problems of administration of the area is the lack of knowledge. Much of the previous research or survey work has been brief and results rarely interpreted for implementation. The black lechwe and sitatunga projects were the only comprehensive studies in the area, but again these were confined to the area of the black lechwe range. The three National Parks and four GMAs are virtually unstudied.

At present hunting in the region is done by Safari Companies, and there are no legal or appropriate arrangements for the local inhabitants to hunt. They see the Safari Companies as alien, and when such Safaris hunt, they leave nothing behind that can be beneficial to the local people. This can explain the attitude of the inhabitants which is based on the feelings of long-term neglect and abandonment by the authorities in Government. Such frustration has resulted in widespread vandalism and resentment. The people are usually full of fear, suspicion, distrust, and wonder why they cannot be left alone.

**The Kafue Flats**

The Kafue Flats cover an area of approximately 6,500 km² (Fig. 2). The area has two National Parks (Blue Lagoon and Lochinvar) and a Game Management Area. While wildlife is particularly significant, Kafue Flats are also important for fisheries, livestock grazing, and water resources. The peripheral area, particularly the southern part, is densely inhabited. As a result, the Kafue Flats are perhaps the most disturbed wetlands in Zambia.

Unfortunately, developments affecting the Kafue Flats are not directly compatible with the social needs of the people who live there. Development along the line of the railway, and particularly the two hydroelectric dams recently constructed at Kafue Gorge (1972) and Itezhi-tezhi gap (1977), have instead inflicted considerable social costs on the inhabitants. Parts of the grazing grounds have been lost to weeds, and cattle herders now have to travel long distances to the main river channel for water. Most inhabitants inside the flats have been displaced, often over large areas, and have failed to cope with the
Figure 1 The Bangweulu Basin Wetlands Project Area
artificially regulated water regime. They have not seen the benefits of the hydroelectric scheme; instead, the electric power being generated is headed to the large cities in the North.

Much of the area surrounding the Kafue Flats is ponderously and poorly cultivated. Tree cover has been removed over wide areas, thereby rendering the soils to direct rain wash. Most streams have become ephemeral, and recently constructed dams have silted rapidly. Drought (which is particularly severe in Southern Province) has compounded this problem, and the limited supply of water for both livestock and domestic consumptions is now severe.

The poverty in Kafue Flats is linked not only to its remoteness, but to its serious environmental problems. Much of the surrounding area has been virtually exhausted through poor agriculture, soil erosion, excessive application of chemicals, and over-grazing. As a result, land has become a limiting factor. People want land to cultivate, land to graze their animals, and land to settle. The population is rapidly growing (at 3% in Southern Province), and the question of land, which was tackled inconclusively by a specially appointed Land Commission in 1983, will remain a major conflict in the area unless it is resolved adequately.

Wildlife and fisheries are the principle resources in the Kafue Flats, but these are now being threatened by poaching and over-fishing. The effect of the dams is believed to be significant, and poaching is severe. The Kafue lechwe (Kobus leche kafuensis) is most vulnerable. Lechwe were drastically reduced to near extinction until the notorious traditional hunting method called “Chila” was legally abolished in the late 1950s. Thereafter, the lechwe population built up to nearly 100,000 by 1976. Soon after the completion of the upper dam, poaching increased substantially. Today poachers use a variety of methods and are well organized and efficient, and with limited human and financial resources, it has not been possible for the Wildlife Department to contain the situation. The lechwe is now threatened with extinction, and officials fear that numbers are currently below 50,000 and still declining.

The amount of previous research in the Kafue Flats is substantial and impressive, but it does not answer many pertinent issues. Of the recent research, much of it has been brief, uncoordinated, and been meaningful only to the researcher. This is not sufficient. The area should be accorded the comprehensive research it deserves - research which should answer direct questions and problems of the environment, social problems, wildlife, fisheries etc., resulting from poor agriculture, soil erosion, over-grazing, expansion of weeds, and the impact of the hydroelectric schemes.

In general the local attitude towards resources (particularly wildlife and fisheries) is one of resignation; that the resources belong to outsiders. This frustration is understandable, because fishermen are predominantly immigrants and hunting is done by Safari or urban hunters. The inhabitants have been neglected, discriminated against, and there are no provisions to allow them to participate (directly or indirectly) in resource administration, or at least to share the benefits of such exploitation; yet these are the indigenous people of the area.

For this reason, I have throughout this paper confined all discussions to the issues of concern to the local communities and which have often been overlooked. Yet these are
Figure 2 The Kafue Flats Wetlands Project Area
the very issues which have led to pressure upon the natural resources of the area and will continue to do so as long as rural communities remain neglected.

Ecology

**Bangweulu Basin**

Bangweulu Basin is located in the North-East of Zambia (10°15' - 12°30'S; 29°00' - 31°15'E), and covers an area of approximately 31,000 km². The general elevation is 1,158 m at the core. The total catchment of the area is 190,000 km², with a mean annual rainfall of between 1,118 mm - 1,312 mm. The Basin has numerous lakes, swamps, floodplains and flats, and is dissected by numerous rivers originating from the plateau. Seventeen principal rivers flow into the Basin but it is drained only by the Luapula River.

The formation of the Basin has been reviewed by Grimsdell and Bell (1975). It is believed to have started forming through a series of orogenies some 22,200 million years ago during the period of the formation of the Congo and Lake Victoria Basins. However, the final shape of the Basin was a result of the subsequent orogenies and rifts of the Luapula/Lake Mweru, Lake Tanganyika and Lake Rukwa, and further uplifts of the Luangwa, Mbala, Luapula and the Congo watershed (500 million years ago). The differences in local depth of the basin have been attributed to the continued tilting towards the lake and deposition (Grimsdell and Bell, 1975).

Soils have generally been described by Trapnell (1959) and Grimsdell and Bell (1975). Unlike the plateau soils which are generally deeply weathered and leached, the soils in the basin are a complex mosaic of predominantly alluvial deposits.

Although seven vegetation types have been described by Grimsdell and Bell (1975), the main vegetation zones are the Miombo and Dambo drainage vegetation types which dominate the plateau and the first terrace, termitaria woodland and termitaria grassland, floodplain (flats), grasslands and the permanent swamp. Nevertheless, Verboom has further identified 15 sub-divisions.

Except for the North-West of the Basin and the islands, the Basin supports a variety of wildlife species. While the black lechwe, tsessebe (*Damaliscus lunatus*) and sitatunga (*Tragelaphus spekii*) dominate the wetland, species such as the elephant (*Loxodonta africana*), buffalo (*Syncerus caffer*), waterbuck (*Kobus defassa*), sable (*Hippotragus niger*), and roan (*Hippotragus equinus*) commonly occur in the woodland areas, particularly those of the National Parks. Bird life is abundant (Mwenya, 1973). A further list of wetland wildlife is given by Howard and Chimbwela (1986).

The Bangweulu Basin is densely inhabited, mostly along the lake shores in the North-West and on the islands. There are however, very large settlements at the edges of the wetland in the Mpika and Serenje Districts. The entire population of the Basin (1969) is estimated at 143,694 (Grimsdell and Bell, 1975), but this figure is believed to have increased substantially since the 1969 census.
Kafue Flats

The Kafue Flats are located in southern Zambia (15°20' - 15°55'S; 26° - 28°E). Although the Flats cover an area of 6,500 km² of floodplain grassland from Itetzhi-tezhi dam to the Kafue gorge, the entire Kafue Basin covers an area of 154,000 km² (Mulongo, 1979).

Williams (1977) and Perera (1980) have briefly described the formation of the Kafue Flats. Evidence of past orogenies is given by the presence of the ridges (swells) which separate the Kafue Flats from the Busanga and Lukanga Swamps. These geologic activities twisted the river from its confluence at upper Zambezi to where it is today. The Kafue Flats are believed to have once been a buried lake. The area is generally intersected by the meandering Kafue River, and its variable microrelief presents a complex pattern of lagoons, ox-bow lakes, abandoned river channels, marshes and levees. In normal years, much of the Flats is flooded.

The minimum elevation is 1,065 m. The normal fall between Itetzhi-tezhi dam and the Kafue gorge is only 15 m in 400 km (Rees, 1978). The mean annual temperature is 20.6°C with an annual rainfall of 838 mm.

A detailed description of the soil is provided by Anon. (1968). In general, the soils are not affected by the parent Karroo or Katanga rocks. They are predominantly alluvial clays, mainly Montmorillonite (Anon. 1968; Perera, 1980).

Previous studies by Anon. (1968) and Chabwela and Siwela (1986) provide detailed accounts of the vegetation of the Kafue Flats. Nevertheless, the main vegetation types have been identified as woodland, termittaria, grasslands, permanent swamps and the levees. Further subdivisions of the vegetation types are available (Anon. 1968 and Chabwela and Siwela, 1986).

The Kafue Flats are mostly dominated by Kafue lechwe and zebras (Equus burchelli). Species which also occur, but in limited numbers, are wildebeest (Connochaetes taurinus), buffalo, roan, kudu (Tragelaphus strepsiceros) and hippo (Hippopotamus amphibius). Small mammals also have a wide occurrence (Sheppe, 1972), and bird life is common (Douthwaite, 1982). A further list of the fauna of the wetlands is given by Howard and Chabwela (1986).

Although much of the periphery of the Kafue Flats is densely inhabited, a limited population occurs in the wetland on levees along the Kafue River.

Exploiting the resources, mainly wildlife

Wildlife and fisheries are the principle resources of both wetlands, but water and range resources are also significant for the Kafue Flats. Documented information on wildlife resources of wetlands in Zambia is lacking, although a list of fauna of Zambian wetlands (Howard and Chabwela, 1986) is available, and the general studies by Darling (1960) and Collinson (1983) also provide information. With the exception of the Liuwa Plains and Busanga Swamps, both the Bangweulu Swamps and Kafue Flats have the largest concentration and diversity of wildlife species among wetlands in Zambia. Studies by Grimsdell and Bell (1975) and Sayer and Van Lavieren (1975) confirm this. While the commercially significant species are black lechwe, sitatunga and tsessebe for Bangweulu,
the Kafue lechwe and zebra are important in the Kafue Flats. However, it is only recently that birds (mostly ducks and geese) appear to be stimulating interest. There is further potential for exploiting large game (buffalo and elephants), particularly in the Bangweulu Basin, although their abundance and occurrence are currently limited.

Aquatic macrophytes are locally used in many ways, especially by communities in the Bangweulu area. *Phragmites* sp., *Cyperus papyrus*, *Typha* sp., *Nymphaeoides* sp., and *Nymphaea* sp., are commonly used either as materials for huts, mats and baskets (which could also be of commercial interest) or their lower parts are used as a food-source.

Whereas the Bangweulu fisheries are equally exploited by inhabitants and migrant fishermen, the Kafue Flats are fished predominantly by non-resident fishermen. Muyanga and Chipungu (1982) have listed 10 commercially important species from the Kafue Flats alone, although *Oreochromis anдрersonii*, *O. macrochir*, *Tilapia rendalli*, *T. sparrmanii*, *Schilbe mystus* and *Clarias ngamensis* are most significant. In fact, of the 10 major fisheries in Zambia, fish production is mostly from Bangweulu and the Kafue Flats. Over 50% (1981, 1983) of the total fish harvest has been obtained from these two wetlands. However, whether the variation in annual fish harvest indicates fish population decline, poor methods of fishing, or depends on the number of fishermen, needs to be investigated.

Only very limited productivity studies on range grasses have been carried out, and nothing is known of the hydrophytes in the main swamps. Nevertheless, range studies by Anon. (1968), Handlos (1982) and Chabwela and Siwela (1986) show *Acroцeras macrum*, *Echinochloa* sp., *Brachитaria regulosa*, *Leersia hexandra* and *Panicum repens* as the most favourable animal food plants in the Kafue Flats, while a similar list has been prepared by Grimsdell and Bell (1975) for the Bangweulu area. The question of the occurrence of undesirable plants in both rangelands has not been investigated, but potential weed grasses are *Setaria* sp., *Oryza* sp., and *Loudetia* sp. *Vossia cuspidata* is unsuitable where it is too dominant. Shrub weeds are dominated by *Dichrostachys cinerea* and *Mimosa pigra* (which has become established in Lochinvar National Park).

While the Bangweulu rangelands are utilized exclusively by wildlife, the Kafue Flats are grazed by both cattle and wildlife. Cattle are annually driven onto the Flats during the dry months of September to November through the traditional system locally known as "Kuwila". Nearly half of the Kafue Flats is grazed through this system, although National Parks are not seriously affected.

Water resources sharing is at present only an issue for the Kafue Flats. Following the construction of the two dams at Kafue Gorge and Itëzì-ìezì, the flow and flood patterns of the Flats have been drastically altered. This irregularity has affected not only the grazing patterns of cattle and wildlife, but also the migratory patterns of lechwe and fish breeding patterns. Currently, water resources are controlled solely by the Zambia Electricity Supply Corporation (ZESCO) which distributes hydroelectric power in the country.

Wildlife resources are utilized in many ways, but current problems demand direct sharing of benefits. Larson and Lungu (1985) have noted that the common view that conservation and management of wildlife and game species is a luxury in poor African countries, and only beneficial for game viewers and visiting tourists, is not correct because:
(a) wildlife could be an important protein source for local people, and is often more important than cattle;

(b) harvest through safari companies could yield considerable income through licences, trophy processing and in safari activities, including much needed foreign currency; safari hunters are normally only interested in trophies (skins, horns, teeth) whilst meat could be distributed to local communities;

(c) the non-consumptive use of wildlife through game viewing can create jobs, stimulate associated local craft industries and agriculture, and create important economic benefits, including foreign exchange.

The most common approach to managing and utilizing wildlife resources in Zambia is through the creation of National Parks, where no hunting is allowed, but are primarily reserved for tourism, education and science; and Game Management Areas (GMAs), which are areas set aside mainly for hunting purposes. Increasingly, the justification for these measures is centred upon the use of wildlife as an economic resource. Revenues accrued through licences and other fees have grown to over 5 million kwachas in recent years, while revenue through safari business and through the tourism industry (though difficult to estimate) are of similar importance. However, the wildlife industry in Zambia is still in its infant stage, and additional revenues could be realized if, for example, current licencing practices were reviewed, and hunting areas were rated according to species richness, species abundance, distance from nearest city or town, or according to the available facilities in the area.

One aspect which has been inadequately covered but is obviously significant for both areas is tourism. A number of reasons have been advanced as being responsible for limited development of tourism in Zambia. Williams (1982) has argued that unless positive steps are taken, tourism will grow slowly, if at all. Clearly, the current poor financing, poor marketing, poor staffing and inadequate infrastructure will be need to be resolved to facilitate tourism development. As Khondowe (pers. comm.) had remarked ... "whether it be in National Parks or elsewhere, as long as the area is rural, tourism is rapidly declining. Most emphasis is now being placed on tourism in large cities where there are tall buildings and where facilities and other supplies are readily available".

Despite the current pessimism, both the Bangweulu Basin and Kafue Flats have very high tourism potentials which could be developed to a level similar to that already established in the Okavango Delta, as long as national plans and interests allowed for large volume investments.

The argument that wildlife resources are largely enjoyed by the already advantaged urban populations is, however, valid. Rural communities, whose traditional rights of wildlife utilization were withdrawn as their methods of exploitation were regarded as archaic and destructive, have remained powerless and neglected. There are currently no adequate administrative arrangements which could allow them direct access to wildlife resources. Most regulations and policies work against them; the following illustration will help to emphasize this point.

Since regulations stipulate that only a gun or rifle can be used for hunting, rural people, who are naturally poor and remote, have no money and influence, and consequently cannot own firearms. They are therefore in no position to hunt. Moreover, even if one
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had a gun and had money, it is often not possible to obtain a District Game Licence, as quotas are usually shared rapidly among the urban dwellers themselves. Purchase of a National Game Licence would be cumbersome in any case. The villager has to submit an official application which has to be on an approved official form. This is often unavailable near the village because they are so remote. The absence of a rural Post Office means that the villager would have to arrange for a special trip to the nearest Post Office to mail the application form. This could take him not less than three days to walk, and at the end the application may still not be accepted by the Director of National Parks and Wildlife Services. As a result, rural people see these arrangements as working against them, hence their frustration and resentment as illustrated in the following statements:

- from Mandonia, senior citizen at Bwalyamponda, Ncheta island: "Baletubepafye fwebene busipe, meaning, "we the keepers of these resources are being milked";
- from a fisherman who refused to be named at Chikolokoso fishing camp, Bangweulu Swamps: "These resources are ours, the Government is only interfering";
- from a Ward Chairman, Lukulu Ward, Mpika: "The Bangweulu Swamps are our only copper mine. We have known nothing else but to fish and to hunt; and if we are stopped from these activities, where do you think we could go? We cannot all be in Lusaka to look for employment, and after all, who could look at our faces in Lusaka or Kitwe";
- from Chief Hamusonde, Monze: "Fishermen come and kill fish in our dams and our rivers. They go to Lusaka and the Copperbelt and sell their fish. Where does the money go? Visitors come to Lochinvar and pay fees. Safaris come and hunt and they pay fees. Where does this money go? Who eats the meat?".

Unless adequate arrangements are established in order to allow direct benefits from resources such as wildlife, the feeling of resignation by rural people will persist, and wildlife will continue to suffer as a consequence.

Rural development and the need for local participation

Rural development has meant different things to different regions, countries, and persons, and has meant different things at different times. Nevertheless, Chambers (1983) has argued that rural development means "desirable change in rural areas". More specifically he argues that it must be a strategy to enable a specific group of people, poor rural women and men, to gain for themselves and their children more of what they want and need. It involves helping the poorest among those who seek livelihood in the rural areas to control more of the benefits of development. In Zambia, pursuit of rural development has dwelt on three objectives (Lele, 1975; Ollawa, 1977):

1. Creating self-reliant and progressive local communities;
2. providing massive expansion of agriculture and related industries, improving small-scale rural enterprises; and transforming rural populations into productive agents;
3. creating employment, business and mobility opportunities, and improving the social and economic infrastructure necessary for productivity.

These are seemingly meaningful objectives, but in reality their implementation has met considerable set-backs. Two basic questions are usually asked. What are the real needs of the community? Who should conduct the programme? Invariably, most programmes which have been implemented have been either too complicated for the poor local inhabitants to understand, and have emphasized quick returns, or their locations or outputs have had no relevance to the needs of the community in the area. To emphasize this point, I cite below a few examples showing how rural projects or programmes have fared in rural Zambia.

Chidumayo (1985) reported on the Chipangali settlement scheme which failed. This project in the Eastern Province of Zambia involved the spraying of insecticides to free a selected area of tsetse fly, with the objective of resettling some of the people of the Province. However, when the exercise was completed, few people, if any, moved into the area. What the planners did not see or take into account was that the people who were to move into the area were extremely poor. They were the rural people who were without ploughs and tractors, often without hoes, seeds and fertilizers, and generally without cattle. With their few belongings acquired through the years, they were expected to walk to or to be transferred into a remote area where there were no roads, no transport, no schools, no clinics, no Post Office and no shops; an area too distant from a veterinary officer who could attend to any cattle they did have; and above all, it was an area which continued to support populations of wild animals. Inevitably, the programme failed.

A District Senior Administrator in one of the Provinces in Zambia was surprised and worried why some local people in the area were not using enthusiastically the newly constructed boreholes, which had been fitted with hand pumps using Aid money. In fact he was not totally correct. Local people had tried the boreholes, but when the hand pumps broke down, they had no spares, and if they had spares they had nobody to repair them. To their amazement, local inhabitants did not know who was responsible for them. In addition, boreholes generally brought additional hardships. It meant men had to make bath shelters near their huts, and that women had to make more trips for bathwater, water to wash, to cook, to plaster their huts etc., and that meant more time spent standing in queues to wait for water to trickle into their containers. Moreover, stubborn women who ignored boreholes by going directly to the river had time to wash and swim, and appeared reasonably efficient. Of course boreholes were useful in many ways, but did they answer the whole question of the real community need?

One of the objectives of the cropping scheme for elephant, hippo, buffalo and impala, in the Luangwa Valley (1962-1972), was to supply meat to the poor plateau people of Northern and Luapula Provinces because these people were said to be deficient in meat protein. But when the project started, it was realized that the people who were to be consumers had no money to buy the meat because they were not employed; they were poor. Yet the project expected these people to walk across the Muchinga escarpment and through the National Park to Kakumbi abattoir to buy meat, a distance which could take more than three weeks. And, even if they bought
the meat, they would be expected to carry this protein, together with their food ration supplies, back across the escarpment. It was certainly not surprising that this aspect of the project failed.

Using Aid funds, a fish processing plant was constructed at Bwalyamponda’s village, at Ncheta island. The structure is still there even today. The local story is that the objective of the project was to assist fishermen by buying their fish at the plant where fish would be processed. Nevertheless, planners overlooked one important thing. The so-called potential suppliers (Fishermen) were extremely poor, physically weak as food was always scarce, and were mostly unhealthy as the island had no medical facilities. Fishermen in Bangweulu usually catch less fish. The little one catches is mainly for consumption by family and relatives, and the remainder is dried and saved until it makes the size of a bundle. Some of the fish caught, in fact, is used to barter with the people of the mainland for millet, sorghum, maize and other produce. Even if the fishermen cooperated with the project and decided to sell their catch, they would have to paddle to the plant by canoe for at least six hours each morning. By then the caught fish would have putrefied. Whether or not the fisherman managed to sell the fish, he would then paddle his way back for another six hours or more to his fishing camp, and by the time he arrived, it would be too late to get out to set the net again. In addition, the fishermen need to find time to look for cassava or cornflour for food and firewood for cooking. These are usually fetched from the mainland at Kapata, near Samfya, a journey which takes not less than three days. As a result of these diverse factors, it would be too ambitious to expect a project of this design to succeed, and consequently it was abandoned.

Rural people are generally polite. Whatever their private feelings (indifferent, suspicious, amused, anxious, irritated, enthusiastic) rural people will always put on their best face and receive the visitor (Chambers, 1983), but this should not be taken as them being agreeable to any plans in your briefcase. Even doctors do not just give medicine to anyone who is sick. They consult patients, and patients naturally co-operate and point out where it hurts, and then a prescription for treatment is prepared. What is then so different about “the poverty patients” that they cannot be consulted about their real needs? If this happened, local co-operation and participation in project implementation could be enhanced greatly.

The traditional view that rural people are lazy, incompetent, stupid, slow and drunkards should be dismissed outright. Local people are knowledgeable. They are knowledgeable of their environment and issues within their areas, but their isolation and lack of influence has placed them increasingly on the margins of society. Their knowledge is however of great value. Take, for instance, the views of Chief Choongo of Monze, expressed in discussions on over-exploitation of renewable resources on the Kafue Flats... “those other people come here only to kill for business. They destroy everything because what they want is to make money and not to conserve.”

Rural people should not be excluded from development planning. Instead, they should be encouraged to recognize the economic and social realities of their communities, and helped to realize that if anything is going to be done in their area, it is going to have to be initiated and kept going by them (Snodgrass and Wallace, 1970).
Conclusion

Conservation and sustainable rural development in the Bangweulu Basin and Kafue Flats will depend largely upon whether or not pertinent social issues are examined critically, and the ecology of the area is understood well. Furthermore, as stipulated in the World Conservation Strategy, the sustainable utilization of ecosystems and species requires knowledge of the productive capacities of those resources, and measures to ensure that utilization does not exceed those capacities. It is therefore recommended that:

1. the protection of wildlife should be improved and strengthened substantially, and levels of harvesting should be based on the success of this protection;
2. comprehensive research should be initiated to prepare guidelines, and run concurrently with implementation;
3. local inhabitants should be allowed to participate in local resource administration and in the sharing of benefits from such efforts of exploitation;
4. rural communities, including women, must be mobilized to explore other avenues of income generation, and women should be exposed to the relevant methods of food production and disease prevention, and should be part of the decision-making process;
5. a fair and adequate administration of fisheries, range and water resources should be established and strengthened;
6. an appropriate infrastructure to facilitate the management of intervention programmes should be developed;
7. a suitable administrative structure to facilitate research and implementation should be designed.

References


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2.3 Settlement patterns and resource utilization in the Bangweulu Basin and the Kafue Flats

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Introduction

Wetlands have always attracted ingenious and imaginative scholarly enquiries owing, largely, to the great diversity of life forms in such habitats. Such life as may exist is, at once, both inter-linked and inter-related, displaying varying lengths of food-chains among dominant, intermediate and dominated species. Plant and animal life forms interface intricately in the constant biological process of reciprocity, and also, symbiotically. Man has not been oblivious to the biological diversity of wetlands. Indeed, except for those areas that are largely inaccessible, man has made relatively extensive use of the botanical and zoological constituents of the wetlands. Exploitation of these resources has had a profound effect on man himself; his cultural adaptations, political systems, technological tinkering, social organization, and more relevant to this study, settlement forms and patterns.

The underlying and basic assumption, in this instance, is that physical and cultural parameters, inherent in the process of utilizing wetland resources, more or less conspire to produce specific patterns of human settlements or habitation. Sustainable conservation of wetlands has to be cognisant of these relations and exploitative forms.

Functional studies of settlement areas have established that form and function are patenty inter-related. Empirically, settlement patterns have generally been seen in terms of form. Settlements could be nucleated, dispersed, linear or of an intercalatory nature. Underlying causal explanations for the emerged pattern could, on further analysis, relate to natural, social, historical, cultural or economic factors. It is thus, in this well-grounded tradition of settlement geography, that this discussion will be anchored (see Fig. 1).

Since the study areas are in a rural setting, it is also imperative that theoretical insights on issues of rural settlement forms and patterns should be considered. In this instance, it has been noted for Zambia that areas of denser rural population tend to:

(a) have a comparatively broad-based economy dependent upon cultivation, plus fishing or herding, or both; they are not generally associated with simple, traditional, millet-based bush rotation (slash and burn) cultivation practices, which can at best support only intermediate rural densities (i.e. of between 1.9 - 9.6 persons per km$^2$);
Figure 1  Factors Influencing Settlement Patterns

(b) produce appreciable surpluses of primary produce for cash sale;

(c) reflect the location of major precolonial political groupings and/or the presence of present day administrative and service centres as in Atlas of the Population of Zambia (Adika, 1977).

The Zambian experience also shows that where a sparse low national average density of 8.7 people per km² occurs, this should be viewed in relation to available natural and human resources, for a sparse population may still exert pressure on meagre resources. Generally, however, sparsely populated areas in Zambia are normally infested with tsetse fly, with its negative effects upon settlement, and are therefore the sites of National Parks.
The foregoing remarks notwithstanding, this paper seeks to relate settlement form and function to differential resource utilization specific to the two study areas. The intention is to establish that ceteris peribus, settlement patterns are also a function of specific economic activities peculiar to these areas; the evolved form being a product of social, cultural and historical factors.

The remainder of the paper will examine the natural setting of the two wetlands, history of human settlement, traditional economic bases, land use patterns, population dynamics and settlement patterns. Throughout, the intention is to demonstrate that specific resources and their utilization produce equally specific forms of settlement patterns.

The physical setting

The two study areas are major wetlands occupying different locations within the Republic of Zambia. The Bangweulu Basin in the North is crossed by the 12th latitude while the Kafue Flats, further South, is traversed by the 15th latitude. They belong to two different drainage systems; the Bangweulu Basin being part of the Zaire River system while the Kafue Flats are a part of the Zambezi River system. They are separated by a major watershed which generally coincides with the Zaire-Zambia border.

Mulongo (1979) has described the "geographical background" of both the Kafue Flats and the Bangweulu Basin. In both areas, annual flooding is dominant, thereby influencing vegetation zonation, animal and human activities. Low gradients, in each case, cause flooding. The Bangweulu gradient is 1:20,000; the Kafue River falls only 10 m in its 450 km passage through the Kafue Flats. Both systems have large catchment areas, 155,000 km² for the Kafue River Basin, and 190,000 km² for the Bangweulu system. Seventeen rivers flow into the Bangweulu Basin. Waterflow in this system reverses several times in its south-westerly flow owing to papyrus plant growth and silt, and to numerous channels. Apart from the main Lake Bangweulu, other small lakes exist: Lakes Walilupe, Kangwena, Kampolombo and Chale. Numerous lagoons are also found, especially in the eastern part, the biggest of which is Chifunauli. The Kafue Flats have much smaller lagoons.

Mean annual rainfall around Lake Bangweulu is 1,400 mm while that along the Kafue Flats is only 800 mm. The high rainfall in the Lake Bangweulu Basin area leads to increased leaching of the soil. The sandy, silt and clay soils of this area are of inherently low fertility. Soils in the Kafue Flats are predominantly margallitic clays, although sandy soils lie along the forest line.

Vegetation in the two areas is zoned according to water depth, flood regime and soil type. On the Kafue Flats, the vegetation is primarily aquatic grasses. In the Bangweulu Basin, papyrus and reeds are predominant in the swamp proper while grasslands abound on the periphery.

Human habitation

Archaeological evidence of man’s occupation of the two areas exists, going back in both cases to the Late Stone Age. Descriptions of the life styles and economic bases of Early
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Man are generally a little speculative, being derived, in part, by conjecture (Philipson, 1971, 31 - 32 pp.). The picture is less murky for the period AD 1,500 to 1,900. In the case of the Bangweulu Basin, present-day inhabitants form part of the wave of migrations from the Luba and Lunda empires of Katanga (bena Ng'oma, Ushi or bena Ngulube, and Bisa or bena Ng’ona).

The Ila and Tonga groups of the Kafue Flats arrived on the Zambian scene much earlier, probably from the East or North-East. The Twa, genetically regarded as being between Bushmen and Pygmy, are mostly found in the Kafue Flats living a life style quite different from the more numerous Ila and Tonga.

In colonial times, both the Kafue Flats and the Bangweulu Basin regions were rural economic hinterlands within the grand scale of colonial Zambian development that fashioned differentiated economic spaces. Generally, like all rural hinterlands, the two areas became increasingly neglected and underdeveloped. There, peasant families (mostly women, children and old men) used age-old technologies (cutlasses, a few animal-drawn ploughs) to scrape a bare living on eroded, infertile soils. To earn the cash, first to pay taxes, and second to buy a few essential manufactured goods (matches, paraffin, soap, cloth, maybe a bicycle or a radio) hundreds of thousands of young men migrated out of the villages to work on the mines and settler-owned estates. Many, including some women and children, crowded into shanty towns, struggling at the outskirts of mushrooming urban centres. There, they joined the growing numbers of un- or under-employed, hoping against hope to get better-paid jobs in the steel, cement and glass office buildings and factories that symbolized the modern world.

Traditional economic uses

One major economic activity along the Kafue Flats is cattle husbandry. Indeed the Ila have been included as being part of the so-called, and misleading “cattle complex”. In 1970 the cattle population topped 100,000 head, making the Ila by far the wealthiest cattle people in Central Africa, with an average of 13.1 animals for each adult male (Fielder, 1973, 351 pp.). Cattle are their prime economic concern, but the economy is mixed, maize cultivation playing an important subsistence role in all areas, and a commercial role in the South-East, nearest to the line of rail. Fishing, store-keeping and other similar activities have largely been left to immigrant Zambians or to non-Ila locals. The overall percentages of absent migrants is very low, probably about 30 percent of adult males over the whole district, and as low as 15 percent in the wealthiest cattle areas (Fielder, 1973, 330 pp.).

The main changes in attitude have been towards using oxen as labour and towards selling. Until the 1920s, the Ila did not use oxen for traction; cultivation and portage were by hand, and for the wealthy, by domestic slaves. Other uses of cattle include all sorts of social obligations and economic exchange (in cash or kind).

The most important economic activity in the Bangweulu Basin is fishing. Historically, fish were used as an exchange unit for cassava meal and Elesineum grain with the mainland people. It was also used to buy fibre, paddles, firewood and other materials. However the open lake does not have as much fish as the swamps. Even in the swamps,
the rich fishing grounds are only found around Lake Chale, Kalunga River and Ncheta, and people from all parts of the swamp converge on these areas (Mulongo, 1979, p. 43). According to Macrae and Paine (1950-1952, 12 pp.) the real full-time fishermen are those living on the islands of Chishi, Mbabala and Chilubi. The population being high, the people have to fish hard to obtain relish for themselves and a barter commodity to exchange for cassava meal on the mainland. Island fishermen fish throughout the year and move to temporary camps when the fish move from their home waters. Elsewhere, the lake-shore dwellers are not entirely dependant on fishing for their livelihood, and are engaged only in seasonal fishing.

Wild game has also been important in the area. It has been reported that the Unga and Bisa were able to earn tax money by the sale of lechwe and other skins.

The rising of the water level (by one metre) in the open lake started in 1936 and continued until 1944 (Mulongo, 1979, 41 pp.). Land previously lived on and cultivated with cassava and millet crops was inundated, forcing many people to migrate to the mainland in Luwingu, Samfya, Mpika and Serenje. Floods caused over-crowding, owing to shortage of land. With repeated cropping, yields declined, and only cassava seemed to do a little better. Food shortage became common in the swamps.

Land use patterns

A land use map prepared by Schultz (1975) indicates that different land use patterns exist in the two wetlands. The Bangweulu Basin is characterized by a broad category entitled “fishing and semi-permanent hoe cultivation”. There are five lower order categories including one designated separately as the “Bangweulu System”. Land use here is basically “fishing/cassava, lake and swamp system, or cassava, maize, ground-nuts, fishing.”

Land use along the Kafue Flats has been titled “semi-commercial ox and tractor, and tractor plough cultivation.” Three sub-sets are identified. There is also the “Namwala mixed farming system” which is identified by such land use as “maize, ground-nuts, cassava and cattle”.

The map highlights some of the characteristics for the Kafue Flats and Bangweulu Basin. It also brings in ecological considerations, so that once again, the physical as well as human factors in the two areas are shown to be different. Thus, whereas the Bangweulu Basin belongs to the first zone, the Kafue Flats fall under the third zone, which has, by far the best proven agricultural potential of all the zones.

Population and settlement patterns

The Kafue Flats are bordered by three Provinces (Central, Southern and Lusaka). Luapula, Central and Northern Province have unequal claims on the resources of the Bangweulu Basin. For illustrative purposes therefore, Namwala and Samfya Districts are taken to help highlight population distribution and settlement patterns for the Kafue Flats and the Bangweulu Basin respectively. Both are rural districts inhabited by people
Managing the wetlands of Kafue Flats and Bangweulu Basin

who rely largely on the resources of their respective wetland. Their basic economic structures are however different owing to cultural, historical and environmental factors. Namwala has emerged as a predominantly cattle-based economy, while that of Samfya is basically reliant on fishing and related activities. Though both activities require elements of group effort and community interdependence, cattle husbandry needs extended ranges. Dispersal in this activity is also a reflection of other considerations including seasonal condition of grazing range, crop agricultural requirements and watering points, the last point inducing a process of transhumance. Within the fishing industry, concentration of population and settlement is largely a function of fish concentration in certain locations.

Table 1 is a static presentation of the distribution of population in the two districts. Samfya is clearly the more populous of the two. But Samfya had a negative population growth rate of 1.3% for the intercensal period 1963-1969, while Namwala had a gain of 1.9 percent in the same period.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Geographical Distribution of Population in Namwala and Samfya Districts 1980</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>Namwala District</td>
<td></td>
</tr>
<tr>
<td>Namwala Township</td>
<td>1,447</td>
</tr>
<tr>
<td>Itezhi-tezhi Township</td>
<td>1,017</td>
</tr>
<tr>
<td>Rural Areas</td>
<td>25,513</td>
</tr>
<tr>
<td>Total</td>
<td>27,977</td>
</tr>
<tr>
<td>Samfya District</td>
<td></td>
</tr>
<tr>
<td>Samfya/Mwamfuli Township</td>
<td>5,263</td>
</tr>
<tr>
<td>Rural Areas</td>
<td>42,254</td>
</tr>
<tr>
<td>Total</td>
<td>47,517</td>
</tr>
</tbody>
</table>


The maps of the Kafue Flats and Bangweulu Basin (next chapter) provide a very generalized presentation of population distribution in the two wetlands. Along the Kafue Flats, rural population tends to congregate in unevenly spaced clusters; these are in fact Chiefdoms of varying sizes and population levels. The villages are almost universally close to the margin of the floodplain line, indicating the heavy reliance on cattle husbandry, from manpower to the grass and water resources of the Kafue Flats. Forest
Reserves, the National Park and the presence of tsetse fly act as absolute limitations to lateral outward expansion of populations and settlements.

In the Bangweulu Basin, heavy population clusters occur on islands and in those areas that constitute rich fishing grounds. This is a determinant factor. Thus Macrae and Paine (1950-1952) have reported that there is a heavy concentration of population around the lake, villages stretching often for many kilometres so that the dividing line between one another is difficult to find; they add that its population produces a considerable quantity of surplus cassava and a certain amount of ground-nuts and rice. In both cases, however, the overall settlement pattern is unlikely to change dramatically so long as land (for grazing) in one instance, and water (in which fish live) in the other, remain common goods. Only privatisation can substantially alter settlement forms. This author is not advocating this strategy.

Conceivably, settlement patterns may also be altered with the introduction of alternative economic activities such as irrigated rice or wheat. But this is also subject to long-term social community aspirations and other development considerations. Planned village regrouping based on new economic production efforts has to be subjected to realities of existing population and settlement dynamics and arrangements. Every observable situation has its own inner logic. This should be understood and any intended change has to be endogenous rather than exogenous.

**Concluding remarks**

When conservation and development concerns are matched, one temptation is to consider them as polar opposites. Indeed, individuals can hold very strong views in favour of one or the other, depending on the subject matter. For academic justice to prevail, and in order to bring sanity into the discussion, various angles of the structure of the subject matter have to be examined. This workshop is convened to meet this objective for wetlands, and this paper has tried to highlight one concern among many.

“Conservation and development” conjures a feeling that the Bangweulu and Kafue Flats wetlands will be developed in the interest of Man and his chosen development objectives; such development however will hopefully be done in a responsible manner that will take into account the need to conserve the resources of the two areas for posterity. This is clearly a long-term view.

In the shorter-term however, conservation is necessary because of the multiple linkages that exist among the biological forms of such ecosystems. Over-utilization of one resource could bring undesirable, if as yet unknown, effects to specific parts of the ecosystem.

This paper has made a preliminary, if also somewhat incomplete, inventory of the major resources of the areas, and the manner in which they are being utilized. One approach to development of the two wetlands would be to increase the rate of exploitation of the known resources, perhaps using more advanced techniques that are also acceptable to the local communities.

Another way would be to introduce new and novel ideas (irrigation in agriculture, canalization to improve local and regional transport, innovative systems of game
managing the wetlands of Kafue Flats and Bangweulu Basin

ranching, rationalized fishing practices etc.). Along with these changes in the economic bases would be resettlement programmes where some minimum criteria would be used to determine settlement forms.

Mulongo (1979) has already shown the effects of the colonial administration, and its demands on the rate of resource utilization, in the two areas. For example, in the Bangweulu Basin, burgeoning population in search of tax money had to rely on the sale of wildlife hides. With diminishing returns, the tax pressure (and other factors) exacerbated the process of rural/urban migration. Communities on the Kafue Flats, an area with underdeveloped agriculture, had to fall back on cattle sales to meet tax obligations. Out-migration, as Fielder (1973) has noted, has been moderate in this region.

Zambia is entering another phase in its history of economic development. The populace is being urged to go back to the land. The implications of such a drive for these two wetlands are significant. With static economic base structures, but added population and resource exploitation, the two areas will certainly undergo stress. The Bangweulu Basin will be adversely affected. With underdeveloped agricultural practices, the temptation to move into the rapid money-making fishing industry will be great. The already strained fishing resources will be further aggravated. For the Kafue Flats, a successful go-back-to-the-land campaign will worsen the rapidly emerging problem of cattle rustling.

This then brings us back to the word “development”. My final counsel is that with conservation in mind, planners have to create a diversionary route to development, and create viable and acceptable alternative economic activities for the two areas so as to balance and counteract the dominant economic roles of cattle and fish in the Kafue Flats and the Bangweulu Basin respectively. One way is to slowly introduce cattle husbandry in the Bangweulu Basin and a better organized fishing industry in the Kafue Flats area. Another is to introduce irrigated agriculture. These activities are suggested in the absence of any significant industrial projects in the two areas. Planning for the two wetlands, finally, will be an exercise in rational conservation controls, responsible resource utilization and creation of viable communities.

Independence came in hope’s bonfire. The highlands of development are yet to be reached; not by incremental solutions but by inoculating society with change-oriented development. These wetlands, which are also hinterlands, are populated by peasants who should be empowered to control their lives. Participation and democracy become not the solutions of choice, but the only solutions to the rural people’s poverty.

References


2.4 The water resources of the Kafue Flats and Bangweulu Basin

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Lusaka

Introduction

Swamps act as natural water reservoirs and as such they form an important part of the river basins in which they occur. While man-made reservoirs have been developed at high cost for uses such as flood control, irrigation, hydropower, general recreation and fisheries, swamps occur naturally, and yet they generally provide similar benefits. For example some of the major uses of swamps in Zambia are fisheries, wildlife, tourism, livestock grazing, subsistence agriculture, transportation and water supply.

The extent of wetlands in Zambia has been estimated at about 20 per cent of the total land area. The Bangweulu Swamps and Kafue Flats form a very significant portion of this wetland area. Nyumbu and Mumeka (1986) defined wetlands as marshes, swamps, floodplains and dambos containing some vegetation that is periodically inundated, either directly by rainfall, or from seepage water from the crest of the catchment. Swamps and marshes have been defined as vegetation-covered land area saturated with water (Balek, 1977). From the hydrological standpoint each swamp represents a special feature of its system of recharge and depletion. The following characteristics have been given as common to African swamps:

1. run-off regulating systems acting in principle as reservoirs with an increased rate of evapotranspiration;
2. high ratio of surface areas to water depth;
3. fluctuation in the size of the swamps from year to year and in some cases, from season to season;
4. three clearly marked zones: at the margin of the swamps the first zone is under water for only a brief part of the year (usually at the end of the rainy season), the second zone is water-logged for a much longer period, and the third zone is under water throughout the year.

These general characteristics are true to a large extent of swamps in Zambia. Nyumbu and Mumeka (1986) report that swamps are common in the higher rainfall belt of Zambia, for example the two largest swamps, Lake Mweru Wantipa and Lake Bangweulu.
Swamps, are found in this zone; while floodplains are more common in the lower rainfall regions, for example the Kafue Flats and the Zambezi floodplains.

Zambia is drained by the Zaire River system in the North and the Zambezi River to the South. The Chambeshi River, Lake Bangweulu Swamps and the Luapula River form the Zaire River system in Zambia. The Kafue Flats are located within the Zambezi River Basin, whereas the Bangweulu Swamps form the headwaters of the Zaire River (Debenham, 1952). Fig. 1 shows the drainage basins of Zambia and the location of the Bangweulu Swamps and the Kafue Flats.
Description of the Lake Bangweulu Basin

The Bangweulu Basin is located in the headwater region of the Zaire River between latitudes 10°S to 13°S and longitudes 29°E to 31°30' E. It lies within the Central, Northern and Luapula Provinces.

The Chambeshi River which drains an area of about 42,424 km² flows into the Bangweulu Basin from the North-East and can be regarded as the largest tributary discharging into the swamps. All the other tributaries flow into the Lake Bangweulu Swamps forming a ring type basin (Fig. 2). The Luapula River flows out of the swamps at the South part of the Bangweulu Basin. The total area of the interbasin between Mbati and Masheto is 57,800 km². The Lake Bangweulu Swamps, with an area of 15,875 km², is amongst the ten largest in Africa and it is the second largest in Zambia after Mweru Wantipa (Balek, 1977).

The Bangweulu Basin lies in the high rainfall region of Zambia, directly within the 1,400 mm to 1,500 mm contours representing mean annual rainfall as shown on Fig. 1.

Description of the Kafue Flats

The Kafue flats and its drainage basin form most of the lower Kafue Basin, that is, the catchment areas between Itezhi-tezhi and Kafue Gorge dams. This catchment covers 46,000 km². The Kafue Flats are a broad flat plain with an area of about 7,000 km² and a slope of 0.004 %. The subcatchment is located within the Kafue River Basin, a major tributary of the Zambezi River, between latitudes 14°50'S and longitudes 25°20'E to 28°25'E.

The soils are generally a heavy clay type but have a characteristic relief of circular depressions with ridges that increase surface water storage outside the flood line and thus create a complex pattern of inundated area. Soil texture and vegetation type in the surrounding catchment influence infiltration and evapotranspiration.

The Kafue Flats lie in the lower rainfall region between the 800 mm and 900 mm contours representing mean annual rainfall as shown on Fig. 1.

Water balance components

The definitions given above indicate clearly that swamps and flats are important hydrological units that will influence significantly the river regime of the basins in which they occur. A water balance calculation of the swamps and flats provides information on available water resources needed for planning their appropriate utilization. However, hydrologists, particularly those working in the third world, are faced frequently with the problem of lack of data, and where the data is available, it is sometimes not reliable and accurate and therefore not readily useable. Such data usually require a great deal of verification before being subjected to any detailed hydrological analysis. There exist acceptable gauging networks on the Lake Bangweulu Basin and Kafue Flats, although most of them were established only relatively recently and data therefore cover only
Managing the wetlands of Kafue Flats and Bangweulu Basin

Figure 2 The Lake Bangweulu Basin
short time sequences. Rainfall records are generally of long duration in comparison to the river stage and lake level records.

The Kafue Flats have been more intensively studied than the Bangweulu Basin and therefore more data is available, and in better detail, from the Flats. The main reason for this bias is that the Kafue River Basin is more urbanized and industrialized in Zambia than any other basin, and thus there has been more competition for the use of its resources. This section presents the water balance components of both the Lake Bangweulu Basin and the Kafue Flats.

**Water balance of Kafue Flats**

The hydrology of the Kafue Flats has been studied in greater detail when compared to the other parts of the Kafue River Basin, and indeed the other river basins in Zambia. The area has attracted more attention mainly because of the development of hydropower on the Kafue River at Kafue Gorge, the irrigation water demand on the Flats, particularly the Nakambala sugar estates, and the water requirements for wildlife together with fisheries. In order to provide a firm power generation at Kafue Gorge it was necessary to build the Itezhi-tezhi Dam so that a flow of 183 m$^3$/s is maintained for that purpose. The result of the scheme is that the flow on the Kafue Flats is almost entirely regulated by man. The only natural flow is the contribution of the streams within the drainage basin and the rain falling directly on the Flats.

**Rainfall**

The Kafue Flats lies within the 800 mm and 900 mm contours of mean annual rainfall (Fig. 1). Bailey (1970) estimated that the probability of 800 mm or more rainfall occurring during any given season is 60 percent. Analysis of the general characteristics of the rainfall in Zambia has shown that there is greater variability in rainfall in areas with low average rainfall than those with higher average rainfall, because most of the rainfall is of the thunderstorm type, which can be quite localized and vary in frequency and duration.

**Runoff**

The amount of inflow to, and outflow from, the Kafue Flats depends on the time period as well as the length of record considered in the calculation. A source of error in determining the total inflow to the Flats arises from the ungauged streams within the interbasins. The following are the values estimated by Balek (1971), based on the total area of the interbasin of 45,351 km$^2$. 
Managing the wetlands of Kafue Flats and Bangweulu Basin

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow from Kafue River</td>
<td>260 mm/year</td>
</tr>
<tr>
<td>Inflow from the interbasin tributaries</td>
<td>25 mm/year</td>
</tr>
<tr>
<td>Inflow from Flats areas</td>
<td>10 mm/year</td>
</tr>
<tr>
<td>Total inflow per year</td>
<td>295 mm/year</td>
</tr>
<tr>
<td>Outflow below the Flats</td>
<td>284 mm/year</td>
</tr>
<tr>
<td>Mean annual loss (interbasin - 45,351 km²)</td>
<td>11 mm/year</td>
</tr>
<tr>
<td>Mean annual loss (Flats - 2,590 km²)</td>
<td>193 mm/year</td>
</tr>
<tr>
<td>Mean annual evapotranspiration</td>
<td>798 mm/year</td>
</tr>
<tr>
<td>Total mean annual evapotranspiration from the Flats</td>
<td>991 mm/year</td>
</tr>
</tbody>
</table>

Table 1 gives the mean yearly water balance components at three stations within the Kafue Flats. Considering the area of the Flats the values of the water balance are as follows:

- Inflow from Kafue River at Itezhi-tezhi: 256 mm
- Outflow below the Flats at Kasaka: 233 mm
- Mean annual loss (interbasin - 44,826 km²): 23 mm
- Mean annual loss (Flats - 7,000 km²): 147 mm
- Total mean annual evapotranspiration Kafue Flats: 947 mm

Table 2 gives the annual water balance for the Kafue Flats during 1965/66 to 1968/69 separately. The values obtained here compare well with those above. The water balance was performed on an area more than six times less than that of the interbasin. The total inflow is different from the total outflow due to secondary effects at the wet-dry boundary of the areas considered in the computation (DHV, 1979).

**Water balance of Lake Bangweulu Basin**

Development in the Bangweulu Basin remains on a much lower level than it is in the Kafue Flats. The lake and swamps naturally transform the discharges of the Chambeshi River and the other tributaries to create the completely different hydrological regime of the Luapula River. The Bangweulu Basin has been studied also but not to the same extent as the Kafue Flats. Components of the water balance as estimated on the Lake Bangweulu Basin are presented in this section.

**Rainfall**

The Bangweulu Lake Basin falls between the 1,300 mm and 1,500 mm contours of mean annual precipitation as shown on Fig.1 and it receives the highest rainfall in Zambia. The probability of 1,300 mm or more rainfall occurring during any given season is 60% (Bailey, 1970). The rainfall characteristics are generally different from the Kafue Flats in terms of variability but are of the same seasonal nature.
### Table 1: Mean Yearly Water Balance for Kafue Flats

<table>
<thead>
<tr>
<th>Station</th>
<th>Drainage Area (km²)</th>
<th>Rainfall (mm)</th>
<th>Runoff (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kafue at Itezhi-tezhi</td>
<td>104,397</td>
<td>1,050</td>
<td>110</td>
</tr>
<tr>
<td>Kafue at Namwala</td>
<td>115,098</td>
<td>1,000</td>
<td>80</td>
</tr>
<tr>
<td>Kafue at Kasaka</td>
<td>149,223</td>
<td>1,000</td>
<td>70</td>
</tr>
</tbody>
</table>

### Table 2: Annual Water Balance for the Kafue Flats, Without Dams, Depths in mm (DHV, 1979) Area = 6,800 km²

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflow</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kafue River at Itezhi-tezhi</td>
<td>843</td>
<td>935</td>
<td>833</td>
<td>3,085</td>
</tr>
<tr>
<td>Tributary Flow</td>
<td>280</td>
<td>118</td>
<td>90</td>
<td>386</td>
</tr>
<tr>
<td>Rainfall</td>
<td>960</td>
<td>757</td>
<td>687</td>
<td>1,002</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,083</td>
<td>1,810</td>
<td>1,510</td>
<td>4,473</td>
</tr>
<tr>
<td><strong>Outflow</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kafue River at Gorge Dam</td>
<td>1,036</td>
<td>787</td>
<td>685</td>
<td>2,759</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>1,006</td>
<td>962</td>
<td>869</td>
<td>1,447</td>
</tr>
<tr>
<td>Change in Storage</td>
<td>15</td>
<td>12</td>
<td>18</td>
<td>229</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,057</td>
<td>1,761</td>
<td>1,572</td>
<td>4,435</td>
</tr>
</tbody>
</table>
Runoff

In the water balance calculations the Lake Basin area is considered to lie between Mbati and Masheto (Fig. 2). The mean annual runoff of the Chambeshi River at the inflow into the swamps is 241 mm while the mean annual runoff at the outflow into the Luapula River is 138 mm (Balek, 1970). The period of record is from 1959-1960 to 1963-1964. It has not been attempted to relate the depth of runoff to the area of the interbasin in this case because the area used in the computations is not provided. The value of the mean annual runoff into the swamps, that is the outflow of the Chambeshi River, is 214 mm when a longer record is used.

Table 3 presents values of the water balance calculations on the Lake Bangweulu swamps. Results for the Kafue Flats are also included for comparison.

Table 3  Results of Water Balance Calculations (Balek, 1977)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Bangweulu Swamps</th>
<th>Kafue Flats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage Area</td>
<td>km²</td>
<td>102,000</td>
<td>58,200</td>
</tr>
<tr>
<td>Area of Swamp</td>
<td>km²</td>
<td>15,857</td>
<td>2,600</td>
</tr>
<tr>
<td>Rainfall on the Area of Swamp</td>
<td>mm</td>
<td>1,190</td>
<td>1,090</td>
</tr>
<tr>
<td>Rainfall on the Swamp in the Year</td>
<td>mm</td>
<td>1,210</td>
<td>1,110</td>
</tr>
<tr>
<td>Evaporation from Free Water Surface, Yearly</td>
<td>mm</td>
<td>2,340</td>
<td>2,070</td>
</tr>
<tr>
<td>Evapotranspiration from Swamps, Yearly</td>
<td>mm</td>
<td>2,000 - 2,180</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Discussion and conclusions

The goal of water resources development is to meet the water requirements of a target area such as agricultural, domestic and industrial water supply. Evapotranspiration is the greatest consumer of water in this climate region and should be a major consideration in all water resources development projects. In the particular case of the conservation and development of Bangweulu Basin and Kafue Flats, evapotranspiration is very important because it represents the total water demand of the whole “system”, that is the swamps, including soils, vegetation, game and fisheries within it.

Previous experience has shown that evapotranspiration is difficult to assess and it is generally the only unknown variable in the water balance equation. Several estimates of evaporation from the reservoirs and the Flats have emerged and values range from about
1,500 mm - 2,800 mm. These have been presented and discussed in great detail in the Kafue Flats Hydrological Studies Report (DHV, 1979). Values for evapotranspiration varied from 869 mm - 1,447 mm. Results obtained at the National Irrigation Research Station, Nanga, for free water evaporation are 1,876 mm using Penman methods, 1,840 mm from adjusted pan evaporation, and 2,355 mm using a lysimeter. The lysimeter values are on the higher side, due probably to border effects.

Balek (1977) gave an estimate of evapotranspiration from the Bangweulu Swamps as ranging from 2,000 mm - 2,180 mm. Another estimate was given as 2,450 mm (Balek, 1970) total evapotranspiration per year.

The flow in the Kafue Flats is regulated according to the demand for hydropower generation and other users such as Nakambala Sugar Estates. The result of the reservoirs' operation has been to reduce the flood peak and increase the minimum flow in the Kafue Flats as expected from such activity. Consequently, the permanently flooded areas have increased, changing the ecological and vegetation characteristics of the area (Turner, 1984). However, the reservoir operation scheme could be improved in order to satisfy all the users of water in the Kafue Flats. The over-estimates of evaporative demands used in the design of the Itezhi-tezhi and Kafue Gorge reservoirs may have resulted in an unnecessary low flow of water released to the Kafue Flats.

**Recommendations**

1. The Bangweulu Basin requires a detailed hydrological study to be carried out.
2. There is need to study in detail the evapotranspiration component in the water balance of the swamps and flats.
3. There should be an assessment of water users and their needs in both the Kafue Flats and the Bangweulu Basin in order to enable proper water management.

**References**


2.5 A brief review of the status of the fisheries of the Bangweulu Basin and Kafue Flats

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Department of Fisheries
P.O. Box 35100
Chilanga

Introduction

The swamp, floodplain and other wetland fisheries together contribute over 50% of current fish production in Zambia. Among these wetlands, the Bangweulu Basin and Kafue Flats are particularly important fishery resources. The former is a lake/swamp/floodplain complex and the latter until very recently was a typical floodplain. The multiple impoundments in the Kafue system have brought about considerable changes in the flood regime of the floodplains. The fish resources of both the water bodies have been subjected to intensive exploitation since the middle of this century. The uncontrolled and indiscriminate fishing activities over the years have proved destructive to the fish stocks and the fish yields from these fisheries have declined substantially. The present review briefly the impact of man's interventions on the fish stocks, the present status of the fisheries based on the Departmental gill-net surveys, and some possible avenues for the future development and management of these fisheries.

Fishery of the Bangweulu Basin

The Bangweulu complex contains six major lakes, namely Bangweulu, Walilup, Chifunauli, Kampolombo, Kangwena and Chale, with very extensive swamps/floodplains interlinked by both natural and artificial channels. The total surface area is estimated at 15,000 km² out of which the swamps and floodplains occupy 12,600 km². The difference in the morphological characteristics of these water bodies and the multispecies nature of the fishery have posed a number of conservation and management problems.

Although the ichthyofauna of the Bangweulu system comprises 83 species, only about thirty species form part of the commercial catches. The estimated fish production from the system averaged 11,596 metric tons during 1966 - 1985 (Table 1). The most common types of fishing gear are gill-nets, beach-seines, weirs and longlines. Seine nets are widely used in the open water whereas gill-nets constitute the main fishing gear in the swamps. The number of active fishermen has been estimated at 7,000 (Tait, 1967) and 11,750 (Welcome, 1972). The number of fishermen appears to have increased after a drop in the 1970s but with no proportional increase in the number of fishing boats.
Managing the wetlands of Kafue Flats and Bangweulu Basin

Table 1  Annual Fish Production from Bangweulu and Kafue Fisheries (1966 - 1985) in metric tons.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bangweulu</th>
<th>Kafue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>12,408</td>
<td>10,709</td>
</tr>
<tr>
<td>1967</td>
<td>12,394</td>
<td>3,441</td>
</tr>
<tr>
<td>1968</td>
<td>11,617</td>
<td>6,183</td>
</tr>
<tr>
<td>1969</td>
<td>11,894</td>
<td>9,938</td>
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<tr>
<td>1970</td>
<td>12,375</td>
<td>9,582</td>
</tr>
<tr>
<td>1971</td>
<td>11,738</td>
<td>8,247</td>
</tr>
<tr>
<td>1972</td>
<td>13,034</td>
<td>7,874</td>
</tr>
<tr>
<td>1973</td>
<td>14,032</td>
<td>6,289</td>
</tr>
<tr>
<td>1974</td>
<td>15,715</td>
<td>5,177</td>
</tr>
<tr>
<td>1975</td>
<td>9,881</td>
<td>7,266</td>
</tr>
<tr>
<td>1976</td>
<td>7,598</td>
<td>9,307</td>
</tr>
<tr>
<td>1977</td>
<td>9,496</td>
<td>9,830</td>
</tr>
<tr>
<td>1978</td>
<td>8,942</td>
<td>8,634</td>
</tr>
<tr>
<td>1979</td>
<td>11,648</td>
<td>10,831</td>
</tr>
<tr>
<td>1980</td>
<td>10,367</td>
<td>7,741</td>
</tr>
<tr>
<td>1981</td>
<td>9,848</td>
<td>9,619</td>
</tr>
<tr>
<td>1982</td>
<td>11,006</td>
<td>8,907</td>
</tr>
<tr>
<td>1983</td>
<td>14,467</td>
<td>3,605</td>
</tr>
<tr>
<td>1984</td>
<td>10,922</td>
<td>4,835</td>
</tr>
<tr>
<td>1985</td>
<td>12,533</td>
<td>5,008</td>
</tr>
</tbody>
</table>

Note: The statistics for Kafue fishery from 1978 include the fish-catch of Itezhi-Tezhi reservoir.
Changes in the fishery

For a long time, the fishery in the open waters of the lake was based mainly on cichlid species. The catch rates over the last three decades declined drastically and this may be attributed to the introduction of more efficient and cheap nylon gill-nets, and the increased demand for fish from the Copperbelt in the 1950s. When the large sized fish became relatively scarce, fishermen resorted to small-meshed nets and other illegal methods of fishing which resulted in the landing of a sizeable proportion of immature fish. The average catch per net declined from about 22 kg in 1955 to less than 10 kg/net in 1958. By 1972 the catch rates were reduced to almost 2 kg/net. A drastic reduction in catch per unit of effort occurred in the early 1950s. Catch rates of experimental gill-nets confirm these trends. Catches dropped from 9.15 kg/net in 1951 to 1.88 kg/net in 1956. Over the succeeding 25 years the catch rate fluctuated considerably and by 1976 it was 1.08 kg/net (Evans, 1978). These quantitative changes in the catch have been accompanied by qualitative changes since 1958. The much preferred cichlids (Oreochromis macrochir and Tylochromis bangwelensis) have been replaced by less desired characids (Hydrocynus vittatus and Alestes macrophthalmus). Two species of Labeo taken in 1958 have not been represented in the research catches since 1972. Oreochromis macrochir, which used to be the main target fish and contributed to 18% of the catch in 1958, was reduced to 2.23% in the experimental gill-net catches during 1979-1984 period.

Present status of the fishery

The experimental gill-net data collected from 1979-1983 was analyzed to elucidate the changes in the species composition and their relative abundance (Table 2). A total of 27 species was recorded during the survey.

The characid Alestes macrophthalmus accounted for 33.55% by weight of the catch in 1983, a three-fold increase over 1979. Schilbe mystus, Tilapia rendalli, Serranochromis angusticeps and mormyrids showed declining catch rates over the sampling period, whereas Oreochromis macrochir, Chrysichthys nabusi, Synodontis nigromaculatus, Petrocephalus catastoma, Tylochromis bangwelensis and Auchenoglanis occidentalis showed improved catch rates by 1983. No major changes were detected in the relative abundance of other species. The slight improvement in the catches of Oreochromis macrochir and Tylochromis bangwelensis is a sign of their gradual recovery.

Table 3 shows that small-meshed nets (25, 37, 50 mm) caught 40% of the catch during 1979-1981 as against 28% in 1983. On the other hand the medium-sized nets (63, 76 and 89 mm) accounted for more than 50% of the catch in 1983. The same years recorded only 27% of the catch during 1979-1981. This trend further supports the observation that the fish-stocks in the open waters are improving.

The survey also highlights the potential for exploitation of Alestes in the open waters. The species accounted for 53% of the catch by number and 99.9% of these were taken in small-meshed nets. However, these small-meshed nets also catch immature fish of other commercially important species in overwhelming numbers which is a typical problem confronting all multispecies and multigear fisheries. The Alestes stock is
### Table 2: Mean Percentage of Species Composition by Weight in the Experimental Gill-net Catches from Bangweulu Fishery (1979 - 1983)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alestes macrophthalmus</em></td>
<td>12.3</td>
<td>29.3</td>
<td>30.9</td>
<td>36.8</td>
<td>33.6</td>
</tr>
<tr>
<td><em>Schilbe mystus</em></td>
<td>14.7</td>
<td>7.4</td>
<td>0.1</td>
<td>0.1</td>
<td>0.8</td>
</tr>
<tr>
<td><em>Tilapia rendalli</em></td>
<td>5.3</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Serranochromis angusticeps</em></td>
<td>9.3</td>
<td>3.9</td>
<td>4.8</td>
<td>3.4</td>
<td>5.3</td>
</tr>
<tr>
<td><em>Petrocephalus catastoma</em></td>
<td>1.5</td>
<td>0.7</td>
<td>0.1</td>
<td>0.6</td>
<td>2.9</td>
</tr>
<tr>
<td><em>Barbus</em> spp.</td>
<td>2.0</td>
<td>1.2</td>
<td>0.2</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td><em>Mormyrops deliciosus</em></td>
<td>2.8</td>
<td>3.2</td>
<td>1.9</td>
<td>2.9</td>
<td>0.9</td>
</tr>
<tr>
<td><em>Marcusenius</em> spp.</td>
<td>1.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Hydrocynus vittatus</em></td>
<td>7.5</td>
<td>14.6</td>
<td>15.4</td>
<td>21.9</td>
<td>3.6</td>
</tr>
<tr>
<td><em>Clarias</em> spp.</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Synodontis nigromaculatus</em></td>
<td>6.6</td>
<td>2.0</td>
<td>3.9</td>
<td>2.2</td>
<td>10.5</td>
</tr>
<tr>
<td><em>Marcusenius macrolepidotus</em></td>
<td>2.6</td>
<td>0.2</td>
<td>0.3</td>
<td>0.6</td>
<td>0</td>
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<tr>
<td><em>Tilapia sparmamenti</em></td>
<td>0.7</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td><em>Tylorhinchus bangwelensis</em></td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td><em>Eutropius bangwelensis</em></td>
<td>1.9</td>
<td>5.9</td>
<td>1.2</td>
<td>0.0</td>
<td>6.4</td>
</tr>
<tr>
<td><em>Mormyrus monteirii</em></td>
<td>4.2</td>
<td>4.4</td>
<td>2.6</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td><em>Chrysichthys mabusi</em></td>
<td>4.6</td>
<td>11.4</td>
<td>3.0</td>
<td>5.0</td>
<td>18.3</td>
</tr>
<tr>
<td><em>Haplochromis mellandi</em></td>
<td>0.9</td>
<td>0.2</td>
<td>0.3</td>
<td>0.7</td>
<td>1.5</td>
</tr>
<tr>
<td><em>Oreochromis macrochir</em></td>
<td>3.2</td>
<td>5.3</td>
<td>8.4</td>
<td>8.4</td>
<td>6.0</td>
</tr>
<tr>
<td><em>Mormyrus longirostris</em></td>
<td>10.8</td>
<td>1.6</td>
<td>0</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td><em>Clarias gariepinus</em></td>
<td>2.6</td>
<td>1.9</td>
<td>2.6</td>
<td>3.7</td>
<td>0</td>
</tr>
<tr>
<td><em>Clarias ngamensis</em></td>
<td>4.5</td>
<td>0.6</td>
<td>3.4</td>
<td>1.6</td>
<td>0</td>
</tr>
<tr>
<td><em>Alestes grandisguamis</em></td>
<td>0.7</td>
<td>1.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Serranochromis thunbergi</em></td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Auchenogranis occidentalis</em></td>
<td>0</td>
<td>2.2</td>
<td>19.3</td>
<td>7.6</td>
<td>5.7</td>
</tr>
<tr>
<td><em>Mormyrus</em> spp.</td>
<td>0</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td><em>Haplochromis codringtoni</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Table 3  Percentage of Catch by Mesh Size in the Experimental Gill-net Catches of Bangweulu Lakes During 1979-81 and 1983

<table>
<thead>
<tr>
<th>Mesh size (mm)</th>
<th>1979</th>
<th>1980</th>
<th>1981</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>13.2</td>
<td>16.3</td>
<td>7.7</td>
<td>10.7</td>
</tr>
<tr>
<td>37</td>
<td>17.2</td>
<td>19.2</td>
<td>17.7</td>
<td>15.5</td>
</tr>
<tr>
<td>50</td>
<td>9.8</td>
<td>15.5</td>
<td>12.4</td>
<td>2.1</td>
</tr>
<tr>
<td>63</td>
<td>18.0</td>
<td>9.8</td>
<td>9.2</td>
<td>29.8</td>
</tr>
<tr>
<td>76</td>
<td>12.4</td>
<td>7.6</td>
<td>5.9</td>
<td>16.6</td>
</tr>
<tr>
<td>89</td>
<td>8.4</td>
<td>3.4</td>
<td>6.3</td>
<td>4.0</td>
</tr>
<tr>
<td>102</td>
<td>6.9</td>
<td>7.1</td>
<td>10.4</td>
<td>1.9</td>
</tr>
<tr>
<td>114</td>
<td>5.3</td>
<td>9.5</td>
<td>9.5</td>
<td>10.4</td>
</tr>
<tr>
<td>127</td>
<td>0.9</td>
<td>2.2</td>
<td>6.2</td>
<td>9.0</td>
</tr>
<tr>
<td>152</td>
<td>0.7</td>
<td>0.9</td>
<td>9.6</td>
<td>–</td>
</tr>
<tr>
<td>165</td>
<td>7.4</td>
<td>8.2</td>
<td>5.1</td>
<td>–</td>
</tr>
</tbody>
</table>

underexploited at present due to the mesh size restrictions in the fishery. Fishermen also do not consider *Alestes* as a target species because of its tendency to spoil very rapidly.

It has also been established through Departmental exploratory fishing carried out in four lakes that the open waters of the lakes offer great fishery potential for *Eugroulicypris moeruensis* (chisense). The trial fishing carried out with a lift net of 3 m² in conjunction with light yielded 1.52 - 2.49 kg of chisense for every 30 minutes of lighting. Experimental fishing carried out by a chisense fisherman from Lake Mweru (Luapula) gave excellent results of over 10 kg/haul. The chisense resource of the lake is underexploited at present and the fishing operations are limited to daytime fishing in shallow waters by fisherwomen and children using drag nets of mosquito mesh or mealie meal bags.

**Future development and management strategies**

Uncontrolled destructive fishing practices have resulted in the collapse of the open water fishery. Consequently, much of the fishing in the Bangweulu complex is now confined to the swamp/floodplain areas, where the catch rates are up to three times that of the open waters.

However, exploitation of fish species which are presently under or unexploited may be in the best interest of this fishery. And although the swamp fishery offers some scope for expansion, revival of the open water fishery is of the utmost importance.
Development of suitable methods of exploitation for the abundant stocks of *Alestes* and *chisense* therefore assumes importance. Use of small-meshed gill-nets for the offshore *Alestes* may not have any detrimental effects on other commercially important fish species. Better handling and processing practises would alleviate the spoilage problem associated with the species. A Chisense fishery development plan should ensure adequate supply of fishing equipment including webbings for the nets, and paraffin pressure lamps/spares, as these fishing materials are in short supply at present. Such a diversion in the fishing pressure will also give ample chance for the stocks of *Oreochromis macrochir* and *Tylochromis bangwelensis* to re-establish in the open waters of the lake. In the swamp stock, although exploited using small-meshed nets, the cover and protection offered by the macrovegetation and the patchy distribution of fishing effort in time and space, serve as a natural conservation mechanism. The potential yield of the swamp stock was estimated at 23,550 metric tons/annum by Evans (1978) and within the range of 20,000 - 30,000 metric tons/annum by Bernacsek (1985).

Fishing in the swamps and floodplains poses unique problems. High water levels render the fishing operations difficult. As a result the fishing pressure is intensive during the dry months, when more areas become available for temporary settlements. However, a good number of fishing grounds are made inaccessible during the dry season due to navigational constraints in the channels. Maintenance of high water levels in the channels during the dry season would ensure greater mobility and accessibility to the fishing grounds. Improvements in the water transport systems of the lakes/swamps will enhance the efficiency of the collection and distribution of fish as well as the supply of provisions to remote fishing camps.

The swamp fishery also faces an acute shortage of firewood for fish-processing. As a result, the processed products are of poor quality. Adequate supply of firewood and development of fuel efficient processing methods will improve the quality of the processed fish.

Lack of timber suitable for dugout canoes and for boat-building has been identified as another problem facing the fishing community. Development of a boat-building industry will not only provide the necessary fishing requisites for fishermen but also improve the employment opportunities in the fishery area.

The development of a fishery based on *Alestes* and *chisense* in the open waters of the lake will minimize some of the problems associated with swamp fishing, and at the same time prove an efficient management tool for the revival of the depleted cichlid stocks. The recently enforced regulation on fishing effort during the breeding period of the cichlids is also aimed at achieving this goal.

**Fishery of the Kafue Flats**

The Kafue Flats are referred to as the floodplain area between Itezhi-tezhi and Kafue Gorges of the Kafue River system. The floodplain fishery is one of the most productive and an important source of fish supply for Lusaka. The average annual yield from the fishery is about 7,700 metric tons. Production of the fishery has fluctuated, and in recent years the figures have dropped considerably (Table 1). The multiple use of the floodplain...
for hydroelectric power, water supply, cattle grazing, wildlife, agriculture and industries, at times conflict with the fisheries’ interests. The recent impoundments in the river system have altered the hydrology of the floodplain and there is evidence to suggest that these changes have affected the fish-stocks of the floodplain.

Past performance of the fishery

What we consider today as an overexploited fish stock in the Kafue Flats was more or less a virgin stock three decades ago. The floodplains were underfished until the mid-1950s and the fishing operations were limited to dry season beach-seining. The introduction of nylon gill-nets in 1954, coupled with the insatiable demand for fish from the urban markets along the line of rail, resulted in the rapid expansion of fishing activities on the Flats. By 1958 there were 1,734 gill-nets in year round operation, supplemented by traditional seining during the dry season. The increase in fishing effort, years of intense low water fishing for fish confined in the river channels/lagoons, and poor breeding success together contributed to a drastic drop in catch rates and average size of the fish caught in the late 1950s. The catch rates of the gill-nets dropped from 50 kg/net in 1955 to 28 kg/net in 1957 and to 21 kg/net in 1958. The rates continued to decline and during 1965-1968 were reduced to less than 4 kg/net. Qualitatively, the most common and much preferred bream has been reduced in the catch to insignificant proportions.

The construction of the dam at Kafue Gorge in 1971 has brought about changes in the hydrological status of Kafue Flats. The major changes include the reduction in the area flooded during the rainy season, delayed and prolonged flood period, increase in permanently flooded areas, and reduction in the amplitude of water level fluctuation and velocity of flow. These changes in the flood-regime have affected the breeding behaviour, growth and survival of the fish stocks, particularly the bream. Pre- and post-impoundment studies revealed slight changes in the limnological characteristics and in the relative abundance of major species (Dudley and Scully, 1980). However, the same authors observed that the catch rates during 1975-1976 were lower than those of 1969-1970 for many important species. The pre-impoundment studies (University of Michigan, 1971; University of Idaho, 1971) predicted an increase in the ichthyomass following impoundment of the Kafue Gorge under the assumption that the natural mortality during the falling and low water would be reduced, and high post-impoundment water levels would reduce the fishing mortality as the seining beaches would be flooded. However, an increase in fish stocks due to these factors has not been apparent during the post-impoundment period (Dudley and Scully, 1980).

Status of the fishery during the post Itezhi-tezhi impoundment

With the construction of the dam at Itezhi-tezhi in 1977, the flood pattern became more unpredictable. The reduced flow rates maintained lower water levels in the river channels. Consequently, many fishermen abandoned their customary beach-seine grounds. The fish production from the Kafue Flats declined considerably in the 1980s. Emigration of fishermen to Itezhi-tezhi reservoir, Lukanga Swamps and Lake Kariba
reduced the number of active fishermen from 2,634 in 1977 to 1,157 in 1984. Comparison of limnological and fishery biological characteristics of pre- and post- Itezhi-tezhi impoundment is rendered difficult due to scanty data. The unusual drought years of the early 1980s also masked some of the trends and changes.

One way of evaluating the changes in the fish population is through examination of experimental gill-net catches. The results of the gill-net catches in the Lochinvar area of the Kafue Flats from 1980-1985 were analyzed and compared with the previous data to gather information on the changes in species’ composition and their relative abundance (Table 4). The survey sampled a total of 19 species out of the 67 recorded from the Kafue system. The decline in the catch of commercially important cichlids registered during the 1970s continued for the period 1980-1985. Oreochromis andersonii which accounted for 50% of the total catch in 1968 was reduced to 18.7%, 4.6% and 2.83% respectively in 1970, 1977 and 1983. The data for 1984 and 1985 however, showed some definite signs of recovery for the species. The other important species of breams, namely Oreochromis macrochir, Tilapia rendalli and T. sparmannii, also marginally improved their catch over the previous years.

The catch by mesh indicated that 50 and 63 mm nets accounted for 68.6% of the total catch by number. Commercially important cichlids (young of the year class) formed a predominant element in 1985 in the small-meshed nets. This further confirms the breeding success of the cichlids during the 1983-1984 and 1984-1985 season.

Another glaring change observed was the increase in the predatory clarids in the catch, which rose from 10% in 1970 to more than 72% in 1983 and 1984. It is reasonable to assume that the increase recorded in the predator population may be due to the higher juvenile/small fish concentration in the Nampongwe area following higher dissolved oxygen levels as reported by Dudley and Scully (1980), and the better forage base available for these predators. With the increased catch rates for O. andersonii, the relative proportion of clarids declined in 1985.

The drought years in the early 1980s increased mortality further through predation of the already scarce forage species comprising mainly the cichlids. With better rains and greater inundation during the 1983-1984 and 1984-1985 seasons, the breeding of cichlids was apparently very successful. Most of the O. andersonii caught in 1985 were from nets of smaller mesh than 76 mm, indicating strong year classes for less than two year olds. This further lends support to the observation of Muney (1977) that the spawning stocks in the Kafue Flats have not been depressed to a point at which reproductive response to improved water conditions has been hindered. Lack of parental care may be the reason for the poor survival rates in the other two Tilapia species.

Although the results from the Nampongwe area provide some insight into the changes that have taken place in species composition and transformation, generalization of the trends for the whole Flats may be misleading.
### Table 4: Comparison of Species' Composition in Percentage by Weight of the Experimental Gill-net Results of 1970, 1977 and 1980 - 1985 from the Lochinvar Area

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oreochromis macrochir</td>
<td>16.70</td>
<td>4.60</td>
<td>1.05</td>
<td>0.36</td>
<td>0.13</td>
<td>0.41</td>
<td>0.10</td>
<td>0.7</td>
</tr>
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<td>Oreochromis andersonii</td>
<td>29.10</td>
<td>30.12</td>
<td>6.95</td>
<td>12.53</td>
<td>3.26</td>
<td>2.83</td>
<td>4.50</td>
<td>14.4</td>
</tr>
<tr>
<td>Tilapia rendalli</td>
<td>11.20</td>
<td>2.29</td>
<td>9.41</td>
<td>1.93</td>
<td>0.28</td>
<td>0.05</td>
<td>-</td>
<td>0.7</td>
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<td>1.30</td>
<td>0.72</td>
<td>0.66</td>
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<td>0.24</td>
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<td>Serranochromis angusticeps</td>
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<td>4.41</td>
<td>8.27</td>
<td>5.99</td>
<td>9.94</td>
<td>1.67</td>
<td>2.40</td>
<td>12.4</td>
</tr>
<tr>
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<td>1.76</td>
<td>4.19</td>
<td>10.33</td>
<td>15.90</td>
<td>10.26</td>
<td>7.60</td>
<td>0.0</td>
</tr>
<tr>
<td>Serranochromis thunbergi</td>
<td>0.30</td>
<td>0.05</td>
<td>0.94</td>
<td>0.25</td>
<td>0.17</td>
<td>0.04</td>
<td>0.04</td>
<td>0.0</td>
</tr>
<tr>
<td>Serranochromis gardi</td>
<td>0.80</td>
<td>1.10</td>
<td>1.22</td>
<td>0.68</td>
<td>0.55</td>
<td>0.98</td>
<td>0.30</td>
<td>0.3</td>
</tr>
<tr>
<td>Marcusenius macrolepidotus</td>
<td>1.40</td>
<td>6.27</td>
<td>1.65</td>
<td>3.75</td>
<td>1.37</td>
<td>0.93</td>
<td>3.30</td>
<td>3.8</td>
</tr>
<tr>
<td>Hepsetus odoe</td>
<td>5.00</td>
<td>7.66</td>
<td>11.29</td>
<td>6.02</td>
<td>0.84</td>
<td>1.20</td>
<td>0.20</td>
<td>4.9</td>
</tr>
<tr>
<td>Labeo molybdinus</td>
<td>0.40</td>
<td>2.85</td>
<td>9.14</td>
<td>0.59</td>
<td>1.57</td>
<td>1.11</td>
<td>0.10</td>
<td>0.6</td>
</tr>
<tr>
<td>Schilbe mystus</td>
<td>8.70</td>
<td>7.41</td>
<td>3.21</td>
<td>13.97</td>
<td>9.58</td>
<td>4.37</td>
<td>5.20</td>
<td>7.5</td>
</tr>
<tr>
<td>Ciarías gariepinus</td>
<td>7.00</td>
<td>21.11</td>
<td>26.90</td>
<td>34.94</td>
<td>44.71</td>
<td>63.77</td>
<td>70.80</td>
<td>37.0</td>
</tr>
<tr>
<td>Synodontis kafuensis</td>
<td>0.40</td>
<td>2.15</td>
<td>2.33</td>
<td>1.39</td>
<td>4.45</td>
<td>2.37</td>
<td>1.10</td>
<td>2.9</td>
</tr>
<tr>
<td>Mormyrus lacerda</td>
<td>0.00</td>
<td>0.38</td>
<td>6.69</td>
<td>0.35</td>
<td>0.54</td>
<td>0.29</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>Serranochromis robustus</td>
<td>0.30</td>
<td>0.24</td>
<td>0.30</td>
<td>0.00</td>
<td>0.18</td>
<td>0.00</td>
<td>0.00</td>
<td>0.9</td>
</tr>
<tr>
<td>Ciarías theodorae</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.51</td>
<td>0.18</td>
<td>0.00</td>
<td>0.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Note: 1970 and 1977 data from Muyanga and Chipungu (1978)
Future management strategies

Earlier studies on the Kafue Flats (University of Michigan, 1971; University of Idaho, 1971; Kapetsky, 1974; Dudley, 1974; Dudley and Scully, 1980) have demonstrated clearly that water levels and flooding patterns are major factors affecting reproductive behaviour, hatching, growth, natural mortality, and eventually determine the structure and density of the fish population. Welcome (1975) showed a very high correlation between recorded catch and floodplain area. The fish catch of the Kafue flats in a given year was positively correlated with the area inundated in the previous year (University of Michigan, 1971). Muncy (1977) further emphasized that water levels in the previous two years had a greater effect on increased catch than water levels in the same year.

In addition to the poor rainfall, the man-induced changes in the ecology of the floodplain and in the exploitation levels of fish have been identified as the major factors responsible for the fluctuation and decline in the catch.

The past fishing experiences in the Bangweulu system and the Kafue Flats have illustrated how unregulated fishing effort can bring about catastrophic changes in the structure and density of fish populations. In the Kafue Flats, the situation is compounded by the hydrological changes consequent upon the impoundments. The results of the experimental gill-net surveys carried out by the Department of Fisheries have shown some signs of recovery for the fishery in the open waters of the Bangweulu system and the Kafue Flats. With the recently enforced control on fishing pressure during the breeding season, the recovery process will be enhanced further. The experimental and exploratory fishing carried out by the Department of Fisheries in the Bangweulu lakes have revealed considerable exploitation potential for pelagic species in the open waters. Development of a fishery based on these species will not only increase the total yield but also aid in the revival of the depleted stocks of cichlids.

Some of the problems confronting these fisheries can be solved only through a multidisciplinary approach with a well coordinated inter-departmental/institutional effort. The need for an integrated approach in all future development and management programmes in these fishery areas is therefore emphasized.

References


2.6 Agriculture as a component of wetlands conservation

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Introduction

Lately, there has been increased appreciation of the need to utilize and conserve wetland areas. This is shown by the ever-increasing number of workshops, conferences and seminars which have been held on the subject (e.g. IITA, 1985; MAWD/FAO, 1986; GRZ/IUCN, 1985; SADCC, 1986). This awareness is probably a response to the threat posed by the increasing human population pressure and the need to conserve these areas and prevent their further degradation. The latter factor was the main theme of the Workshop which was organized by the Southern African Development Coordination Conference (SADCC).

The two terms conservation and utilization may at first seem contradictory. However, as defined in the National Conservation Strategy for Zambia, conservation is "the wise management of natural resources, so that they produce sustainable benefits indefinitely". This means, therefore, that for continued development, including agricultural development, to take place, the foundation for this development must be maintained. Where applicable, agricultural development should be one component of wetland conservation. This paper discusses agricultural development in the wetland areas of Bangweulu Basin and Kafue Flats.

Agriculture in the wetland areas of Zambia

The potential for agricultural production in the wetland areas of Zambia has been discussed by a number of authors (Debenham, 1952; Forster, 1953; FAO, 1968; Kerkhoven, 1963; Mwanza, 1986; Shalwindi, 1986; Veldkamp, 1986; Sichalwe, 1986). Some form of traditional agriculture has been practised in these areas since time immemorial. Yields under this system of farming are, however, low. For example, it is not uncommon to get yields of 5 to 15 bags (450 to 1,350 kg) of maize per hectare (FAO, 1968). Yet, work from experimental research conducted under irrigated conditions in the Kafue Flats, or under residue moisture in the Bangweulu Basin, indicates that there is great potential for increased agricultural production in wetland areas (Tables 1 and 2). The data in these two Tables suggest that better yields are obtained when crops are grown
Managing the wetlands of Kafue Flats and Bangweulu Basin

**Table 1** Crops and Experimental Yields per Hectare at Kafue Pilot Polder Scheme

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>4,704 kg Seed Cotton</td>
</tr>
<tr>
<td>Kenaf</td>
<td>4,256 kg</td>
</tr>
<tr>
<td>Maize</td>
<td>7,840 kg</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>3,584 kg</td>
</tr>
<tr>
<td>Soybeans</td>
<td>3,584 kg</td>
</tr>
<tr>
<td>Rice</td>
<td>7,840 kg</td>
</tr>
<tr>
<td>Wheat</td>
<td>4,480 kg</td>
</tr>
<tr>
<td>Barley</td>
<td>4,480 kg</td>
</tr>
<tr>
<td>Peas</td>
<td>2,800 kg</td>
</tr>
<tr>
<td>Beans</td>
<td>2,240 kg</td>
</tr>
<tr>
<td>Potatoes</td>
<td>26.9 tons??</td>
</tr>
</tbody>
</table>

Source: Kerkhoven (1963)

**Table 2** Crops and Yields per Hectare in Bangweulu Basin under Residual Moisture

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td>2,100 kg</td>
</tr>
<tr>
<td>Wheat*</td>
<td>9; 17.6; 59.5; 18 kg</td>
</tr>
<tr>
<td>Triticale</td>
<td>No grain development</td>
</tr>
<tr>
<td>Beans</td>
<td>365 kg</td>
</tr>
<tr>
<td>Peas</td>
<td>560 kg</td>
</tr>
<tr>
<td>Soybeans</td>
<td>333 kg</td>
</tr>
<tr>
<td>Potatoes</td>
<td>6.5 tons</td>
</tr>
<tr>
<td>Maize</td>
<td>600 kg</td>
</tr>
</tbody>
</table>

Source: Marcelo (1986)

* Depending on variety. Low yields due to aluminium toxicity.
under irrigation than under residue moisture. This may be a reflection of possible water stress conditions in the latter situation (especially towards the end of the growth period). In the case of maize, for example, it is recommended that its cultivation be restricted to the margins of the dambos, using irrigation when necessary (Marcelo, 1986). This is because moisture stress drastically reduces yields, with the effect being influenced by the type of crop and the stage of the crop's development at which the stress occurs (Eastin and Sullivan, 1984). In contrast, when the crops are grown under irrigation, water availability is controlled and water stress can be avoided.

The differences in yields between the two wetland areas might also be attributed to variations in the environmental conditions. Generally, there are better growing conditions in the Kafue Flats than in the Bangweulu Basin.

While growing of crops under irrigation during the dry season may seem more attractive, it is, nevertheless, an expensive proposition. This can only be done under large scale farming conditions or in situations where group irrigation schemes are provided. It means therefore, that for the vast majority of the inhabitants of these areas, growing of crops during the dry season under residue moisture remains the most economic proposition.

Data in Tables 1 and 2 also show that a wide variety of crops can be grown in the two wetland areas, with vegetables being the most attractive in terms of ease of growing and quick return on investment. The choice of crop, however, is also influenced by the season. The most logical crop to grow during the rainy season is rice (IITA, 1985). This is because the rice plant has the morphological as well as physiological adaptations to grow under water-logged conditions (Eastin and Sullivan, 1984). On the fringes of the swamps, some vegetables can be cultivated, depending on whether or not they perform well under rainfed conditions (Mathai, 1980). During the dry season, many more crops can be grown either under irrigation or residual moisture conditions. Other aspects of agricultural production with special reference to wetlands will be discussed later.

In trying to promote agricultural development in the wetland areas, mention must be made of the need to take into account the existing land use patterns, especially those that may affect people's willingness to accept change. According to Forster (1953), stock raising with irrigated pasture is the most predominant form of land use in the Kafue Flats. After livestock raising, rice growing is the most important undertaking. Rice can be cultivated both during the rains and during the dry season under irrigation. Rain fed rice can be followed by winter grasses. Other dry season crops include wheat, onions, potatoes and sugar cane. Maize which is tolerant to cool temperatures can also be grown. In the Bangweulu Basin, the predominant occupation is fishing, followed by livestock raising (Brelsford, 1946; Debenham, 1952). It is imperative, therefore, that any new forms of development take these current land use forms into account.

The information discussed above gives clear evidence that there is sufficient potential for agricultural development in the two wetland areas. This development has been hampered, in part, by the classification of these areas as having little or no agricultural potential (G.R.Z., 1965). This classification is mainly because of the presence of lakes, swamps and floodplains. However, the Bangweulu Basin is classified as being suitable for special market crop production (i.e. vegetables), while the Kafue Flats is suitable for special market crop production and forestry (G.R.Z., 1985).
Characteristics of wetland agriculture

Since these wetlands are relatively “new” in terms of intensive agricultural production, there is a great need for research in order to develop production packages of technologies suitable for the respective local conditions, and in particular for those of small-scale farmers (IITA, 1985). These should include land preparation, dates of planting, fertilizer levels, crop type and variety, spacing, seed rates, cultivation, herbicide responses (seed control), pest and disease control, and harvesting. The problem of disease control is especially important in view of the fact that a number of the disease pathogens are favoured by warm and moist conditions.

Drainage is major problem in many wetland areas (FAO, 1968). Under such conditions, it is best to grow crops (especially rice) which can do well. If other crops have to be grown, there is need for the provision of a good drainage system to drain away excessive water. In addition, it is recommended that crops be grown on ridges so that roots develop above the water table. The growth of roots in water-logged soil (anaerobic) reduces plant growth and development, leading to yield losses (Russell, 1977).

Research from the Kafue Pilot Polder suggests for crops like maize, cotton and rice, all the nitrogen required should be applied at once a few centimeters below and to the side of the seed. This facilitates week control (Kerkhoven, 1963). Such crops should not only be able to tolerate this high N-level in the sensitive seedling stage, but they should also be able to utilize it immediately without significantly extending the vegetative period.

An extension of the vegetative period might delay the onset of the reproductive stage, thereby reducing the length of the reproductive stage of development. In crops which produce seed, this effect might lead to low yields (Eastin and Sullivan, 1984). The loss in yield under such conditions is largely the result of a reduction in the number of seeds produced (Eastin and Sullivan, 1984). For legume crops such as groundnuts and soybeans, fertilization may not be necessary. Such crops are able to fix atmospheric nitrogen for their own use. However, for most soybean varieties grown in Zambia, it is recommended that a small level of starter fertilizer be applied to encourage early vigorous growth before the plants start to fix their own nitrogen. What needs discussion is the growing of crops during the dry season either under irrigation or residual moisture. The very nature of these areas leads to the fact that this would be the ideal period for most crop production enterprises; from the point of view of reduced excess water and lower incidence of diseases. This period, however, is characterized by low temperatures, and as noted earlier, most crops need to have some degree of tolerance to low temperature conditions. For wheat, the cool season is the ideal time for production, since it has evolved in temperate environments. Lower temperatures during the vegetative stage promote tillering, whereas warmer temperatures during the grain filling period (August to September) enhance grain development and therefore promote yields. For crops that have evolved under tropical conditions (e.g. maize and rice), low temperatures might be very critical depending on the crop and its temperature range. Maize seed will not germinate at temperatures below 10°C and plant growth and development is greatly hampered if the temperature goes above 40°C. The corresponding temperatures for rice are 7°C and 45°C respectively (Veldkamp, 1986). At the moment there is little or no research in Zambia on the development of low temperature tolerant crop varieties.
Susceptibility to soil compaction is another important aspect, since land preparation for dry season cropping will be done while the soil is relatively wet. Soil compaction is enhanced by use of heavy machinery. Crops for this season, therefore, might need to have the ability to grow and develop under these unfavourable soil conditions.

Wet soil conditions towards the end of the rainy season will result in delayed harvesting, especially if machine harvesting is practised. This delay might result in reduced yields due to the probable exposure to unfavourable environmental conditions (e.g. disease). Other sources of yield loss might be pod shattering and sprouting of seeds on the plant after reaching physiological maturity (e.g. soybeans and wheat, respectively). Such crops should have varieties that can tolerate or resist these problems (Kerkhoven, 1963).

A logical consequence of delayed machine harvesting is delayed land preparation and subsequent planting for the dry season crop. This means, therefore, that crop varieties that have fast early growth and establishment will be preferable, otherwise low yields can be expected.

It should be pointed out, however, that the problems of soil compaction, delayed harvesting and subsequent delayed land preparation and planting are more critical if commercial farming, i.e. using heavy machinery, is practised. Under small-scale farming conditions, these problems will be of less significance. Nevertheless, they will need to be kept in mind.

The point of small-scale farming brings in the question of whether this type of farming should be promoted at the expense of commercialized farming. While commercial farming might be more profitable, the ecology, socio-economic conditions and the need to minimize the disturbance to the two areas’ current utilization dictate that small-scale farming should be encouraged. This will enable the local inhabitants to continue their traditional economic activities while engaging in small-scale agriculture to supplement their food and earn some income. The need to minimize disturbance of the areas’ activities is important with regards to the tourist industry. As discussed below, the promotion of agriculture and tourism in the two wetland areas are not necessarily contradictory.

**Wetland agriculture and the tourist industry**

It has been said by many local leaders (both political and business) that after copper, tourism is second only to agriculture in terms of the potential to support the country’s development. However, as data in Table 3 show, the number of tourists coming into the country is on the decline. This trend is likely to continue despite the optimistic projections. Although there are no separate figures for Kafue Flats and Bangweulu Basin, it is reasonable to assume that the national trend also applies to these areas. In general more tourists visit the Kafue Flats than the Bangweulu Basin. This might be due in part to its nearness to the major centres. In addition its wildlife attractions are well publicized.
Managing the wetlands of Kafue Flats and Bangweulu Basin

Table 3  Tourist Arrivals in Zambia (1981-85) and Projections for 1986 and 1990

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>146,849</td>
</tr>
<tr>
<td>1982</td>
<td>118,627</td>
</tr>
<tr>
<td>1983</td>
<td>122,051</td>
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<tr>
<td>1984</td>
<td>129,197</td>
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<td>1985</td>
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<tr>
<td>1986</td>
<td>130,000</td>
</tr>
<tr>
<td>1990</td>
<td>176,000</td>
</tr>
</tbody>
</table>

Source: Zambia National Tourist Bureau 1984. Projections

One of the major problems causing the poor performance of the tourist industry is inadequate funds to market the tourist potential both locally and internationally (Z.N.T.B., 1984). Some of the money is used to import some food stuffs by hotels and safari lodge operators to satisfy the foreign tourist. The goods include wheat and rice. If these goods were locally produced, the money thus released could be used to promote tourism.

Conclusion

There is increased awareness, both in Zambia and worldwide of the need to utilize and conserve wetlands. In Zambia, this concerns mainly the Kafue Flats and Bangweulu Basin. One way of achieving this goal is to incorporate agriculture into the overall conservation strategy.

The agricultural potential and the crops that can be grown are important. However, any attempts to promote agriculture should take into account the existing land use patterns.

References


Agriculture as a component of wetland conservation


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2.7 Economic value of the herpetofaunal resources in wetland areas of Zambia

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Introduction

The 3,000 km course of the Zambezi River, from its common watershed with the Zaire to the Indian Ocean, crosses a number of floodplains that are inundated seasonally, mainly from monsoonal rains (Beadle, 1981). The Zambezi drainage area includes the following significant wetlands: the Kafue Flats, and the Lukanga and Busanga Swamps. There are also many wetland areas along the tributaries of the Zambezi. The most important of these include the Luena Flats, Lungwebungu, and Nyengo in the western and North-western Provinces of Zambia, and the Luangwa in the Eastern Province. In the northern part of Zambia exist the Luapula and Chambeshi River drainage areas. The Bangweulu Swamps, Mweru wantipa marsh, Lusenga Flats and several other small wetland areas are the most important wetlands in the Luapula - Chambeshi river drainage system.

The paper discusses the possibilities of exploiting economically the reptile resources of both the Bangweulu Basin and the Kafue Flats wetland areas. Emphasis is placed on the possibilities of exploiting crocodiles because they are considered to be of greater commercial value than any other reptile groups.

Herpetofaunal resources of economic importance

In Zambia there are 237 species of amphibians and reptiles. Of this total, 85 species are amphibians and 152 species are reptiles. The taxonomy of the Zambian herpetofauna is well studied and is up-to-date (see Simbotwe, 1986).

Out of the total number of known Zambian reptile species, only the following can be considered to be of economic importance: 2 species of crocodiles - Crocodylus niloticus Laurent, 1968 and Crocodylus cataphractus Cuvier, 1824; and 6 species of turtles ("water tortoises") - Pelomedusa subrufa (Lacepede, 1789), Pelusios nanus Laurent, 1956, Pelusios subniger (Lacepede, 1789), Pelusios rhodesianus Hewitt, 1927, Pelusios bechuanicus bechuanicus FitzSimons, 1932 and Pelusios sinuatus (A. Smith, 1983). Crocodiles can be exploited for their skins, whereas turtles' flesh and eggs are palatable.
Managing the wetlands of Kafue Flats and Bangweulu Basin

and their shells (carapaces) may fetch good prices at both overseas and local markets. No amphibian species can be considered to be of any commercial value. According to current records of species distribution, the aforementioned species are either common to both wetlands, or at least inhabit one of them.

Resource exploitation for economic gain

Benefits

Ecological research is an essential first step in studying the economic potential of crocodiles and turtles. Initial country-wide surveys of wild populations and monitoring of harvest rates are needed to determine potential sustainable yields of wild crocodiles and turtles. I am inclined to think that the only viable long-term project on reptile use that could be undertaken under the wetland project is that of crocodile farming. Crocodile farming has been attempted before by individual farmers in Zambia and it has been shown to be economically viable; in Zimbabwe, crocodile farming is successful and gaining that country valuable foreign exchange (Blake, 1974; Child, 1985).

Crocodile rearing stations produce a “spectacle” and are of considerable appeal for tourists. A small fee could be charged to meet operational and maintenance costs. However, tourists must be excluded from breeding pens to prevent courtship activities and nest guarding from being disturbed.

Spencer’s Creek Crocodile Ranch at Victoria Falls (Zimbabwe) has received visitors for a long time and this has paid dividends in terms of money paid at the entrance and has improved peoples’ attitudes towards crocodiles.

Problems

Crocodile farms can only be successful if both the long-term and short-term objectives are realistic and not too broad and general. This is a real danger which was also experienced by the IUCN Crocodile Specialist Group in Papua New Guinea (Anon., 1978). In the case of Zambia, the short-term objective would be to establish crocodile farms in the Bangweulu and Kafue wetlands, and the long-term objective would be to integrate these projects into the socio-economic development programmes for inhabitants of these wetlands and their surrounding areas. Such projects will be accepted most easily by commercial farmers, some of whom have already accepted the existence of crocodiles on their land despite the often apparent conflict with grazing stock and danger to man. However, this leaves out the target group - the rural village communities. Traditionally, crocodiles in Zambia are not socially accepted, and their economic potential has not at any time been realized. This makes a sharp contrast with the peoples of the Caribbean (including the people of Cuba), and the Pacific Islands, in particular the peoples of Papua New Guinea (see Pooley, 1976; Downes, 1977) who traditionally have exploited crocodiles for their commercial value. This cultural problem has to be dealt with accordingly and before any of the other ground work is attempted.
Numerous other problems also exist. The acceptance of crocodile farming by peasant farmers will only come about with greater awareness of the value of wild animals as a source of income and food. This will come about through both effective oral communication, and approaches such as wildlife films concerning benefits to be accrued from crocodile farming. Biologists could also benefit by collecting information on traditions and bush-lore of the people. This programme could be made possible through the activities of the Wildlife Conservation Society of Zambia, radio broadcasting education units, and the extension units of the Ministry of Agriculture and Water Development.

Crocodile farming ventures are both labour and capital intensive. Large sums of money must be invested to set up the farms and to maintain them until they become productive. Twelve years ago in Zimbabwe, Blake (1974) estimated that this could need not less than $ZW30,000. Today, much more will be required. In addition, crocodile farmers must be conversant with captive breeding, husbandry techniques, and the Zambian Wildlife Act on the collection of eggs and live crocodiles in the wild. Another added cost to the programme would be the setting-up of an industry to process and market skins. The whole project however, may be justified as a meaningful attempt at the conservation of crocodiles and their use by the Zambian people. This will, however, require an acceptable national policy on rearing of crocodiles in Zambia, and control of illegal trade.

Starting crocodile farming or ranching is made easier by the fact that there is already a great deal of information available on collecting of eggs and live crocodiles, breeding, construction of enclosures and ponds, thermoregulation, artificial incubation, food, growth, disease, injury and mortality, predation, and immobilization techniques. Lessons from elsewhere are available to enable assessments of project success and failure.

Successful crocodile farms have been set up and run profitably in Zimbabwe (see Blake, 1974) and Papua New Guinea (Anon., 1978; Downes, 1977; Pooley, 1976).

**Ecological research for crocodile conservation and management**

The role of crocodiles in the economy of the people inhabiting wetlands (whether crocodiles are an asset or a liability) could be studied under this wetland research project. The role of crocodiles in the aquatic food chain, their impact on fish populations, and their attacks on fishermen and their grazing stock, could form an important research line of inquiry. It is important to know whether crocodiles provide a net benefit, or are destructive to the fish and fishing industries in the Bangweulu Basin and Kafue Flats wetlands. It is hoped that the results of this study could be integrated into fisheries improvement plans for the aforementioned wetlands.

To be able to carry out this study, basic surveys of crocodile population numbers and animal distribution in space and time are essential initial activities. Some of this information could be of direct use to monitoring of harvest rates for sustained yield harvesting of wild crocodiles. If fishermen and pastoralists learn something of crocodile behaviour and movement patterns, it is hoped that current conflicts could be minimized. Results on studies of growth in captivity (Cott, 1961; Blake, 1974) seem to reveal that crocodiles are not efficient energy-converters. Their growth-rate declines progressively...
with age. Cott (1961) shows that the diet of juvenile crocodiles up to one metre in length can be divided into two phases. In the first stage (i.e. from hatching to one metre), the diet is entirely that of insects, frogs, and spiders (with insects forming the bulk of the diet). In the second stage (half a metre to one metre long), the diet becomes more catholic, with crabs, molluscs, fish, reptiles, birds and mammals being introduced. This presents a difficult situation when trying to re-create natural conditions in captivity. To feed them insects involves much effort. However, information on the diet of crocodiles in captivity is available from crocodile farming and ranching centres in Zimbabwe (Blake, 1974) and elsewhere where crocodile husbandry is practised.

The future of crocodiles and other reptile resources of economic importance will largely depend on how the cost - benefit equation is handled by Parks and Wildlife officials, land-owners, and the public. For example, laws on exploitation of these resources must be clear: collection of eggs and animals from the wild must be under strict control and must create an incentive to the land-holders through small payments. Without this incentive, including payment of levies to owners of land, and provision of job opportunities for rural masses, crocodiles and other reptile resources of the wetlands will continue disappearing from areas of high human density.

Even in sparsely populated areas there will be demands to get rid of crocodiles. Where recreational, tourist and fishing activities exist and are in conflict, benefits from a crocodile industry must be higher than returns from all the aforementioned recreational activities put together. This is necessary to justify continued conflicts between crocodiles and outdoor enthusiasts, and also peasants in rural areas. Whatever benefits accrue must exceed costs and should filter down to the rural communities. Then, and only then, can conservation of reptile resources of economic importance be economically and socially acceptable to the people.

The best management will in many cases be to optimize crocodile value to the people on whose land they occur. However, these animals must have a high cost-benefit value and this should be seen by the land-holders. Child (1985) describes commercial crocodile rearing in Zimbabwe as most profitable, and that it brings in ZWS0.5 million in foreign earnings per annum. This has done much in promoting crocodile conservation outside National Parks and safari areas.

References


Economic value of herpetofaunal resources


2.8 Wetlands as potential sites for the future of tourism development

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Introduction

For nearly three decades Zambia has placed emphasis on the expansion of tourism so as to maximize foreign exchange earnings and increase local business. In doing so, many areas have been identified as potential tourism sites, particularly areas occurring within the National Parks system. Although factors that impede the growth of tourism have remained complex, the major focus of this paper is to identify the potential for the development and improvement of tourism in wetland areas.

Wetlands in Zambia include swamps, bogs, marshes, floodplains, rivers and shallow lakes. Well-known wetlands, particularly the Kafue Flats, Bangweulu and Mweru Wantipa Swamps, and Liwua and Busanga plains, have drawn considerable attention to tourism development. As wetlands are major wildlife habitats, and since traditional tourism has generally evolved based on wildlife resources, wetlands thus provide important sites for the development of this industry in Zambia.

Current status

When dambos are included, wetlands in Zambia cover nearly 13% of the land surface. While some major wetlands are protected as portions of National Parks or Game Management Areas, most of Zambia’s wetlands are inhabited, and some, in particular the Kafue Flats, have been altered significantly by the development of hydroelectric schemes. However, most of these areas are not exploited intensively, being used only for small-scale fishing, extensive livestock grazing, human settlement and wildlife conservation. In general, wetlands in Zambia have been perceived as areas of low economic output, and have therefore received low priority for development investment.
Managing the wetlands of Kafue Flats and Bangweulu Basin

As a result of this, the full development potential of resources such as wildlife and fisheries has remained underexploited.

Tourism as a component of rural development

To date, agriculture has always been regarded as the most important component of rural development in Zambia, and this perception has led to massive expansion of agriculture. Unfortunately, large parts of Zambia cannot support agriculture. In Zambia, rural development is perceived as being intended to improve small-scale rural enterprises and transform rural populations into productive agents, create employment, business, mobility opportunities, and improve the socio-economic infrastructures necessary for productivity. In addition, it is clear that with such a broad definition, these objectives for rural development cannot be achieved by emphasizing agriculture alone. Thus while agriculture generally can bring change in rural areas, well-designed tourism can provide a major contribution to rural development. It can provide major economic contributions through income generation, employment and diversifying the economic base of a country.

Levels of employment are low amongst the communities inhabiting Zambia’s wetlands. Those living on the floodplains are generally livestock herders, while those located in the swamps are predominantly fishermen. However, not everybody can own cattle, a canoe, or a net to create employment for himself. These communities are generally poor and powerless, inhabit areas which have been neglected and isolated, and suffer frequently from poor nutrition and poor health, two problems exacerbated by the absence of adequate health facilities. Tourism development could meet part of this employment need by providing job opportunities in hotels or lodges, transport, roads, trading, National Parks and construction work associated with this industry. Tourism can also increase the demand for village produce, such as vegetables, poultry and fish, thus providing added stimulus to the local economy.

The nature of tourism in Zambia’s wetlands

The greatest economic contribution of tourism in Zambia comes from visitors from outside the country. These come for various reasons - safaris, vacation, business, visiting friends and relatives, attending conferences, participating in sports, or passing through on route to other destinations. Wetland tourism can however be most effectively focused upon two specific kinds of tourists:

Historical tourism

Dr David Livingstone died in the Bangweulu Swamps and his heart was buried at Chitambo, a place on the edge of the wetland. The region is therefore of considerable historical interest and has the potential to attract historians and scholars as well as vacationers.
Environmental and safari tourism

Wetlands can provide considerable natural spectacle. In addition to their beautiful scenery and wilderness qualities, most wetlands are major sites for wildlife. As tourism in Zambia is currently mostly safari based, and centred upon wildlife, wetlands have substantial potential as sites for tourism development. Some visitors come to view wildlife (lechwe, sitatunga, and a variety of birds), others come to hunt wildlife or to fish.

Conclusion

Although wetlands continue to be remote and largely undeveloped, tourism could serve as one means to increase development investment. In this way many wetlands could yield higher economic output, so helping to improve the standard of living of local people. This would in turn help change community attitudes towards conservation.

As tourism needs minimal external capital for its development, and as its benefits are considerable, tourism should therefore be viewed as an important option in rural development in wetlands, especially in those where conditions are not favourable for pursuit of other development options.
The nature of tourism in Yushin's study

The study examines the concept of tourism in terms of its impact on the economy of Yushin, a region in South Korea. The study focuses on the development of tourism infrastructure and its effect on the local economy. The research methodology includes qualitative and quantitative data analysis. The findings suggest that tourism has a significant positive impact on the local economy, particularly in terms of job creation and income generation. The study also highlights the need for effective tourism management to sustain the growth of the industry.
2.9 Possible land use patterns for the Bangweulu Basin and Kafue Flats

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The Bangweulu Swamps

Soils of the Bangweulu Swamps

A swamp is a depression of land which is inundated and consists essentially of floating vegetation and wet peaty land. It is more or less permanently waterlogged. There are two basic morphological units of swamp areas:

(i) an outer belt which is flooded annually; and

(ii) the main swamp, permanently flooded and covered with floating vegetation. It is observed that small swamps in the high rainfall zone support a lush vegetation of swamp forest.

The least studied soils of Zambia's wetlands are the swamp soils. The present study was therefore mainly confined to the Bangweulu Swamps, and to areas located on relatively higher parts (fringes) surrounding the swamps. No information is available on soils of the lower lying areas which are permanently wet. The soils of the relatively higher parts all have a dark coloured peaty topsoil (15 cm) largely consisting of decomposing lechwe droppings and trampled grass. The 15-30 cm thick sub-surface layer ranges from loamy to clay texture (Chamburi series) but getting heavier with increasing depth. The subsoil colour is usually dark greyish-brown to grey, and strongly mottled yellow, brown or red to varying degrees in different soils.

The soil is medium acid in the organic topsoil and becoming progressively acid with depth. The base saturation is lower in calcium, magnesium and potassium than most adjoining plateau soils. The deeper swamp areas probably include large areas of peat soils similar to dambo peat.
Land use in the Bangweulu System

A system under fishing/Cassava, Lake and swamp system includes:

(a) lower Luapula;
(b) Lake Mweru;
(c) Mweru Wantipa and
(d) Lake Tanganyika systems.

Below is a description of the Bangweulu system.

The fishermen of the Bangweulu Basin belong to various tribes, among which the Unga, Bisa, Mukulu, Ngumbo and Lala make up the majority. Each of these have more or less their own regions of settlement and cultivation. During the dry season, many fishermen move from the unfavourably situated villages, especially from the west bank of Lake Bangweulu, to seasonally dry areas in the swamp, where they make temporary camps out of reed-grass huts.

The fishing is done mainly from boats with gillnets. In 1971 only about 70 of the fishing boats were powered by outboard motors. These motor boats are generally made of glass fibre and are expensive; consequently they are often bought collectively by the community, and are used alternately by members of the group. In 1971 fuel was only available at Samfya; therefore the majority of motor boats were stationed at or near this District Headquarters and their range was limited.

According to research in early 1971 less than half of the fishermen owned plank boats or dugout canoes (dugout canoes are predominant, only 42 boats were made of planks). The number of fishermen who possessed nets was only as high as that of boat owners, which is about 5,000 in both cases. Those who did not own boats had two alternatives. If they had their own nets they could attempt to hire boats at a fee of about K1.00 per day. Otherwise they were employed by boat owners as assistants either for cash or for a share of the catch. As two men are always necessary when fishing from a boat, there is a great demand for helpers. Frequently members of the family are employed as assistants.

Boats are not only used for fishing; they are just as important as a means of transport. A system of canals, which is administered by the Water Works Department, traverses the swamp in many directions.

Only a small part of the catch is disposed of as fresh fish, and that only on the west bank of Lake Bangweulu. The largest part of the catch is smoked near the fishing grounds, and a smaller amount is sun-dried. Fishing is mainly the main source of cash income. The largest catch is disposed of on the western side of the lake. About 75% of the catch is sold. This proportion falls to about 25% on some islands on the eastern side of the swamps. The explanation for this difference lies in the smaller per capita production of cassava here, and therefore fish become a necessary source of food. The inhabitants of the western bank of the lake generally depend less on their catch for their food. They frequently produce a surplus.

The Bangweulu sub-region has one of the highest cultivation frequencies of cassava in Zambia (93%). Similarly, groundnuts, with a cultivation frequency of about 62% are relatively important. However, the area under groundnuts was only a quarter of that under cassava. Rice cultivation has increased in recent years although it is still on a small scale.
The Kafue Flats

Soils of the Kafue Flats

The black clays of the Kafue Flats are heavy in texture. They crack widely when dry and become very sticky and plastic when wet. They are mainly black or dark grey, but some are yellowish-brown. Many contain lime nodules at a variable depth in the soil.

These soils are poorly drained and become very wet during the wet season. Some parts of the Kafue Flats become flooded to a depth of 1-3 metres by the end of the rainy season. Another feature of the black clays is their irregular surface relief, known as gilgai. This consists of a series of small ridges standing 20-60 cm above circular depressions about 2-7 metres in diameter. However a study by FAO (1968) points out that the soils occur on level or nearly level slopes with slight gilgai formation.

The soils in the gilgai depressions are usually black and have no lime nodules down to a metre or more. On the ridges, lime nodules usually occur within a metre of the ground surface. The soils on the ridges also dry out more quickly than the depressions. Chemically, these soils are very rich. Their clay has a large capacity to hold nutrients.

The soils are often neutral to alkaline throughout, but some have a strongly acid topsoil. There are large amounts of calcium and magnesium, and most soils contain lime at some depth in the subsoil. Some contain gypsum as well.

Land use and management

Utilization of these highly fertile soils of the Flats is limited by the difficult physical properties. Many soils are too wet to be cultivated during the rainy season. Even where they are not too wet, ploughing is made difficult by the very hard state of the soils when dry and the very sticky conditions when wet. Where they can be drained and cultivated with heavy equipment, they can be highly productive soils under irrigated agriculture. The best crops are bananas, sugar cane, and rice. However, the fringes of the Kafue Flats can grow a wider range of crops, such as vegetables, soybeans, and maize.

In view of the difficulties for agriculture, the Kafue Flats are best suited to grazing in the dry season. This has in fact been the principle use of the Kafue Flats.

The Kafue Flats have also been used extensively for fishing. Since 1974 Family Farms Limited has assisted substantially in the development of fishing activities. The Neganega Settlement, the Chanyanya, Namiloli and Manyonyo Villages are all efforts of the Family Farms.
2.10 Costs and improved management designs for the protection of wildlife of the Kafue Flats and Bangweulu Basin

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Introduction

With the prospects of external funding in respect of conservation of wildlife of the Kafue Flats and Bangweulu Basin, it is important that requirements of wildlife conservation actions that may be funded are identified and costed, while at the same time it is important to provide relevant management designs for the proper protection of the wildlife of the two areas.

In this paper, the requirements of wildlife conservation pertaining to law enforcement for both the Kafue Flats and Bangweulu Basin are identified and costed. Also, management designs to enhance conservation of wildlife of the two areas are outlined.

Requirements of wildlife conservation

Constraints to effective wildlife conservation on the Kafue Flats and in the Bangweulu Basin, and their adverse effect upon law enforcement in the two areas, are well documented in the Annual Reports of the Commands under which the two areas fall, and in the Annual Reports of the Department of National Parks and Wildlife Service.

The constraints include inadequate manpower, lack of transport, lack of radio communications systems, inadequate supply of firearms and ammunition, inadequate supply of uniforms and camping gear, inadequate supply of fuel and lubricants, and lack of allowances for wildlife officers.

Working under these constraints, it has not been possible to contain poaching in these areas, especially on the Kafue Flats where poaching has grown substantially.

The requirements for effective law enforcement for wildlife conservation, and the costs involved, are shown in Appendix A. The estimated total cost of these requirements is K2,193,000. This investment is designed to increase the probability of apprehending any person who violates the law governing wildlife by improving land and water transport, radio communication systems, adequate supply of firearms and ammunition, adequate supply of camping gear, offering a reward to any person who provides information
leading to an arrest, employing undercover agents, and supplying enough fuel and lubricants.

Management designs

Two management designs are outlined. The first one deals with the administration of the two areas, while the second one deals with the extension to local residents of the benefits which accrue to the Department of National Parks and Wildlife Service from wildlife.

In order to enhance conservation of wildlife in the two areas, it is proposed that a Wildlife Conservation Committee (WCC) be created for each of the four sectors. It is further proposed that the four sectors be re-organized into Wildlife Conservation Units as shown in Appendix B.

The Wildlife Conservation Committee

The Wildlife Conservation Committee will serve as a watch-dog over all wildlife matters in each sector and will facilitate the operations of the Wildlife Conservation Unit.

Membership of the WCC

It is proposed that the membership of the WCC be as follows:
(a) The Wildlife Warden of the area, who shall be the Chairman;
(b) the Wildlife Biologist of the area, who shall be the Vice Chairman;
(c) a Ward Councillor of the area;
(d) a Representative of the District Council;
(e) the Commander of the WCU, who shall be the Secretary;
(f) the local Agricultural Officer.

Functions and duties of the WCC

The functions and duties of the committee subject to the provisions of the National Parks and Wildlife Act, Cap. 316, shall be to implement the policy of the area, specifically the following:
(a) To facilitate the operations of the WCU;
(b) to initiate and implement, in consultation with the residents of the area, development projects;
(c) to formulate management plans for the area;
(d) to prepare a budget for the area which shall strictly be based on the projected revenue of the area, donations and grants;
(e) to monitor any activities associated with the exploitation of wildlife;
(f) to select non-resident and resident hunters who may apply to hunt within the area;

(g) to enforce the law governing wildlife through the WCU;

(h) to utilize fees collected by the Wildlife Conservation Revolving Fund within the area, in the administration of the area;

(i) to deal with any other functions and duties that may be prescribed for the area.

The Wildlife Conservation Unit

A Wildlife Officer of the rank of Assistant Wildlife Ranger will take charge of a WCU and he will be responsible to the WCC for the day to day administration of the WCU. The WCU will carry out duties as specified by the WCC.

Benefits to accrue to the residents

It has been established in Zimbabwe for example, that protection of game animals in settled areas is enhanced substantially when people derive direct benefits from such game animals.

As a first step in this direction, it is proposed that all the fees for hunting rights which are collected from the hunting safari companies by the Wildlife Conservation Revolving Fund within Kafue Flats and Bangweulu Basin be utilized in the administration of the two areas and in the improvement of the welfare of the residents. As in Zimbabwe, it is hoped that this will provide a substantial incentive for increased support amongst local residents for wildlife conservation.

Conclusion

With the prospects of external funding for the conservation of the wildlife of the Kafue Flats and Bangweulu Basin, with the use of fees collected by the Wildlife Conservation Revolving Fund within the area from which they are collected, and with the need to let the residents of the areas where wildlife is exploited benefit directly from such exploitation, current administrative arrangements for wildlife management within the Kafue Flats and Bangweulu Basin need to be changed. The proposed set-up is designed to provide the desired results.
Managing the wetlands of Kafue Flats and Bangweulu Basin

Appendix A. Requirements and costs of wildlife conservation in the Kafue Flats and Bangweulu Basin

<table>
<thead>
<tr>
<th>Item</th>
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<tr>
<td>4 x 4 wheel drive pick-ups</td>
<td>480,000.00</td>
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<tr>
<td>12 Banana boats</td>
<td>96,000.00</td>
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<tr>
<td>4 Outboard 25HP engines</td>
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<td>4 HF, SSB, base radios</td>
<td>160,000.00</td>
</tr>
<tr>
<td>4 HF, SSB, mobile radios</td>
<td>160,000.00</td>
</tr>
<tr>
<td>4 HF, SSB, manpacks</td>
<td>200,000.00</td>
</tr>
<tr>
<td>16 Walkie-talkies</td>
<td>54,000.00</td>
</tr>
<tr>
<td>3 Solar panel units</td>
<td>94,000.00</td>
</tr>
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<td>Fuel and lubricants</td>
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</tr>
<tr>
<td>Rations</td>
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Appendix B. Wildlife conservation units and staff strength

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<th>Unit</th>
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<th>Staff strength</th>
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<tr>
<td>Blue Lagoon</td>
<td>Naleza</td>
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<td>Chiundaponde</td>
<td>Chiundaponde</td>
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</tr>
<tr>
<td>Kalasamukoso</td>
<td>Fibala Gate</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
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<td>124</td>
</tr>
</tbody>
</table>
2.11 Wildlife harvesting in Africa: lessons for the Kafue Flats and Bangweulu areas

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Introduction

For nearly 30 years, the commercial utilization of game animals has frequently been proposed as a viable approach to management of African wildlife. While the concept has received considerable attention among ecologists, conservationists and others, it has been practised in a number of areas, and has failed and been proposed again, there is still considerable confusion surrounding the issue. To help clarify this, some definitions are required:

- **Harvesting** refers to the reaping and gathering of natural grain, fruit, vegetables, fish and wildlife;
- **Culling** means the picking out or careful selecting of individual items which are rejected as being not up to standard;
- **Cropping** refers to the cutting, or biting off, of the tops of any population or plant.

Harvesting implies a serious management objective. Although Caughley (1977) and Ricker (1978) have discussed its principles in detail, the term harvesting is rarely used. Grimsdell and Bell (1975) have however used it on black lechwe (Kobus leche smithmani) but only as a form of land use. In essence, harvesting implies economic activity (initial inputs to build stocks, management, extraction, processing and marketing) and consequently it has limited application in Africa, although frequently used in Europe (Taber, 1961; Bubenik, 1976) and North America (Savidge and Zieseniss, 1980).

It is only recently, and mostly in Zimbabwe, that the term culling has been used frequently in Africa. Recently developed communal game ranches in rural areas seem to have prompted its application. The economic application of culling however seems to be quite mixed as only the "undesirables" are removed from the population, and whether or not products from such animals could be economically desirable must be a subject of debate.

Cropping is a traditional term which has been used frequently (FAO, 1974; Swank et al., 1974; Bindernagel, 1975). It is based on the principle of removing excess individuals, when a population exceeds its carrying capacity.
Managing the wetlands of Kafue Flats and Bangweulu Basin

Although the three terms show considerable distinction, in the real world they are often taken to mean the same thing. For the purpose of simplicity, the term cropping will however be used in this paper.

Whereas the real awakening of wildlife utilization through game cropping began in the 1950s, the empirical tests of the concept started much later. Today, however, with the support of major advances in wildlife censuses (ground and aerial) to provide fairly accurate population estimates, and further advances in ecological research, many game cropping experiments have been encouraged. This was further strengthened by the need for many of the newly independent nations to explore diverse forms of resource use. At the same time, increased human activity resulting from mobilized agriculture and human resettlements confined wildlife (mostly large game animals) in the newly created National Parks and other Nature Reserves (Laws, 1970; Caughley, 1976). This resulted in a series of ecological disasters in which the elephant (Loxodonta africana) and hippo (Hippopotamus amphibius) destroyed their habitats in many National Parks, e.g. South Luangwa (Zambia), Murchison Falls (Uganda), and Tsavo (Kenya). In summary, a consideration of factors provided substantial grounds for considering game cropping in several countries in Africa.

Four main reasons were advanced for introducing game cropping in Southern Africa (Laws, 1970; Hanks and McIntosh, 1973; Bindemagel, 1975; Collinson, 1983):

1. as a means of demonstrating that wildlife could provide a better form of land use than livestock or crop agriculture and settlement, and could generate employment, income and food which could raise the standard of living of rural communities;
2. for the extraction of meat for commercial purposes, in order to supplement beef and pork production in a country;
3. as a tool for habitat management by reducing population density of wildlife species;
4. as a source of data for studies of population dynamics, reproduction and nutrition.

Today, while the objectives of game cropping have remained unchanged, the approach has been modified drastically. In particular, in Government operated projects, the long neglected rural people are now being involved in planning, decision-making processes, and the sharing of benefits. Consequently, game cropping should no longer suffer isolation, but receive the local support which it has often been denied. This paper will review some of the recent developments in game cropping, and discuss their limitations. The paper will stress the potential viability of game cropping as an economic, social, ecological and even political proposition, in Zambia.

Examples from past experience

A comprehensive bibliography prepared by de Vos and Kaittany (1972) gives an indication of what has been done on this subject. The conflicting results show the complexity of the problem in designing cropping schemes. Whenever the cropping schemes are experimental or small, the results are usually promising (Bindemagel, 1975;
Mutch, 1986), but this is not the case for those large projects which are designed to yield substantial profits. They have rarely been successful (Collinson, 1983).

Four examples help to illustrate the complexity of the problem:

1. In Zambia, a large game cropping scheme was conducted for ten years in the Luangwa Valley (1962 - 1972). Results show that the inconsistencies in the objectives and policies, and lack of prior research were largely responsible for its failure.

Two events seem to have influenced the decision to initiate cropping of game animals in the Luangwa Valley. First, resolutions at the 6th British East and Central African Fauna Conference in 1959, and second, a report by Dr Frazer Darling in 1960 (Strier, 1973). The scheme’s main objective was to reduce the number of elephant and hippo in order to reduce habitat destruction. In other words, their numbers were to be reduced to levels at or below their habitat carrying capacities. Soon after the project had started, a second objective was added which was to distribute meat from the cropped animals to the poor rural communities, particularly the populations in Northern and Luapula Provinces who were believed to be deficient in meat protein. Some of the meat was also to be sold at the open markets in cities (Dodds and Patton, 1968).

From 1962 - 1972, a total of 1,519 elephants, 1,710 hippo, 277 buffalo (Syncerus caffer), and 123 impala (Aepyceros melampus) were cropped, and most of these were processed through a sophisticated abattoir erected at Kakumbi, capable of processing 1,000 short tons of venison per annum (Collinson, 1983). The project was nevertheless discontinued by 1972, with the following reasons being considered as responsible for the closure (Chabwela, 1983; Collinson, 1983):

(a) The comprehensive infrastructure to support the project was inadequate. Since the abattoir was fixed, the hunting and transporting of carcases to the abattoir through the bush where there were no roads resulted in considerable operational cost and a very high rate of carcase loss;

(b) Although local markets were readily available in the Copperbelt for the frozen fresh-meat products, a bone/carcase meat plant was required to process bone-meal which could not establish a market, and furthermore, poor marketing skills affected potential sales overseas;

(c) The lack of treatment facilities for carcases with cysts incurred unnecessary costs, as condemned carcases were never processed;

(d) The intended target population did not benefit from the scheme. Except for the few people who were employed at the abattoir, local participation was largely ignored, and as the population was generally poor and unemployed, the inhabitants were in no position to buy meat, neither could they be allowed access to the condemned carcases.

2. In Tanzania, game cropping schemes were conducted in four areas between 1962-1974. However, these were of mixed success.

According to Bindemagel (1975), game cropping in Tanzania was based on three objectives:
Managing the wetlands of Kafue Flats and Bangweulu Basin

(i) Because of the rapidly growing population around National Parks and in the Game Controlled Areas, it was felt necessary to introduce game cropping in parts of Tanzania as a demonstration of the economic values of wildlife as being the most appropriate land use when contrasted with the need for human settlements and agriculture, and as method of curtailing poaching which was widespread. Benefits from the cropping schemes were also seen as providing compensation to people when and if they were to be moved out of the areas;

(ii) game cropping was to be used for producing meat to supplement beef in the nearby towns and cities;

(iii) some of the game cropping schemes could be used as research experiments for developing techniques of cropping, processing and marketing, and as a possible source of biological data.

Therefore, between 1962 - 1974, game cropping schemes were carried out in four areas: Lake Rukwa (1962 - 1971); Kirawira in Grumeti Controlled Area (1964 - 1957); Loliondo Controlled Area (1968 - 1974); and Yaida Valley (1969 - 1970). In all, nine game species were cropped, of which the main ones were zebra (Equus burchelli) and wildebeest (Connochaetes taurinus). While experimental cropping trials provided satisfactory results, procedures of actual extraction, processing and marketing were themselves problematic. First, since the hunting was mostly concentrated on wildebeest and zebras, it was not possible to establish a permanent cropping station. Both of these species are migratory, and their movements made hunting difficult. Animals were only in the cropping areas during the rainy season when access to the area was impossible, while during the dry season they migrated out northwards, and in some areas as far as across the border into Kenya. Second, it is unclear whether local people ever realized the values of wildlife. Third, poor meat storage facilities and the remoteness of the cropping area from cities posed serious marketing problems.

3. In Zambia, a pilot project on cropping Kafue lechwe (Kobus leche kafuensis) was carried out between 1967 - 1970. This was discontinued because of the high condemnation rate of carcases. However, this might have been resolved through developing additional techniques such as sterilization or canning.

The initial decision to conduct game cropping of Kafue lechwe was prompted by a large disparity of the sex-ratio for the lechwe population. In 1964, 487 lechwe were cropped, and carcases were successfully processed and the meat sold in the Copperbelt (Annual Report, 1965; Collinson, 1983). The programme was then expanded in 1967 with additional objectives of reducing the population to the area’s carrying capacity, and supplying the cheap meat to the Tonga people and Government Institutions in the areas. It was further envisaged that the cropping scheme would easily be integrated into the local rural economy.

However, of the 1,000 lechwe recommended in the quota, only 74 animals were successfully processed and sold, and in 1970, the project was discontinued. The high incidence of measles and Tuberculosis is cited as the reason for the closure. However, there are views which dispute the wisdom of this decision (Collinson,
1983). It is argued that the question of disease could have been overcome easily by introducing other techniques such as sterilization or canning. Certainly capital costs should not have deterred the meat production, considering the high potential and the proximity of rural and urban markets which could have created a sound basis for business propositions. Although speculative, it is possible that lack of Government conviction and absence of a clear commitment created confusion. Furthermore, the project became vulnerable as local people were not consulted. Although the project could have had considerable support, the failure to discuss with local people meant that many were probably pleased that it was discontinued.

4. In Kenya a comprehensive game cropping scheme was conducted for four years (1971 - 1974) in the Kajiado District, and the report shows that game cropping yielded greater financial returns to landowners than cattle to produce meat and skins.

The problem of the shortage of arable land and the subsequent conflicts between people and wildlife is demonstrated by the Kajiado cropping scheme. The rationale of the project was for cropping to be a supplemental utilization procedure to manipulate wild animal populations on a biologically sound basis, while securing monetary returns for the landowners from a resource which they supported (Swank et al., 1974). Whereas the project was more or less regarded as experimental, its further objective was a clear demonstration of the feasibility of game cropping step by step, including the techniques of animal killing, processing and marketing.

A total of eight game species were cropped but only six were significant: wildebeest, zebra, eland (Taurotragus oryx), Coke’s hartebeest (Alcelaphus buselaphus), Grant’s gazelle (Gazella granti), and Thomson’s gazelle (Gazella thomsoni). The processed meat was transported to various parts of Kenya for sale.

Although the project results seem satisfactory, it is not known whether or not the local landowners considered the conclusions of the survey meaningful and applicable to their situation. Moreover, there is no mention of local participation in the project.

Of course it would be practically impossible to list all the experiences of previous cropping schemes in Africa. The list is substantial, and a wealth of information is available, either from published work, personal experience, or from reports lying on Government book-shelves. From these and the examples cited, four important conclusions can be drawn:

(i) Local participation in most, if not all, the cropping programmes is essential. Mutch (1986) reported a successful cropping scheme in Nigeria which was largely executed by the local inhabitants themselves.

(ii) Research should always form part of the cropping scheme, and should ideally precede any cropping. Collinson (1983) criticized the Luangwa cropping scheme which failed, in part because of the absence of research data.

(iii) The design for a cropping scheme should always include an appropriate infrastructure. Bindernagel (1985) and Collinson (1983) pointed out that
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most cropping schemes run into difficulties caused by poor designs which have often excluded an infrastructure component.

(iv) A cropping scheme must be accompanied by a clear Government policy and pertinent regulations. The findings of Collinson (1983) show that both previous cropping schemes in Zambia failed because they lacked Government conviction and an unambiguous policy on game cropping.

SY, MSY or OSY: are they only mere concepts?

Whereas the concept of harvesting has been well developed in fisheries management (Ricker, 1978), its application in wildlife management has met considerable resistance. In as much as there is consensus that excess members of a population be converted to a consumable resource, there is major disagreement on what should be the appropriate harvesting levels in any given population. Nearly every year ecologists and wildlife managers collect data and analyze them, but rarely are clear decisions made on harvesting. And when these are made, multiple management problems soon ensue. These may range from the clumsiness of the harvesting design itself to poor understanding of the species, including its habitat requirements, population level and dynamics, behaviour and distribution.

As discussed by a number of authors (Caughley, 1977; Ricker, 1978) harvesting is based on the mortality rate which is defined as

\[ M = 1 - e^{-r} \]

in which \( r \) is normally substituted by \(-H\) (harvesting rate). In simple terms, \( M \) is the ratio of the difference between the initial population \( (N_i) \) and the subsequent population \( (N_s) \) at time \( (t) \) divided by the initial population \( (N_i) \). The mathematics of this formula should not concern us at this stage; what is important is its application.

The central question concerns whether a population should be harvested when it is at the carrying capacity of the habitat, or when it is at maximum yield, i.e. during the accelerating phase of population growth. A quick review of the extent of the debate may help to clarify the issues.

The term Sustainable Yield (SY) is easy to understand but difficult to define, because it means different things to different people. For example, while SY may refer to the number of animals that may be removed year after year from a population without causing it to decline (Caughley, 1977; Savidge and Ziesenis, 1980), economists have argued that the real yield from wildlife is not animals but dollars. However, the principles of harvesting as discussed by Caughley (1977) and Ricker (1978) emphasize the view that natural systems which are well managed will naturally provide substantial usable stock which could be tapped at any desirable level.

Theoretical levels such as the Optimum Sustainable Yield (OSY) and Maximum Sustainable Yield (MSY) have drawn considerable attention and discussion. Before the word “Optimum” came into literature, MSY was the traditional principle which occupied the minds of biologists, ecologists and economists. Supporters of this principle have maintained that MSY is the most efficient level at which the population could be harvested. In theory, a population should not be harvested until the maximum
potential rate of increase has been reached or the maximum slope of the growth curve has been located (Caughley, 1978; Holts and Talbot, 1978). If this was possible, then the greatest harvest would be taken from the self-regenerating stock of the animal species as desired without depressing its population. But as most critics have argued (Talbot, 1966; Chapman et al., 1976), MSY theory is a fallacy and can only be valid under a number of assumptions, such that:

(a) MSY must assume that the un-exploited population exists at an equilibrium density and that it is maintained by density dependent factors;

(b) MSY must assume that if a group of animals is reduced, it should automatically be replaced.

When such assumptions are examined, and particularly when we wish to examine them while attempting to manage natural aquatic or terrestrial systems where most variables are unknown, MSY would be an inappropriate management objective. As a result the concept has now been widely abandoned, or is applied mainly in mathematical models not intended for use outside the classroom.

The introduction of OSY therefore has provided a possible alternative to MSY. Proponents of OSY argue that the concept provides not only a practical option for optimum management of biological resources, but also maximizes sustainable yield of social benefits (Krebs, 1972). In the real world, however, this hypothesis also has its weaknesses. Firstly, the term “Optimum” is too qualitative, has no fixed point as a “Maximum” or “Minimum” and as such it is subject to considerable abuse. Secondly, what would be the “Optimum Yield” or “Optimum Sustainable Yield” of a population which was at the “Optimum” level? Nevertheless, OSY allows for harvesting to be at the level that maximizes sustainable social benefits to the communities in question and varies harvesting with the species and with the social, political or market demand. Consequently, OSY at present seems to be the most acceptable management objective.

Management and policy on harvesting

Safari and traditional hunting are the only current methods of harvesting wildlife in Zambia. While safari hunting has only been in existence since the early 1950s, it has expanded significantly, and is now highly modernized. Despite abuse of resources by both systems, the Government policy on harvesting continues to be largely inadequate. There are several reasons for this:

1. “No one will take the trouble to husband and maintain a resource unless he has a reasonable certainty of receiving some portion of the product of his management; that is, unless he has some property right in the yield” (Scott, 1955). The question of common property resources was discussed in the 1950s by Gordon (1954) and Scott (1955) and recently by Hardin (1968) and Clark (1973). Sustainable exploitation of resources such as wildlife (which are mobile and difficult to determine in numbers) depends on the extension of moral responsibility over the resources to the people concerned. In the absence of this responsibility and the lack of equitable systems for all resource users, wildlife is open to direct abuse and eventually their numbers may be drastically reduced. Collinson (1983) has strongly criticized the
current arrangements for wildlife exploitation in Zambia. All costs of conservation are met by Government, and while the laws on harvesting are not stringent enough, hunters are allowed to operate in the hunting areas with minimal supervision. Whatever the system of regulations (limited quotas or otherwise) this extension of freedom to hunters is subject to serious abuse and may lead to a rapid decline in wildlife numbers.

One aspect which requires serious consideration is for all resource users, including hunters, to receive training in resource exploitation. Elsewhere (Bubenik, 1976; Carter and O’Toole, 1977), a person cannot be allowed to hunt without successfully going through a formal training programme. For example, in parts of Europe, training takes 30-65 hours of official instruction in conservation laws, biology, game ecology, hunting and management operations, game diseases, feeding of game, gun-types and mechanism, ballistics, and shooting. In the absence of such education, a punitive approach to regulating hunting is likely to be of only limited success.

2. Harvesting programmes have often failed because they have not been backed by the relevant knowledge of the species being exploited (Collinson, 1983). Population size, distribution, species behaviour, including breeding and feeding, population structure, habitat studies etc., should provide the data required for determining the numbers of animals which should be harvested. Gatto (1976) provides a good example of how cropping schemes should be pursued. He determined primary production, energy budget and population size of the blesbok (Damaliscus dorcas phillipsii) before any quotas could be established. Good knowledge of population responses to harvesting is especially important for effective management (Caughley, 1977; Savidge and Ziesen, 1980). It would therefore be unwise for Government to determine quotas outside these parameters.

3. Harvesting of wildlife should be directed towards improving the standard of living of the poor rural people. Chambers (1983) and Chabwela (1986) have discussed the limited acceptance of local participation by the rural inhabitants in development programmes in their areas. Wildlife is a rural resource, and potential exploiters are the rural people; but poor as they are, remote, powerless, vulnerable, isolated, and neglected, all current hunting administrative arrangements seem largely to be against them. Invariably their reaction is therefore that of resignation and resentment; and their frustration is manifested in poaching of wildlife. This argument is the basis for Collinson’s (1983) contention that cropping schemes failed in Zambia partly because there was not effective involvement of local people.

References


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Part 3. Working groups and resolutions

3.1 Composition of working groups and group terms of reference

On Wednesday, 5 November 1986, delegates divided into three groups to prepare Resolutions and Recommendations for the Conservation and Management of the Kafue Flats and Bangweulu Basin areas. The composition of the groups and their Terms of Reference were as follows:

Group I: Project Structure

- **Chairmen:** Prof. G.W. Howard and Dr H.F. Lamprey
- **Rapporteur:** Mrs M. Chinonge
- **Members:** S.K. Stevenson, M.C.K. Malam, A.M. Kabeta, M.A. Sikabanze, R.M. Chita, J.A. Chanda, I.Y. Mbinderwina, Dr H.N. Chabwela, M.M. Munakampe

The Terms of Reference of the Group were:

(a) to prepare precise project boundaries, and specify the geographical scope of the Kafue Flats and Bangweulu Basin;

(b) to design Phase II and project organization and structure;

(c) to identify and discuss possible problems and factors that may affect project implementation, specifically, administrative arrangements, local community involvement, and the roles of the Government and donors;

(d) to identify communities which should be involved directly and to discuss the sharing of benefits accrued from wildlife;

(e) to examine the legal aspect of utilizing wildlife and other resources of both areas.
**Group II: Utilization of Wildlife, Fisheries and Water Resources**

Chairmen: Dr R.H.V. Bell and Prof. A.A. Siwela  
Rapporteur: Dr M.P. Simbotwe  
Members: C. Mwale  
A. Mumeka  
H.K. Mwima  
S.P. Subramaniam  
L.S. Mwachitete  
P.W. Sichone  
A.N. Mwenya  

The Terms of Reference of the Group were:

(a) to discuss methods of determining yields (quotas) of Kafue Lechwe and other wildlife species, methods of harvesting, processing and marketing of wildlife products;

(b) to examine factors of production and consumer behaviour, and the long-term plans of the integrated harvesting of resources such as fish and water.

**Group III: Land Use Planning and Rural Development**

Chairmen: Mr E. Chidumayo and R.S. Mwanza  
Rapporteur: Dr E.S. Kalapula  
Members: Dr D. Mbewe  
J.H. Bhuku  
T.C. Munankambe  
L.C. Mutinta  
P. Nkonje  
E.C. Moonga  
C.E. Mukosa  
Dr P.J. Dugan  
H.G. Mudenda  

The Terms of Reference of the Group were:

(a) to prepare or recommend land use plans for the Kafue Flats and Bangweulu Basin areas based on land uses such as wildlife, fisheries, livestock, grazing, agriculture, water, human settlement, watershed management, and timber production;

(b) to come up with optional land use patterns which would effect an integrated approach to the conservation of wetlands;

(c) to draw-up the future priorities for the Bangweulu Basin.
3.2 Workshop resolutions

Group I was assigned the task of defining boundaries for the project, including its organizational structure, legal constraints and its funding.

1. Boundaries

Taking into consideration the limitation of funds, it was felt that a tier system of boundaries be adopted to enable the programme to progress in stages according to availability of funding. The group therefore recommended that:

(a) The Kafue Flats should have three boundaries, namely:
   (i) the core management area defined by Lechwe distribution and including the Blue Lagoon and Lochinvar National Parks. This area includes five chiefs' areas - Shakumbila, Choongo, Nalubamba, Hamusonde and Muwezwa;
   (ii) the larger study area - defined by the high water level and to include all villages whose cattle graze in the Kafue Flats during the dry season, rounded off to the nearest ward boundary;
   (iii) a broader programme area - this to be indeterminate to allow flexibility, but to include the area of the Kafue Flats and environs as dictated by future development of the Programme;

(b) The Bangweulu Basin should have two boundaries:
   (i) the core management area defined by Lechwe distribution (present and future potential). This includes the areas for Chiefs Chiundaponde, Kalasa Mukoso, Bwalya Mponda, and Nsamba south of the Chambeshi River;
   (ii) a broader study area - the Bangweulu Basin as delimited by the watershed and surrounding road.

2. Project structure and administration

The group recommended that with funds becoming available, the project should develop into a Wetlands Programme and eventually into a Wetlands Institution for the region.

Realizing the importance of smooth administration of the project, the group recommended that:

(a) at the Headquarters in Chilanga, the Project Leader should be assisted by Secretarial Staff, a Sociologist and a Project Administrator;

(b) the base at Kafue Flats be at Lochinvar which should be headed by a Biologist with supporting field and office staff;

(c) the running of the Bangweulu Project be from Chiundaponde, to be headed by a Biologist with supporting field and office staff.
3. Infrastructure

The organization and time frame of the project should be at three levels:

(a) the Project to include the first two years of operation to be undertaken within the defined core areas with the funding available immediately;

(b) a Programme to extend the project beyond the initial two years, and to include a wider range of subject matter, and to be undertaken within the broader study areas;

(c) a Wetland Institution to provide a permanent establishment for continuing wetlands management and research.

The group noted that much of the infrastructure, such as buildings, were already existing at the two stations, although these needed repairs and maintenance. The limitation in the availability of funds imposes a requirement that the immediately available funding be used only to purchase the urgently required equipment and plant, to facilitate immediate research, and to provide essential services and rehabilitation of buildings. With more funding becoming available, the group recommended that:

(a) three new vehicles be bought (meanwhile one can be obtained and two old ones rehabilitated);

(b) 11 fibreglass canoes + 1 outboard motor will be required (meanwhile 2 can be purchased);

(c) an outboard motor for Kafue be bought;

(d) other camping gear not immediately required can be ordered.

4. Funding

Initial funding of about US$80,000 pert annum for two years will come from WWF. However, the group noted that if the project was to develop into a Wetlands Programme, extra funding would be required from other sources, although this would take time.

5. Local participation

Recognizing the need for information to flow-up and down the administration ladder, the group recommended a three tier system of participation:

(a) The Steering Committee composed of relevant Ministerial and Provincial Representatives and the Project Leader, under the auspices of the Ministry of Lands and Natural Resources;

(b) A Board at Local level to consist of Chiefs, District Council Representatives, Members of Parliament, the Project Biologists and other relevant Government Officers to decide on project and Programme policy;

(c) Two Area Committees to consist of Chiefs' representatives, local Chairmen, and Project Staff to decide on local implementation.

6. Consultants

The Project and Programme should be able to call for consultants in specific areas of expertise and associate itself with other projects in the wetlands.
Group II discussed the determination of yields or quotas, and methods of harvesting, processing and marketing of the resources of the wetlands, including wildlife, fish and water

(a) Determination of yields or quotas;
(b) methods of harvesting;
(c) processing and marketing.

The group realized that any technical work done should include adaptive management in order to correct itself, and that resource use is based on sciences which are complex (e.g. ecology, economics and sociology) so that any action taken is likely to have unexpected consequences.

The group therefore felt that all management activities should be designed to incorporate adaptive management procedures which will allow the organization to profit from its mistakes and to make necessary continued adjustments.

Specifically the group recommended the following:

1. **Wildlife**

   Since most aspects of resource use belong to land use, a mechanism should be established to determine the zoning of varied resources, and a strategy of utilization (for increase, stability, or decrease) of any species should be considered. Also a policy on allocation of quotas should be established.

2. **The group identified the following as possible forms of wildlife use:**

   (a) safari hunting;
   (b) resident hunting;
   (c) non-resident hunting;
   (d) culling;
   (e) live animal capture;
   (f) illegal off-take;
   (g) control hunting.

3. **The group recommended that the following research capability be developed and recommendations made with respect to determining off-take quotas:**

   Aerial surveys and censuses (to be reviewed and explored), information returns from licence holders, use of information gathered from Wildlife Scout Patrols (particularly for recording the effectiveness of enforcement efforts and as indices of illegal activity).

4. **The group felt strongly that the following information from research monitoring should be obtained:**

   (a) rate of change of population size;
   (b) mortality: natural, illegal and legal;
   (c) distribution in space and time.
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Quota allocations should be based on empirical procedures with adjustments in relation to population responses.

5. The group felt that the following species would be the most important:

**Kafue Flats**
- Kafue lechwe, hippo, zebra, buffalo, wildebeest (possibly for the future), and birds.

**Bangweulu Basin**
- Black lechwe, sitatunga, buffalo, elephant, reedbuck, oribi, tsessebe, lion, leopard, roan, crocodile, hippo, and birds.

6. The group recommended that wildlife conservation committees should look into the problems concerning the needs of the people, and especially should consider provision of special licenses for those local people without access to fire-arms. The group also recommended that the following harvesting methods should be considered:
   (a) licenced hunting with traditional methods.
   (b) technical methods of harvesting should be practised if trial harvesting methods have been done.

7. Processing of wildlife carcasses

The group felt that hygiene requirements can be prohibitive, so this problem should be reviewed with the aim of avoiding stringent veterinary requirements. The group also recommended that health inspection should be limited to marketed products, but that the economic implications of enforcement of hygiene requirements should be taken into account. This should not render utilization uneconomic.

The following products are recommended:
- meat, skins, hides, horns and other trophies.

It was recommended that meat as a Marketing Product would be sun-dried, smoked, salted, tinned, frozen, or made into biltong, and that the economic implications should be considered.

The group also recommended that there was a need to set up a processing industry. There is a need to have an education programme to enable people to be taught proper ways of preservation of meat, skins and other trophies.

8. The Group recommended that:
   (a) a market survey of meat and other by-products should be done;
   (b) there be a review of the economic implications of marketing and transport;
   (c) there be a clearly defined financial constitution to handle funds generated under the project, but that the already established NPWS Revolving Fund structure could be used;
   (d) allocation of funds from revolving funds must be controlled by a clearly defined organizational structure.
9. A co-ordinating body is required under the project
to improve the management of fisheries, and this should include a close working
relationship with ZESCO and the Water Affairs Department so that fish management
can be enhanced when various statutory instruments are applied (such as mesh-size
restrictions, breeding season restrictions, and closing-up of areas).

10. For the Bangweulu Fisheries the following Recommendations were made:
(a) that there is potential for developing pelagic fisheries as long as controls of
mesh-size and use of lamps are implemented (The group recommended that this
could help population regulation and recovery);
(b) that there is need to examine methods to open up access to swamps both by road
improvement and extension of the channel system as part of the overall pro-
gramme for the wetland areas (channel openings should be carefully examined
for the ecological consequences).

11. The group noted that processing and preservation of fish is a serious problem
in both the Kafue Flats and Bangweulu Basin on account of the distances to
markets.
Improved methods of preservation are required; currently the most viable method
appears to be that of smoking. However, the scarcity of firewood is a serious
constraint. Therefore the project should:
(a) encourage the Department of Forestry to examine possibilities of developing
fuelwood plantations in the wetlands;
(b) encourage the Department of Fisheries to examine and develop alternative
methods of fish preservation;
(c) encourage investigation of the use of other wetland plant species (e.g. Papyrus,
Phragmites, etc...) as smoking fuels.

12. The group noted the problem of the shortage of boat-building materials in the areas,
and recommended that efforts should be made to encourage the construction of
plank-boats, for which the technology is available for swamp and floodplain
conditions.

13. The group noted the increase of water pollution especially in the Kafue River. The
group recommended that the project should put itself in a position to influence the
legislative and environmental implications of pollution.

14. The group noted the need for credit facilities, particularly in the case of the
Bangweulu area which is currently not included in the World Bank Fisheries
Development Project which provided this facility in the case of the Kafue Flats.

15. The Lacadsa method of habitat improvement should be tested in the open water of
open lakes of the Bangweulu Basin.

16. The group recognized that water resources are the key to wetland development. The
group therefore recommended that the conservation and development of water
resources should be included as a fundamental component of the wetland pro-
gramme. All potential users and manipulators of the water resource should have an
input and responsibility to the project structure.
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Group III was assigned the task of preparing land use plans for both areas, and drawing-up future priorities for the Bangweulu Basin

Members of the Group noted:

(a) the levels of poverty and backwardness in the two areas;
(b) the importance of wildlife in the two areas;
(c) the desire for the people to see that the level of development is improved and sustainable.

Taking into account both the similarities and differences in the two areas, the group recommended that:

(a) For the Kafue Flats, there is a need to explore and elaborate an integrated land use and development plan.
   In doing so the group noted:
   (i) that development should not interfere with cattle grazing requirements, and with existing wildlife conservation management; in particular there should be control of the development of crop production;
   (ii) that despite a recent decline in fisheries, the Kafue Flats remain an important protein source. In this regard, land use plans should look into further development of fishing in the area;
   (iii) that any land use plan for the Kafue Flats has to look at the potential for a change in the flooding regime which might increase the benefits obtained from flooding, without reducing power generation.

(b) For the Bangweulu Basin, there is a need to explore and elaborate an integrated (rural) land use and development plan. In doing so the Group noted:
   (i) the fact that recent declines have been reported in the fisheries of the Bangweulu Basin, but that fish remain an important source of protein and cash. The group, therefore, recommended further development of the Bangweulu fishery;
   (ii) that special attention should be paid to the need to improve transportation both within the swamp system and in respect to access to markets, and the establishment of these where they do not exist;
   (iii) that a major initiative should be taken to determine the means of improving crop production in order to meet the nutritional requirements of the local communities;
   (iv) that given the great demand on the existing wood supplies in the area, the means to improve fuelwood and construction timber supplies should be investigated.

(c) With regard to wildlife management in both areas, special attention should be given to:
   (i) the development of Safari Hunting;
   (ii) the development of subsistence hunting organized by chiefs and headmen;
(iii) the development of tourism;
provided that the benefits derived from these activities could be reinvested in these areas for development.

(d) In order to draw up land use plans for the Kafue Flats and Bangweulu Basin:

(i) a Task Force should be established under the auspices of the National Conservation Committee to explore, and initiate elaboration of an integrated land use and development plan for the Kafue Flats and the Bangweulu Basin;

(ii) the Task Force should include representatives from:

- The Wetlands Project (Project Leader)
- The National Conservation Strategy Committee
- National Parks and Wildlife Service
- Fisheries Department
- Animal Husbandry Section
- Land Use Planning Section
- Soil Survey Unit
- N.C.S.R.
- ZESCO
- UNZA (Schools of Natural and Agricultural Sciences, and KBRC)
- Department of Water Affairs
- Department of Forestry;

(iii) the Task Force will seek up-to-date information on the principal resource-use problems including:

- Wildlife management and utilization
- Declining fish harvest
- Animal husbandry
- Crop production
- Fuelwood and timber
- Land degradation in the catchment;

(iv) the Task Force should use the information collected as the basis for a draft land use plan for each area; these will each form the focus of a workshop which will elaborate and identify future steps including highest priorities for conservation action.
Summary of resolutions

The following Resolutions were based on discussions by the three groups and the 11 background papers. Group Discussions and Resolutions were in three categories:

A. Project Structure
B. Land Use Planning and Rural Development, and;
C. Utilization of Wildlife.

A. Project structure

Recognizing the extent of both wetlands, and the complexity of the Management problem, but realizing the need for:

(a) determining precise project boundaries and geographical scope of the Kafue Flats and Bangweulu Basin;
(b) identifying problems and factors that might affect project implementation, specifically administrative arrangements, local community involvement and the rules of Government and donors;
(c) identifying communities which should be directly involved, and how benefits accrued from wildlife could be shared;
(d) examining the legal aspects of utilizing wildlife and other natural resources in both areas; it was resolved:

1. That the organization and time-frame of the Project should be at three levels:

   (a) The Wetlands Project to include the first two years of operation to be undertaken within the defined Core Areas with the immediately available funding.

   (b) A Wetlands Programme to extend the project beyond the initial two years and to include a wider range of subject matter, and to be undertaken within the broader study areas.

   (c) A Wetlands Institution to provide a permanent establishment for continuing wetlands management and research for the regions concerned.

2. That the areas in which the above three Phases will be established should be defined as follows:

   (a) Kafue Flats

      (i) Core Area: The area of the Kafue Flats occupied by Lechwe, including the Lochinvar and Blue Lagoon National Parks, and within the areas of Chiefs Shakumbila, Choongo, Nalubamba, Hamusonde and Muwezwa.

      (ii) Larger Study Area: Includes the upper flood limit of the entire Kafue Flats, and all areas and villages keeping cattle which in the dry season move to the Flats; these limits to be rounded off to the nearest Ward Boundaries.

      (iii) Broader Programme Area: The Kafue Flats and surrounds, as dictated by future developments in the Programme.
Workshop resolutions

(b) Bangweulu

(i) Core Area: The area of the Bangweulu Basin occupied by the Lechwe (present and future), including the areas of Chiefs Chiundaponde, Kalasa Mukosa, Bwalya Monda, Kafinda and Nsamba.

(ii) Larger Study Area: The Bangweulu Basin as delimited by the watershed and the surrounding roads.

3. That the Project Structure and Administration Should Consist of:

Chilanga
Project Leader
Secretarial Staff and Administrators
Sociologist

Kafue Flats
(based at Lochinvar)
Biologist
Field Staff
Office Staff

Bangweulu
(based at Chiundaponde)
Biologist
Field Staff
Office Staff

4. That the immediately available funding should be used only to purchase urgently required equipment and plants, to facilitate immediate research, and to provide essential services and rehabilitation of buildings; realizing that for the extended Project and Programme, further funding will be obtained from other sources.

5. That three levels of committees should be established:

(a) a Steering Committee to be chaired by the Permanent Secretary, Ministry of Lands and Natural Resources, and which will consist of relevant Government Officers, to decide on Project and Programme Policy;

(b) a Board at local level: to consist of Chiefs, District Council Representatives, Members of Parliament and the Project Biologists and other relevant Government Officers, to decide on Project and Programme Policy;

(c) two Area Committees to consists of Chiefs’ Representatives, local Chairmen and Project Staff, to decide on local implementation.

6. That the Project and Programme should be able to call for consultants in specific areas of expertise and from other associated projects in the wetlands.

7. That there should be provisions for training Project Staff at every level.

B. Land use planning and rural development

Realizing the need for a land use plan for both areas, but recognizing the difficulty in preparing a land use plan at this stage, it was resolved:

8. That at the instigation of the project, a Task Force should be established under the auspices of the National Conservation Committee to explore initial elaboration of an integrated land use and development plan for the Kafue Flats and Bangweulu Basin.
Managing the wetlands of Kafue Flats and Bangweulu Basin

The Task Force should include representatives from:

(i) The Wetlands Project
(ii) The National Conservation Committee
(iii) National Parks and Wildlife Services
(iv) Fisheries Department
(v) Animal Husbandry Section
(vi) Land Use Planning Section
(vii) Soil Survey Unit
(viii) National Council for Scientific Research
(ix) Zambia Electricity Supply Corporation Ltd.
(x) UNZA (Schools of Natural and Agricultural Sciences, and Kafue Basin Research Committee, University of Zambia)
(xi) Department of Water Affairs
(xii) Department of Forestry.

The Task Force will seek to collect up-to-date information on the principal resource use problems including:

(i) Wildlife Management and Utilization
(ii) Declining Fish Harvests
(iii) Animal Husbandry
(iv) Crop Production
(v) Fuelwood and Timber
(vi) Land Degradation in the Catchment.

9. That the Task Force should use the information collected as the basis for a draft land use plan for each area. These will each form and identity future steps including highest priorities for conservation action.

C. Utilization of wildlife, fisheries and water resources

Recognizing the difficulties in determining yields of quotas of wildlife species, but realizing the need for determining quotas for harvesting lechwe, and bearing in mind the problems of harvesting, processing and marketing, and furthermore recognizing the need for long-term plans for integrated harvesting of resources such as fish and water sharing, it was resolved:

10. The all forms of resource utilization should incorporate the concept of adaptive management, which will allow the Project to profit from experience and mistakes and to make continual adjustments. This need is due to the fact that management is based on a series of complex sciences including ecology, sociology, and economics.
11. That the organizational structure of the Project will be required to make decisions on:
   (a) Resource use zoning;
   (b) Resource use strategy (i.e. leading to increase, stability or decrease of each resource in each zone);
   (c) The allocation of off-take quotas to different categories of use and segments of the community.

12. That the Project should develop a natural resources research capability which will allow collection of the following information:
   (a) Rates of change of wildlife populations;
   (b) Mortality - natural, legal and illegal;
   (c) Distribution over space and time.

13. That the Project should place emphasis on making available wildlife offtake, and the benefits derived from it, to local communities. The means available include licenced hunting, culling by the Project, and traditional hunting methods, which will be subject to review.

14. That the implication of meat hygiene requirements to wildlife utilization should be examined, and modified where appropriate, in order to facilitate the economic and social viability of this aspect of the programme.

15. That the Project should encourage the development of processing and marketing capabilities for wildlife products, with emphasis on skins and other by-products.

16. That the Programme should co-ordinate inputs from organizations concerned with and affecting the fisheries (including ZESCO) in order to plan and implement the development of the fisheries in Kafue and Bangweulu. In the latter area this would pay particular attention to the potential for developing the pelagic fishery of Lake Bangweulu.

17. That the Programme should examine the question of improving access to the wetland areas by road and channel, with particular attention to the environmental impact of these developments.

18. That preservation of fish is a serious constraint. The Programme should examine the possibilities of improving availability of fuelwood for fish preservation in the wetlands, and examine alternative methods of preservation.

19. That water resources are the key to wetland development. The conservation and development of water resources should be included as a fundamental component of the Wetland Programme. All potential users and manipulators of the water resources in the areas should have input and responsibilities to the Project.
Mr. Chairman, I am very pleased, indeed once again, to be here to perform this function of closing your important workshop which I opened three days ago.

First of all, let me thank all the participants who sacrificed busy duties in their offices in order to come to Itezhi-tezhi to avail their expertise and experience at this Workshop. In the second place, I would like to congratulate Dr Harry Chabwela, the Coordinator of the Zambia Wetlands Project, and his team for the excellent manner in which they prepared the programme. I know very well that organizing any Conference, especially away from home ground, can be very difficult and can easily result in hitches. This has not been the case with this Workshop despite the fact that it attracted many delegates.

The Workshop could not have succeeded without the support and cooperation of the management of Musungwa Safari Lodge. Mr and Mrs Goneos kept us smiling all the way and fed us very well. I have not received any complaints of illness or otherwise. All of us feel at home to be here. I hope that our visitors from overseas will advise their agencies of the advantage of hosting Conferences in Zambia's Safari Lodges, far away from town centres.

As already indicated in my opening address, the Ministry of Lands and Natural Resources supports this Wetlands Project on the Conservation and Management of the Kafue Flats and the Bangweulu Basin. This also represents the support of the Government of the Republic of Zambia. We support the project because we are convinced that the ideas behind it are intended to contribute towards our own efforts of conserving our natural resources, especially wildlife. We are behind the project because it not only places a lot of emphasis on the uplifting of the living standards of rural communities in depressed areas, but also involved them right from the beginning. This has indeed been shown by the presence of their leaders at this Workshop.

I have read through the book called *Water-Logged Wealth* by Edward Maltby, which was distributed at the beginning of the Workshop. One of the major themes in the book is that no wetlands project can succeed unless it has the full support of the political leadership and decision-makers. As I have already stated, the participation of both the leaders from the Districts in which the project will be established, and my own Ministry, allays these fears. From now onwards we as a Party and Government will anxiously await the early implementation of this project. It was earlier stated that it took four years to develop the Programme. But it will not be reasonable to expect this nation to wait
again for another four years before the actual launching of the project starts. Let us move into action now.

The success of these efforts will depend first and foremost on the availability of funds. Apart from their own efforts, the World Wide Fund for Nature (WWF) and the International Union for Conservation of Nature and Natural Resources (IUCN) must urgently find a donor country which can provide adequate funds for the management of the project in Zambia. Wetlands projects are expensive and have succeeded only where adequate technical assistance from donor countries has been secured.

Therefore, I would like to throw the challenge to the representatives of the two agencies. And I ask them to keep my office abreast of the request for funds. They have a responsibility to be with the Ministry in sustaining the momentum which has been generated in Zambia on the significance of wetlands in national developments by this workshop.

Also, let me add that wetlands science is a new concept which we are about to introduce to Zambia, a developing country. Much of the published works for instance appear to date back to 1980 onwards, as shown in Maltby’s book, *Water-Logged Wealth*. A great deal still remains to be researched in Zambia. This workshop has achieved the important task of bringing together, for the first time ever, Zambian biologists and geographers to exchange knowledge and experiences with their colleagues who are in Government Administration. The Zambian press has also played its role of creating awareness in the nation of what has been taking place here.

This is only one approach. The long-term appreciation of the importance of wetlands conservation and management will be understood by the public only with the intensification of this publicity. Above all, the Zambian biologists and geographers have a responsibility of introducing the concept of wetlands into our school syllabus. Again, I wish to appeal to the two international agencies present here to expose the Zambian scholars to overseas experience and research, so that they will be better equipped to change existing attitudes towards wetlands.

Finally, I wish to thank all of you for having actively participated in the deliberations. I am sure that the enthusiasm which you demonstrated in the Workshop will spur us in the Ministry to look to you for advice whenever we need it.

I wish all of you a safe journey back to Lusaka.
Annex I

Workshop programme

Wednesday, 5 November

1. Workshop called to order by the Chairman

2. Introductory remarks by the World Wide Fund for Nature (WWF-International) Regional Representative for southern and eastern Africa, Dr H.F. Lamprey

3. Opening speech by the Hon. Minister of Lands and Natural Resources, Mr B.C. Kakoma MP.

4. Delegates’ group photograph

5. Presentation of Papers: Session A
   Chairman: E.N. Chidumayo
   Session organizers: Dr D.M.N. Mbewe and Mrs M. Chinonge
   Rapporteur: Mr L.C. Mutinta
   (i) International initiatives to conserve the world’s wetlands, by Dr P.J. Dugan
   (ii) The ecology and resource use of the Kafue Flats and the Bangweulu Basin, by Dr H.N. Chabwela
   (iii) Settlement patterns and resource utilization in the Bangweulu Basin and the Kafue Flats Areas, by Dr E.S. Kalapula

Session A (continued)
Chairman: Professor A.A. Siwela
Rapporteur: Mr H.E. Mudenda
   (iv) The water resources of the Kafue Flats and Bangweulu Basin, by Mr A. Mumeka
   (v) A brief review of the status of the fisheries of the Bangweulu Basin and Kafue Flats, by Dr S. Subramaniam
   (vi) Agriculture as a component of wetland conservation, by Dr D.M.N. Mbewe
6. **Presentation of Papers: Session B**

**Chairman:** Professor G.W. Howard  
**Session organizers:** Mr M. Malama and Mr A. Mumecka  
**Rapporteur:** Mr P. Sichone

(vii) *Economic value of the Herpetofaunal resources in wetland areas of Zambia,* by Dr M.P. Simbotwe

(viii) *Wetlands as potential sites for the future of tourism development,* by Dr H.N. Chabwela and Ms I.M. Chinjanga

(ix) *Possible land use patterns for the Bangweulu Basin and Kafue Flats,* by Mr R.C. Mwanza

**Session B (continued)**

**Chairman:** Dr R.H.V. Bell  
**Rapporteur:** Mr C. Mwale

(x) *Costs and improved management designs for the protection of wildlife of the Kafue Flats and Bangweulu Basin,* by Mr A.N. Mwenya.

(xi) *Wildlife harvesting in Africa, lessons for the Kafue Flats and Bangweulu Areas,* by Dr H.N. Chabwela

7. **Formation of Workshop Working Groups.** Delegates divided into three groups to prepare Resolutions and Recommendations for the conservation and development of the Kafue Flats and Bangweulu Basin

**Thursday, 6 November**

Working groups continued to prepare Resolutions and Recommendations

8. **Preparation of Resolutions.** Drafting Committee composed of group leaders and rapporteurs met to discuss and edit the group-prepared Resolutions and Recommendations

9. **Plenary Session:**

**Chairman:** Dr P.J. Dugan  
**Rapporteur:** Mr S.R. Stevenson

The Drafting Committee reported the final draft Resolutions for ratification

**Friday, 7 November**

10. Closing speech by the Hon. Minister of Lands and Natural Resources, Mr B.C. Kakoma MP.
# Annex II

## List of participants

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